# Moving Localities and Creative Circulation: Travels as Knowledge Production in 18th-Century Europe

Pedro M. P. Raposo*, Ana Simões*, Manolis Patiniotis† and José R. Bertomeu-Sánchez‡

*Abstract.* In recent historiography of science, circulation has been widely used to weave global narratives about the history of science. These have tended to focus on flows of people, objects and practices rather than investigating the spread of universal patterns of knowledge. The approach has also, to a great extent, concentrated on colonial contexts and treated 'European science' as a more or less homogeneous knowledge realm. Furthermore, these studies of circulation have usually been tied to a contextualist view of knowledge formation in which *locality* is taken as a set of specificities linked with particular *locations*. In this article we redirect the focus of the discussion on circulation to Europe, and reference spaces that are often absent from other scholarly accounts. We will ground our discussion on a comparative study of three travelling actors from the European periphery through whom we will introduce the notion of 'moving locality' in order to depict circulation as a knowledge production process *per se*.

*Keywords.* Centres and peripheries, circulation, enlightenment, locality, networks, travels

## *1. Introduction*

The goal of this article is to deepen our understanding of the role of circulation in the production of knowledge, and in so doing expand the historiographical frame for studies in this subject area. Interest in circulation developed from historiographical discussions and reflections on the role of travels in the making of modern science, and in particular those travels undertaken by historical actors from the European periphery. The article is developed through a comparative study of the travels of Portuguese, Spanish and Greek scholars in the 18th and early 19th centuries, which addresses three major issues: circulation, locality and the mutual configurations of centres and peripheries. In this sense the contention we aim to put forward is three-fold. First, that circulation is not only a way of transmitting or spreading knowledge but also a way of producing it. Second, that *locality* is not necessarily coincident or constrained by *location*. Third, that centres and peripheries

*Centro Interuniversitário de História das Ciências e Tecnologia, Faculdade de Ciências, Universidade de Lisboa, 1749-016 Lisboa, Portugal. E-mail: pmraposo@fc.ul.pt
†Department of History and Philosophy of Science (M.I.Th.E.), National and Kapodistrian University of Athens, Athens, Greece
‡Institut d'Història de la Medicina i de la Ciència "López Piñero", Universitat de València-CSIC, València, Spain

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must be regarded as co-constructed and mutually dependent entities that can change with time, and not tokens of a steady, hierarchical geography.

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 (Raj, 2007, 2010, 2013), and by recent developments in the broader field of social anthropology (Appadurai, 2001). Circulation is not anymore about the mobility of scientific 'commodities' from one context to another or about the cultural adaptation of particular scientific 'products' to particular social 'needs'. As opposed to the notions of dissemination and diffusion of scientific ideas and practices, it implies mutually transformative encounters between different localities. Cultural conflicts and power games doubtless arise, but for science the transformations, which both scientific achievements and their respective intellectual apparatuses undergo in order to circulate from one locality to another, can only contribute to the discipline's universality (Patiniotis, 2013, pp. 18–19).

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 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' (Roberts, 2009, pp. 17–18).

The conception of circulation as a knowledge making process opens the way for new kinds of historical actors. Much of the positivist historiography of science drew on the work of the great thinkers who conceived or definitely shaped the great scientific discoveries. The turn to circulation as a *site of continuous knowledge production* reveals the work of those intercultural subjects who move across disciplinary *and* territorial borders 'by juggling possibilities and constraints, construct spaces tailored to their own activity, cultivate solutions of continuity, and function through networks' (Raj, 2013, p. 347). As noted in a recent collection, 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 knowledge helps historians tell more nuanced stories about the complex cultural encounters, social negotiations and material potentialities which contributed to the making of science (Schaffer et al., 2009).

In this new scenario, circulation is also considered a useful approach for weaving together global narratives of the history of science by unveiling connections and disconnections, instead of searching for universal patterns. This in turn can help rekindle the dialogue between history of science and neighbouring disciplines such as philosophy, anthropology and sociology (Sivasundaram, 2010) or facilitate the move from a history of science to a more encompassing history of knowledge (Renn, 2012).

However, a focus on global narratives must not overshadow the encounters, exchanges and divergences that took place *within* Europe and its border areas, and which were constitutive of the emergence of modern Western science (and the modern West) itself. Studies oriented towards the phenomena of circulation have spurred a growing understanding of imperialism and colonialism as historical movements that created opportunities for interaction with native traditions and systems of knowledge, giving way to mutual appropriations and reconfigurations. But while post-colonial works vaguely recognize that such phenomena are not exclusive to colonial spaces (e.g. Raj, 2007, pp. 6–7), they tend to focus on colonial contexts and overseas imperial circuits. Furthermore, these perspectives remain significantly tied to a contextualist view of knowledge formation that tends to take locality as a set of specificities tied to particular locations. Travelling savants and brokers are depicted as moving around between these localities, well circumscribed in space and time, establishing trading zones and negotiating between worlds apart. While acknowledging the relevance of encounters with traditions from abroad for the definition of Western science (Elshakry, 2010), it is also important to reflect on how this widely adopted knowledge system came to develop within Europe itself. It is our argument that such a system can only have come into being through a dynamic and multi-layered process that cannot be explained by simple models of production, dissemination and reception (Clark, Golinski and Schaffer, 1999, part 4; Gavroglu, 2012; Patiniotis, 2013).

The picture we would like to suggest, therefore, is one that has Europe as its focal point, and which sheds light on spaces often absent from the scholarly discussion. To develop our perspective, we will carry out a comparative study of three travelling actors from the European periphery: the Portuguese naturalist and diplomat José Francisco Correia da Serra (1751–1823), the Spanish chemists José de Elhuyar (1754–1796) and Fausto de Elhuyar (1755–1833) and the Greek-speaking clergyman and scholar Eugenios Voulgaris (1716–1806).

Through these travellers we will introduce the notion of 'moving localities', which plays a central role in the picture of circulation as knowledge production conveyed in this article. We argue that locality means a complex set of connections, allegiances and commitments which travel with people and thus extend beyond perceived and effectively marked boundaries, and create interconnected intellectual spaces over wide geographical locations. The sense of locality enables actors to *perform* distinct cultural identities in the course of their travels, informed, but not confined by those assigned by their places of origin. Thus, locality can be said to be a local culture made active and open to transformation thanks to encounters fostered by travel conditions.

It is appropriate to approach these three cases comparatively, since they share some important commonalities. Notwithstanding their individual peculiarities, our actors can be placed within wider groups stemming from the European periphery; they travelled across Europe whilst maintaining strong links with the networks and the cultural environments centred around their places of origin; and more importantly, they participated in the production of new knowledge through their wanderings.[1]

Such actors have generally been absent from the mainstream narratives of modern science, while traditional narratives of Enlightenment in their home countries have tended to depict them essentially as gatherers of ready-made knowledge found away from home.[2] The concept of appropriation, discussed at length in Gavroglu et al. (2008), favoured a more nuanced approach to the epistemic endeavours of historical actors from the European periphery, emphasizing their capacity to reframe and recreate knowledge, instead of vesting them with the role of mere receptors.[3] This represents an important conceptual shift, from the idea of production followed by dissemination to a more comprehensive notion of knowledge evolving through circulation. The role of communication practices in the making of knowledge has been approached from a similar perspective, according to the concept of 'knowledge in transit' (Secord, 2004).

However, the creative strength of circulation seems to remain understated, as the emphasis is still put on particular encounters in certain places, and on the movement of certain forms of knowledge, not so much on their transformation in transit. This is probably due to the fact that the analytical apparatus employed to approach such phenomena is still tied to traditional divides, particularly those of a spatial nature.[4] Deepening a conceptual shift from *circulation of knowledge* to *circulation as knowledge production* thus requires us to question the distinction between 'home' and 'abroad' – or, in one word, the notion of 'locality', and the way it is operationalized in historical research. Similarly, we ought to further investigate the mutual reconfigurations of centres and peripheries, which must be approached in their own historicity, instead of being taken for granted.

This article aims to make a contribution to these discussions. We begin by presenting the three cases selected, showing how they illustrate our notion of 'moving localities', within the framework of circulation as knowledge production. Then we proceed to show how local tensions can act as catalysers of creative circulation, by focusing on the role of political events in the wanderings and epistemic pursuits of our travellers. Finally, we use the latter to illustrate how centres and peripheries are mutually constructed and re-configured.

## 2. *Moving Localities and Circulation as Knowledge Production*

Before publishing his *Théorie Élémentaire de la Botanique* (1813), Augustin Pyramus de Candolle (1778–1841) handed the manuscript to a Portuguese friend for criticism. Candolle deemed his counterpart an authority in botany and praised the vast culture and argumentative prowess he had shown in conversations with the likes of Alexander von Humboldt (1769–1859) and Georges Cuvier (1769–1832). The Swiss botanist keenly credited his friend for having developed the concept of symmetry, a contribution he considered essential for his own typological thinking in botanical taxonomy (Diogo, Carneiro and Simões, 2001b, pp. 371–379; Simões, Diogo and Carneiro, 2012, pp. 88–93). Candolle admired not only the Portuguese savant's intellectual stamina but also his ability to foster scholarly pursuits while indulging in what the Swiss Calvinist regarded as 'enormous

laziness', something he thought attainable only by those from the Mediterranean. Years later, Candolle's son Alphonse found it hard to accept that an obscure southern-European wanderer could have had such a degree of influence on his father's botanical accomplishments, and suggested that his alleged ideas were more likely to be due to the Scottish botanist Robert Brown (1773–1858) (Candolle, 1862, p. 163).

The obscure wanderer, already forgotten by the time Alphonse was editing his father's recollections, was Correia da Serra, a man who, like many of his contemporaries, played so many roles that it is difficult to reduce his winding life path and multifarious career (if the word makes any sense in this context) to a single word. A clergyman, a botanist, a founding member of the Royal Academy of Sciences of Lisbon, at times politician and political refugee, diplomat and expatriate, Correia da Serra was above all a globetrotting seeker of knowledge, prestige and recognition, who travelled far and wide out of necessity as much as for the sake of his own pursuits and ambitions. If we have to pigeonhole Correia da Serra the most convenient way to do it is to gather him up with the *estrangeirados*, a group of Europeanized intellectuals, 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 (Carneiro, Simões and Diogo, 2000; Diogo, Carneiro and Simões, 2001b). The *estrangeirados* constituted a very diverse group of people whose life stories were generally marked by a frequent mobility across geographical, political and cultural boundaries. But above all, they took Portugal as the main frame of reference for their endeavours, even when they were dismissed or rebuffed by the country's authorities.

This was often Correia da Serra's case. His wanderings took him to Italy, Britain, France and the USA, and allowed him to befriend Joseph Banks (1743–1820), James Edward Smith (1759–1828), Thomas Jefferson (1743–1826) and other figures of similar rank, besides the aforementioned Candolle, Cuvier and Humboldt. But while his North–American friends called him the 'Franklin of Portugal' (Simões, Diogo and Carneiro, 2012, p. 131; Davis, 1993, p. 324), Correia da Serra often complained about a lack of recognition for his efforts and deeds in his own country, as if the place whose backwardness he himself bemoaned was where he was expecting to garner his most rewarding laurels.

By the time a young Correia da Serra was returning to Portugal after receiving holy orders in Rome (c. 1777), two Spanish brothers of French-Basque origins were pursuing higher studies in Paris. One of them, José de Elhuyar (1754–1796), was soon commissioned to act as a spy for the Spanish government and the Basque industrial elite. José de Elhuyar was thus entrusted with studying the manufacture of cannons and other metallurgic activities. This assignment took him on a journey that covered several scholarly and industrial sites in Paris, Freiberg, Uppsala and Scotland (Bertomeu-Sánchez and García-Belmar, 2003). He was expected not only to observe, learn and report but also to establish personal relations with relevant practitioners (both chemists and technicians). The Spanish Navy Department and the Basque Economic Society could not predict that a long lasting spinoff of this mission was the identification of the chemical element tungsten

(or 'wolfram' according to the Elhuyar's brothers). In Uppsala, José de Elhuyar visited Torbern Olaf Bergmann (1735–1784), a professor of chemistry and mineralogy, known for his ground-breaking contributions to quantitative analysis. In the early 1780s, Bergmann's protégé and Carl Wilhelm Scheele (1742–1786), one of the so-called co-discoverers of oxygen, had produced tungstic acid. José's meeting with Scheele's master certainly played a pivotal role in his celebrated achievement. In 1782, back in Spain, José isolated tungsten together with his brother Fausto de Elhuyar (1755–1833). Fausto was to become an equally well-travelled chemist himself. He carried out various missions to investigate artillery, smelting and new amalgamation methods in Central Europe around 1786. He was also commissioned to hire experienced German miners for the Spanish colonies in America; after this trip, Fausto was appointed director of the Royal Corps of Mining in Mexico and he later organized the new School of Mines (Caswell and Daley, 1999; Pelayo and Rebok, 2002).

The brothers Elhuyar were, in fact, part of a wider group of privately or publicly sponsored Spaniards engaged in similar fact-finding, espionage and networking missions, known as the *pensionados* (Bertomeu-Sánchez and García-Belmar, 2003). Like the *estrangeirados*, they travelled far and wide to a variety of destinations, for different purposes. Their fates were often conditioned by the internal affairs of their home country, and their journeys were significantly dependent on support from fellow Spaniards already living or staying abroad.

At this point, we should perhaps question what 'abroad' really stands for, that is, what 'locality' really means. But let us bring in yet another character (and a third group). By the time the Elhuyars were studying in Paris and the recently ordained Correia da Serra was returning to Portugal, Eugenios Voulgaris (1716–1806), a Greek-speaking, Orthodox clergyman and scholar, was taking a clerical post at Poltava, recently taken by Russia from the Ottoman Empire, where he was expected to facilitate the assimilation of the recently arrived Greek-speaking settlers. This appointment (similar ones followed) was the fruit borne of the effort Voulgaris had put into cementing his position in the patronage networks, first in the Greek-speaking world, and then in the Russian Empire. Voulgaris was one of the most erudite 18th-century Greek-speaking scholars. According to contemporary evidence, he was the person who decisively contributed to the revival of Greek philosophy and the director of some of the most influential Greek schools of the time (Κούμας, 1832, v, 12 pp. 559–564; Κοραής, 1833, pp. 15–18). The intellectual itinerancy of the Corfu-born scholar had taken him to places such as Venice, Epirus, Western Macedonia, Constantinople, Bucharest and Leipzig. His religious allegiance allowed him to feel at home either travelling the Greek-speaking circuits, or finding his way through the state and church hierarchies of the Russian Empire. But, contrary to the brothers Elhuyar and Correia da Serra, Voulgaris did not have a proper state which could act as a patron or as a frame of reference for his learning pursuits. Nor in fact did he travel abroad; rather, he moved around within extensive Greek-speaking spaces and networks.

Voulgaris translated and authored a great number of books in metaphysics and logic, literature and theology, history and politics; and, above all, he wrote some of the most influential scientific treatises of his time. However, he did not develop a concept helpful for taming the astounding diversity of life like Correia da Serra, nor did he contribute to broadening knowledge of what constituted the material world like the Elhuyar brothers. Instead, as a committed teacher, he focused on shaping a doctrinal body in which developments belonging to what came to be known as modern science, and especially Newtonianism, were carefully interwoven with the neo-Aristotelian philosophy that had dominated the Greek intellectual life since the early 17th century (Patiniotis, 2007). One of the many examples of this attitude is the way Voulgaris dealt with modern atomism. In his *Philosophers' Favorites* (*T*α αρέσκοντα τοις φιλοσόφοις, published in 1805 but written much earlier), he clearly endorsed Newton's views on the constitution of matter. Speaking of the 'first principles of natural body' he explained that the building blocks of all material bodies were the immutable and indivisible minute particles created by God for this purpose. However, this perception did not necessarily contradict the typical Aristotelian perception of natural body as *matter* and *form*. For Voulgaris the traditional Aristotelian hylomorphism retained its validity as a *metaphysical* principle, while atoms, which also consisted of matter and form, were the first *natural* principles of body. In another treatise, also published in 1805 but written earlier (*Elements of Metaphysics,* Στοιχεία της *M*εταφυσικής), he completed the synthesis in a language that cunningly wavered between traditional and modern natural philosophy. The *form* of the atoms, he explained, is the set of primary qualities that characterized them and distinguished them from each other. As a consequence, the *form* of the natural bodies is the macroscopic combination of these qualities that result from particular arrangements of the atoms. This assumption enabled him to connect metaphysical Aristotelian hylomorphism with Newtonian atomism and so make the modern natural perception functional within the context of traditional metaphysics (Πατηνιώτης, 2013, pp. 322–333).

Notwithstanding their own agendas, idiosyncrasies and intellectual pursuits, Correia da Serra, the brothers Elhuyar and Voulgaris took with them on the road the Portuguese aspirations to Enlightenment, the Spanish economic ambitions and the Greek valorization of classical antiquity.

Traditional centre-periphery perspectives would favour a focus on networking processes, and in particular the links established by backward peripheral scholars striving to establish relevant connections with the actors from the centres, in order to create an effective chain of transmission, and acquire a capital of legitimation for their local pursuits. This view entails an implicit distinction between well-defined and localized contexts of production (where new knowledge is made), contexts of assimilation (where new ideas and practices are learnt) and contexts of appropriation (where those ideas and practices are reframed and reconfigured). Contexts of production are allocated to centres, contexts of assimilation either to centres or peripheries (e.g. travellers teaching what they have learned to their

fellow locals on their return) and contexts of appropriation are allocated usually to peripheries.

It must be noted that talking of appropriation already represents a significant conceptual shift from the traditional centre-periphery dichotomy, as a more conservative diffusionist view would rather talk of transfer and reception (Gavroglu et al., 2008). But even when we think in terms of scholarly and technical journeys *just* as a form of collecting knowledge instead of making it, we will most likely find out that there is seldom an inscription of new ideas and practices over a *tabula rasa*. We are more likely to find an active incorporation of what is learnt into a complex template grounded on the *moving* locality that frames the agency of the travellers. In other words, what travellers bring in is as important as (or even more important than) what they collect on their way, and what they bring back will bear a strong mark of what they took with them upon departure. Consequently, reconstituting and analysing the travellers' fabric of local relations and commitments is at least as important as focusing on the connections established with relevant actors and institutions away from their places of origin. Let us now apply these considerations to our travellers.

The *estrangeirados* were involved in a network with important international nodes but their defining commonality was an epistemic commitment directed towards their national space: the rationality of Enlightenment was seen as the ultimate solution for the modernization of Portugal. When they were seeking knowledge, making the acquaintance of the international intellectual milieu and striving to become full-right players within it, the *estrangeirados* acted in accordance with aspirations of national development on the basis of rational values, even if individually they were driven by varied perceptions and motivations.

Correia da Serra was thus enticed to contribute his own ideas to the development of botanical studies, instead of moving around as a mere spectator. He was influenced by scientific debates in Italy, Britain, France or the USA in which he had an active participation. But he always kept in mind the predicaments of his country, and interacted with colleagues and academicians who stayed in Portugal. He also maintained his liaisons with members of the Portuguese political elite, making himself available to perform functions that bordered on scientific and technological espionage.[5]

During the long periods he spent abroad, Correia da Serra developed original ideas about different topics of natural history, playing a prominent role as a mediator and a communication catalyst among naturalists. He harboured that same attitude when he was in Portugal, keeping up with the Academy of Sciences of Lisbon's first steps. Later, in exile, he stayed in touch with Portuguese academicians, and with like-minded aristocrats and politicians in the country.

In the process, Correia da Serra became a naturalist of the world who affirmed his presence in European and American networks. His innovative research reflected the transition that took place in botany at the turn of the 19th century.[6] In Portugal, his studies were shaped by a utilitarian agenda for natural history, but moved towards a focus on aspects of fundamental research in the areas of physiology and plant systematics,

when he was in Britain and France. His reflections shifted from the natural landscape, human and economic, towards a much more specialized query that favoured the search for an organization guided by comparative anatomy and physiology, rather than a Linnaean approach to plant description and classification. This was the context of the emergence of the concept of symmetry, later appropriated by Augustin Pyramus de Candolle. His practice shifted once again following his departure for the United States of America, where he returned to fieldwork. Botanical studies were still in their infancy, and the scientific priority was to carry out an inventory of plants and natural resources to secure the economic viability of the new nation, a job he shared with aspiring young naturalists.

Similarly, a group of *pensionados* participated in a wider network of chemists that constituted a social basis for the consolidation and legitimation of modern chemistry. Besides depending on political, diplomatic and academic connections with other Spaniards, they were guided by the industrial and technical traditions and ambitions fostered in Spain. In this case a deep immersion in the practice of applied chemistry, rather than the theoretical understanding of this science, became the key factor in the Elhuyars' identification of what was eventually recognized as the chemical element tungsten. Had they been just seeking ready-made chemical knowledge perhaps they would not have dared (or even cared) to spot hitherto unknown entities. And their travels cannot be reduced to straightforward categorization. When devoted to disciplines such as applied chemistry, mineralogy, metallurgy and mining, a single journey was likely to entail equal doses of overt fact-finding queries and cunning espionage stratagems. On a single journey, such travellers would probably have visited academic institutions, attended public chemistry lectures and bribed craftsmen to access their workshops. Thus they crossed not only geographical and political borders, but also cultural frontiers between scientific and technological traditions with distinct norms and values. And this certainly added to the creative potential of their wanderings.[7]

Voulgaris' journeys also resonated with the routes of many other Greek-speaking scholars scattered over these places, who provided crucial support for his own quests (Patiniotis, 2003). Most of these scholars shared with contemporaneous European thinkers the desire to inaugurate an intellectual enterprise that would transform philosophy. The question they faced, though, was not about the acceptance or rejection of a new philosophical system, but about the way they would revive and broaden the scope of their contemporary philosophy. Some European philosophers did 'unheard of' acts in order to set up the new edifice of philosophy: they were experimentalists who tried to unveil the laws of Nature, which would disclose important aspects of the divine design, but only those that God allowed man to grasp. Others formulated mathematically the discovered regularities and expressed them with the help of geometry, algebra and, above all, calculus in order to arrive at a more secure type of knowledge. Both enterprises were rather distant from the style of philosophizing of Greek-speaking scholars. Neither experimental empiricism nor abstract mathematical contemplation fitted this particular style. They were closer to a third group of philosophers who trusted that only metaphysics could lead natural enquiry to a really secure shelter, in the (strictly technical) sense that only metaphysics could provide the proper philosophical

devices for causal thinking (Ahnert, 2004). Thus, what Greek-speaking scholars intended to do was upgrade their traditional philosophical context through the incorporation of the most precious pieces of modern knowledge (Patiniotis, 2011).

Voulgaris' *nation* was primarily Eastern Orthodoxy, and his main cultural reference was the Greek-speaking education of the 18th-century Ottoman Balkans. His contact with contemporaneous Newtonianism was defined by these two factors. He did not seek to embrace the new natural philosophy at large, but rather particular elements of the new trends that would enforce the connection of physics with theology on the one hand, and restore the interpretational range of the Aristotelian philosophy on the other. Thus, during his travels, he actively picked up particular aspects of the emerging science in order to build a new metaphysical discourse about nature, while manifestly leaving aside any empirical or utilitarian concerns (Πατηνιώτης, 2013, pp. 302–333 and 349–377).

## *3. Tensions of Locality*

Throughout their wandering lives our travellers had often to reframe their intellectual endeavours in the face of changing political and social situations, which were not always favourable to their pursuits.

In the case of the Portuguese *estrangeirados* three distinct periods of analysis can be considered: the reigns of João V (1707–1750), José I (1750–1777) and Maria I (1777–1816). The first corresponded to a period of opulent absolutism, sustained by the income of gold from Brazil. It was marked by a form of sovereignty that sought international recognition and respect through a display of wealthy grandeur. In this context, royal patronage promoted learned undertakings that could convey an image of magnificence. Such is the case of the foundation of an observatory at the Royal Palace in Lisbon, which was run by Jesuits who also carried out astronomical observations and taught at the Jesuit College of Santo Antão (Carvalho, 1985; Leitão and Martins, 2008). The Society of Jesus was able to promote intellectual exchange within its own networks, without constraints from the Portuguese state powers. Lisbon was thus placed within a wider space of epistemic circulation that overlapped with the state apparatus and served its policies (Leitão, 2003).

Although travels related to intellectual pursuits had already a long history in Portugal, it was at this time that the first generation of *estrangeirados* emerged. Their modus operandi was, at first, generally detached from these political and religious circuits. Instead, they resorted to private connections and undertakings as a way of sharing and promoting their commitment to bring scientific rationality not only into the country's intellectual and scholarly life, but above all into its polity. Their agenda developed through the establishment of private academies and informal associations and meetings. A philosophical discourse focused on enlightening the country was thus collectively carved out. Travels were undertaken mainly on the grounds of personal initiative but relied on

the support from this network of like-minded individuals. Individual agency, mobility and networking were thus combined in an ideological and epistemic endeavour for which the Portuguese state represented an entity to be revamped on philosophical and scientific grounds.[8]

In the reign of José I travelling was accommodated into official policy as a way of mobilizing expertise towards the modernization of the country, whilst political persecution propelled many *estrangeirados* into forced journeys that nonetheless proved fruitful. Under the policies of enlightened absolutism implemented by the plenipotentiary minister Marquis de Pombal (1699–1782) some savants were hired from abroad to participate in a renewal of the country's learned institutions. This was the case of the Italians Domenico Vandelli (1735–1816) and Giovanni Antonio Dalla Bella (1730–c.1823), who became *estrangeirados* as a consequence of their engagement with the Marquis's agenda.[9] On the other hand, the policies implemented by the Marquis included a stark persecution of religious orders. The Jesuits were consequently ousted from Portugal in 1759, an event that reversed the previous influx of Jesuit scholars.

The flow of knowledge in this period of Portuguese history bespeaks the complexity of relations between travelling savants and sovereignties. Portuguese authorities promoted connections with wider learned networks both by providing support and by exerting repression. Whilst exiles were able to translate their predicaments with the Portuguese establishment into philosophical endeavours, the regime itself promoted a renewal of the state apparatus based on the tenets of Enlightenment, for which it needed to attract scholars that suited Pombal's political project of Enlightened absolutism.

Although the basic absolutist precepts were maintained, the beginning of Maria I's rule was marked by a stark reaction against Pombal's policies. Marquis's opponents and those who suffered from his persecutory measures were able to re-enact their scholarly activities within the Portuguese establishment, and new policies designed to modernize the state apparatus were set in motion.[10] Study missions abroad were officially promoted and funded; a policy of expertise import was thus replaced with a policy of expertise acquisition. Eventually new military academies and scholarly institutions were founded, and several students were sent abroad on state stipends, especially to Great Britain, to study medicine (Sousa, 1983). The importance of international learning missions was recognized in official documents such as the statutes of the Astronomical Observatory of the University of Coimbra, where periodic international travels were established as a means for the Observatory (and other scientific facilities and equipment of the University) to profit from the expertise of its European counterparts (Observatório Real Astronómico de Coimbra, 1803).

A similar pattern of relations between sovereignties and the movement of scholars can also be found, albeit with some nuances, in the case of the *pensionados.* The period 1770–1796 coincides with the enlightened rule of Carlos III in Spain and the ground-breaking work of Lavoisier in France. Like the situation in Portugal during the enlightened absolutism of José I and Pombal, the Jesuits were ousted from the

country, whilst scholarly and espionage travels were promoted in order to upgrade learned institutions and spur the economy. France was a favoured destination for the study of chemistry. However, it was not Lavoisier's work on oxygen that drove Spaniards to France on chemical missions, contrary to what is assumed in traditional narratives of Spanish Enlightenment which were mostly focused on the 'reception' of the new chemistry in the Iberian context (Gago, 1988). It was rather a broad range of local interests in fields such as medicine, surgery, pharmacy, dyeing, mining and metallurgy that shaped these travels (Bertomeu-Sánchez and García-Belmar, 2003).

During this period the Spanish governments provided a favourable political framework for these pursuits. Moreover, the 'Sociedades Económicas de Amigos del País', a large number of local societies set up to develop agriculture and industry (the most famous one was the Basque Economic Society), played a very important role in the promotion of travels through which chemical knowledge circulated and evolved (García-Belmar and Bertomeu-Sánchez, 2003; Nieto-Galan, 2003). As seen above during the reign of João V, the Portuguese *estrangeirados* also relied on unofficial gatherings and societies as a national framework for their endeavours. These local networks of support were critical given that in Portugal, as far as the period under study is concerned, the state apparatus took longer than the Spanish to start funding the circulation of savants. And when it finally did, an ambivalent situation arose, especially under José I and Pombal, as the hiring of foreigners was concomitant with the exile of persecuted nationals.

*Pensionados* also went through troubled times. As a result of the stark reaction of the Spanish crown to the French Revolution, Spaniards were forbidden to leave, but a change of direction in the affairs between the two countries soon came to favour the return to the routes followed since the early 1770s. In 1796, Spain joined France against England. This event inaugurated a new period in the travels of the *pensionados* that extended until the Peninsular War (1807–1814). The new configuration of Franco-Spanish relations favoured the re-enactment of study missions in France, although support for travels of learning was hampered by the effects of war expenditure on government budgets and the difficulties experienced by many economic societies. As for the Portuguese, for whom Great Britain was traditionally an ally, this international context was particularly unfavourable. Portugal was especially vulnerable to the Napoleonic campaigns; the country was invaded by French troops in 1807 and shortly after the Portuguese royal family fled to Brazil. Continental travels of Portuguese scholars were significantly hampered. This situation was particularly awkward given that, as mentioned above, travels of learning had been inscribed in the general renewal of the state apparatus and given specific institutional framings as exemplified by the reformed University of Coimbra. Nevertheless, the transatlantic flow of knowledge was reinforced with the displacement of the court and the establishment of new institutions in the colony (which was proclaimed independent in 1822) (Raminelli, 2008).

As was the case for several Portuguese intellectuals under José I's and Pombal's rule, between 1814 and 1833 a number of learned Spaniards were persecuted by the absolutist

king Fernando VII, re-enthroned after Napoleon's defeat. Liberals and *afrancesados*, a small but influential group of Spaniards who collaborated with the Napoleonic government during the Peninsular War, sought sanctuary in Britain. Formerly Spanish scholars had mainly visited Britain to study astronomy, nautical science and related subjects. Political networks became an important basis of support for exiled Spaniards. After the Napoleonic War (1808–1814), most of the economic societies, which supported 18th-century travellers, entered a period of decadence and inactivity, and official policies that had promoted the influx of knowledge lost momentum and almost disappeared during the years of the absolutist government of Fernando VII (1814–1833). As a result, political exile and personal initiative and funding became prominent factors in intellectual mobility (García-Belmar and Bertomeu-Sánchez, 2001).

As for the Greek-speaking scholars, they did not travel to what they perceived as favoured centres of knowledge production. Instead, they circulated through the nodes of extensive networks of Greek-speaking communities spread throughout various areas of the Ottoman Empire and central Europe. They travelled in the geographical sense of the word, but essentially stayed within their primordial cultural space, where political and religious factors did not operate so much in terms of allegiance or opposition but rather as elements of cultural affinity. Besides the late establishment of the modern Greek state (which took place in 1832, and demarcated an area much narrower than that covered by the networks of Greek-speaking communities) an essential difference to the Portuguese and Spanish cases is the absence of nationalistic sentiments in the largest part of the Greek-speaking populations of the time. Indeed, the collective identity of most Greek-speaking people was a composite consisting of loyalty to the Sultan, a steady commitment to the practice of the Orthodox Church, a deeply rooted aversion for Catholicism and a culturally guided admiration for the achievements of the ancients. Clear nationalistic sentiments and the first uncertain claims for a political unity that would transcend the nostalgia for the revival of the Byzantine magnificence did not appear before the late 18th century, when Greek-speaking merchants of various central European communities felt compelled to strengthen their ties in order to compete economically against other 'nations' (Κατσιαρδή-Hering, 2003). Thus, a basically religious term ('nation') came to signify for them a political and economic association, which gradually appropriated a glorious past (Ancient Greece) and projected itself to the future as part of an alternative arrangement of the Eastern European space. But this is mostly a development of the 19th century.

During the 18th century an important factor that favoured the mobility of Greek-speaking scholars was religion. Their travels to Venice, the German states and Russia were to a great extent motivated by shared anti-papal feelings, a resonance between Calvinism and Orthodoxy and the hope for a revival of an extended Orthodox empire, respectively. However, it must be noted that these choices were not strictly dictated by religious affinities. Many Greek-speaking scholars departed from an area comprising Epirus, Western Macedonia and some parts of Thessaly, where a dynamic trade activity spurred the quest for new knowledge. The current of intellectual migration, which had

developed as a result of particular historical circumstances, brought young scholars to the universities of Italy and Germany. The libraries and the reading-rooms of Venice, Padua, Vienna and Leipzig hosted many of those who were seeking to broaden their cognitive horizons. After having spent significant time in the European educational centres, they continued their travels mostly eastwards looking for proper intellectual environments (and seeking patronage networks) to reap the benefits of their intellectual qualifications. Constantinople provided such an environment, as Greek travellers sought appointments as teachers or doctors under the patronage of the Phanariots, a group of Greek-speaking nobles who held important administrative positions in the Ottoman Empire. But Russia was also a non-Greek-speaking area where these travellers could expect to build successful careers as courtiers, thanks to the kinship of the Russian Church with the Ecumenical Patriarchate, but also because of the classicism dominating the court of Catherine II during the last decades of the 18th century.

In most cases, the Greek-speaking scholars perceived themselves and were perceived by their patrons as agents of a new spirit in the local intellectual life. Far from serving a homogeneous programme of modernization and far from having gained the general consent of the local authorities, they were considered the agents upon whom the most dynamic social groups of the emerging Greek society counted for the shaping of their collective physiognomy. But the constituents of this physiognomy were still under negotiation. As a result, the Greek-speaking scholars of the time found themselves at the intersection of multiple cultural traditions and social interests; and the philosophical discourses they elaborated reflected exactly their attempt to meet the requirements of these crossing demands (Patiniotis, 2003, esp. pp. 68–69).

This is another difference from the Spanish *pensionados* and the Portuguese *estrangeirados* who had or envisioned a well-defined state apparatus to place the results of their intellectual undertakings. Although we should not mistake Greek-speaking scholars for mere pedagogues, it is a fact that their cognitive pursuits were almost exclusively placed in the context of the educational structures of the Greek-speaking communities. In this sense, the means for achieving their intellectual goals were limited to teaching and writing for teaching purposes. Even pieces of knowledge representing the attainments of modern natural philosophy entertained a discursive reception, not in the sense that they were passively and unalterably reproduced, but in the sense that they were appropriated in an intellectual structure, which was trained to produce new knowledge about nature by means of contemplation and written commentaries. Thus, from a comparative point of view, the Greek intellectual life displays a quite different orientation than that of the two other cases. Besides the differences in the methods of knowledge production, the demand for confirmation and practical application of such knowledge seems to be absent in the Greek case. Lacking the economic and institutional background that would profit from the appropriation of particular pieces of scientific and technological knowledge, Greek-speaking scholars got involved with the new natural philosophy with a view to extending the limits of traditional philosophy and upgrading its function in the context of a society that sought

to define a distinctive cultural identity in the constantly unstable political landscape of Eastern Europe (Πατηνιώτης, 2013, pp. 226–232).

## *4. Evolving Centres and Peripheries*

Let us now return to the *estrangeirados* and *pensionados*. For these two groups, which had to deal with a state apparatus that was absent in the Greek case, political vicissitudes often brought to the surface the complexity of conflicting *moving* localities in the same geographical location. In fact, the most significant clashes and predicaments they had to face were often found at home. In the case of the *pensionados*, for instance, the regime of Carlos III favoured appointments to scientific and teaching institutions (including admissions to state-funded chairs of chemistry), and to key positions in royal factories and trading boards but, in the next period, long-term projects were thwarted by political instability, exile and persecution. In this way, political circumstances shaped the results of the confrontation between *moving* localities taking place in one specific location. In spite of having had to face similar problems, the *estrangeirados* played a very important role in the establishment of cultural and scientific institutions, and the revamping of the local channels for the circulation of knowledge. However, the utilitarian view of science towards the enhancement of the country's economy, promoted by the Academy of Sciences of Lisbon, collided with the conservatism and backwardness of the few national entrepreneurs. Furthermore, the general lack of communication between the learned elite and the rest of the Portuguese society thwarted ambitions to grow a steady and sustainable scholarly system. Once again, the confrontation between *moving* localities was shaped by the political, economic and intellectual constraints effective in certain specific locations.

As already emphasized the *estrangeirados* and *pensionados* both travelled via various routes to a variety of destinations. Some were common to the three groups, such as the case of Italy, the German states and France. The *estrangeirados* sought to foster their pursuits in philosophy and exact sciences mainly in Italy, France and Britain, where their paths might well have crossed those of the *pensionados*. Elements of both groups, however, followed specific routes according to their particular interests and engagements. In France, for instance, Paris was the privileged destination for Spanish students of chemistry, who, from the beginning of the 19th century onwards, attended mainly the courses in chemistry at the Collège de France (García-Belmar and Bertomeu-Sánchez, 2010). However, a first wave of Catalan medical students had preferred to enrol at the University of Montpellier. *Pensionados* entrusted with missions related to mining and metallurgy mostly travelled to places such as the German cities of Freiburg and Schemmitz. Moreover, these travellers did not constrain their routes to traditional sites of study and learning such as schools and universities; they also visited factories, chemical plants, dying centres and other places relevant for the kind of technical practices they were expected to learn and master. Other *pensionados* travelled to Britain in search of relevant sites for the study and practice of

medicine, nautical science, astronomy, optics and instrument making (García-Belmar and Bertomeu-Sánchez, 2003).

At this point, it is fair to accept that a rigid notion of centre (say, Paris, London and Venice as focal points of knowledge production, and as major destinations of travelling savants) does not provide us with a satisfactory description of circulation over large geographical areas, if we approach circulation not as knowledge *in motion* but as knowledge *in the making*. At best, there are geographical places (countries, states, cities, etc.) and sites (which can range from universities to factories and workshops), which, in certain periods and circumstances, constitute favoured nodes for specific epistemic pursuits in the context of evolving networks. We could summarize what we mean by saying what confers the statute of a 'centre' to a certain place depends on a specific frame of associations and on its inherent set of representations. Concomitantly, our travelling actors themselves carved notions about their places of origin as opposed to the places they sought, contributing in this way to a collective process of co-construction of their places of departure as peripheries and the places of arrival as centres. Correia da Serra, for instance, often complained about the intellectual and scholarly predicaments of Portugal, which he liked to contrast, for instance, with the magnificent spaces of knowledge he found in Paris, such as the *Jardin des Plantes* and the Natural History Cabinet (Simões, Diogo and Carneiro, 2012, pp. 84–85). Notwithstanding these grievances, he still saw his home country as the main backdrop to his endeavours. In a sense, Portugal, the country he himself depicted as peripheral and backward, was the very centre of his pursuits.

Moreover, Correia da Serra and other *estrangeirados* were so adamant at rescuing their country from what they perceived as its backwardness that they (intentionally or not) overlooked the centrality that could also be ascribed to their origins. Lisbon was, for a long time, an imperial capital (just like Madrid), and, from the 16th- to the early 18th century, a major hub for the circulation of Jesuit missionaries, as shown above. The Portuguese capital, as any other place, can in fact be regarded as both peripheral and central, according to the period of time and the specific web of associations, interests and power relations in which we choose to place it. Although people and material resources undeniably concentrate differentially at certain places throughout time,[11] the depiction of these asymmetries in the form of cultural hierarchies is ultimately a matter of being able to craft enduring narratives, and to secure a place in there.

Once again Correia da Serra's case provides a telling example. As suggested by Alphonse de Candolle's dismissive attitude towards the intellectual stamina of his father's Latin friend (for Augustin Pyramus de Candolle, a lazy but nonetheless clever Mediterranean), historical actors who do not succeed in promoting generational reproduction cannot secure the perpetuation of their scientific and intellectual prestige and influence over the prejudices about their provenance. The end result for these actors is that when they disappear physically, any notoriety they may have achieved while living, vanishes into thin air (Simões, Diogo and Carneiro, 2012, p. 93). Thus, in order to understand the complementarity and interdependence of centres and peripheries, we must also deconstruct

the ways in which their representative actors were historically depicted (or not depicted at all).

## *5. Conclusion*

There was no road *to* Enlightenment for our travellers. Enlightenment *was the* road. That is, travelling allowed them to participate actively in the various processes of knowledge formation at the core of the Enlightenment. Those processes developed throughout their journeys, which 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 continuous movement that promotes creative encounters and undertakings, but in which travellers never cease to be connected with their spaces of origin. The meaning of their stories in terms of how knowledge is made becomes clearer if we think about *going through* rather than *going to and fro*. A view encompassing routes, circuits and their dynamical reconfigurations must thus replace a narrow focus on interactions taking place at specific points of departure and arrival. The *estrangeirados* did not bring the Enlightenment to Portugal; they placed the country within the Enlightenment. The *pensionados* did not limit themselves to taking back a ready-made chemistry to Spain; they actively appropriated and practised it throughout their journeys. The Greek-speaking scholars did not replace the 'old' with the 'new'; through their travels they brought into dialogue two different versions of natural philosophy with the aim of producing a more complete and integrated interpretation of nature.

The paths they followed 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 travelling as a transformative activity that we seek to contend, but rather the notion of travelling as a radical transformation of the traveller from a *tabula rasa* state: the transformative effect of travel is exerted both *on* the traveller and *by* the traveller.

Travelling spurs the ability to negotiate, to build and revamp meanings and to design and readapt paths and routes through conflicting agencies. Travellers bring the localities they experienced elsewhere into their spaces of departure in the same way they carry their original localities with them. Thus, the movement of localities must be regarded symmetrically, i.e., travellers must be approached as bearers of their original localities as much as actors who apprehend elements of the other localities they experience through travelling. Ultimately, travelling is mediating between *moving* localities, and making it possible for them to converge and coexist in a certain location. This mediation may take place independently of travelling people – for instance, through the exchange of correspondence and the circulation of data, samples, instruments, standards, etc. But the displacement of people has always been, and probably will always be, the most efficient catalyser of cultural encounters, collisions and recombinations. All other instances of

displacement and circulation in the making of knowledge are, after all, just the *ersatz* that keeps the process running, as people cannot move around all the time.

The exercise carried out in this article has emphasized that a picture of the historical development of modern science focused on circulation should be constrained neither by constructs such as nations and boundaries, nor by taken-for-granted asymmetries. We have seen that the latter are often the product of prejudices crystallized and replicated through pervasive narratives. Not only centres and peripheries are co-constructed, as their mutual configurations also change through time. Overall, if we take circulation as a process of knowledge production, a contextualist view of the making of knowledge tied to rigid notions of spatiality must give way to a more dynamic approach, that seeks to understand how knowledge evolves through fluxes of people crossing heterogeneous spaces, and to apprehend how the nature and status of these spaces change altogether.

Correia da Serra, the Elhuyars and Vourgaris were, in their own various ways, 18th-century men whom we have followed throughout the 18th-century world. But it might be worth applying these considerations beyond their time and routes. After all, people and their localities keep on moving, and knowledge evolves more intensely than ever.

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NOTES

1. The historiographical reflections developed in the remainder of this essay are illustrated mainly with research presented in the following works: Simões, Carneiro and Diogo, 1999; Simões, Diogo and Carneiro, 2012; Carneiro, Simões and Diogo, 2000; García-Belmar and Bertomeu-Sánchez, 2001, 2003; Diogo, Carneiro and Simões; 2001a, b; Bertomeu-Sánchez and García-Belmar, 2003 and Patiniotis, 2003, 2007, 2011. These works are specifically cited in the text (or in the notes below) when appropriate. On comparison in the history of science see: Paty, 1999; Pyenson, 2002; Cohen and O'Connor, 2004; and Simon and Herran, 2008.
2. Regarding the Portuguese case, see: Andrade, 1966, 1982; Carvalho, 1996; and Macedo, n/d. For the Spanish case see: Selles, Lafuente and Peset, 1987 and Martínez Ruiz and Pazzis Pi Corrales, 2008. And for Greece see: Καράς, 1991 and Δημαράς, 1993.
3. As recognized in Gavroglu *et al.* (2008) the concept of appropriation has been used extensively in social and cultural history as well as in art history and has been also used in history of science for many years (see Sabra, 1987). However, we have appropriated the concept of appropriation itself by endowing it with two novel meanings: using it as opposed to the concept of 'transmission', and shifting our attention to the 'creative role of the receivers'.

4. These issues have been largely discussed after the 'spatial turn' in history of science. See Harris, 1998a, 1998b; Livingstone, 2003; Withers, 2007, 2009 and Finnegan, 2008.
5. Diogo, Carneiro and Simões, 2001b and Simões, Diogo and Carneiro, 2012.
6. Diogo, Carneiro and Simões, 2001b and Simões, Diogo and Carneiro, 2012.
7. García-Belmar and Bertomeu-Sánchez, 2001, 2003 and Bertomeu-Sánchez and García-Belmar, 2003. For a better contextualization in 18th-century scientific and espionage travels see Harris (1998) and Bertucci (2013). Although focused on the late 19th and the 20th century, Kikuchi's work on the training of Japanese chemists also provides an interesting example of an approach that values the encounter between different cultures and the passage of historical actors by various places. See Kikuchi (2013).
8. Carneiro, Simões and Diogo, 2000; Carvalho, 1959, 1978, 1982; Diogo, Carneiro and Simões, 2001a; Simões, Carneiro and Diogo, 1999; and Simões, Diogo and Carneiro, 2012.
9. Carneiro, Simões and Diogo, 2000; Carvalho, 1959, 1978, 1982; Diogo, Carneiro and Simões, 2001a; Simões, Carneiro and Diogo, 1999; and Simões, Diogo and Carneiro, 2012.
10. Carvalho, 1981; Simões, Carneiro and Diogo, 1999; Carneiro, Simões and Diogo, 2000; Diogo, Carneiro and Simões, 2001a; and Simões, Diogo and Carneiro, 2012.
11. Cf. Edwar Shils's view on the notions of centre and periphery in: Bulmer (1996, p. 14) and Orlans (1996, p. 25).

## REFERENCES

Ahnert, T. (2004) Newtonianism in early Enlightenment Germany, c. 1720 to 1750: metaphysics and the critique of dogmatic philosophy, *Studies in History and Philosophy of Science*, 35(3), 471–491.

Andrade, A. B. (1966) *Verney e a cultura do seu tempo* (Coimbra: Imprensa da Universidade de Coimbra).

Andrade, A. B. (1982) Manuel de Azevedo Fortes, primeiro sequaz, por escrito, das teses fundamentais cartesianas em Portugal, in: *Contributos para a história da mentalidade pedagógica portuguesa* (Lisboa: Imprensa Nacional-Casa da Moeda), pp. 119–126.

Appadurai, A. (ed.) (2001) *Globalization* (Durham and London: Duke University Press).

Bertomeu-Sánchez, J. R. and García-Belmar, A. (2003) El *Curso de química general aplicada a las artes* (1804–1805) de José María San Cristóbal y Josep Garriga i Buach, in: J. L. Barona, J. Moscoso, and J. Pimentel (eds.) *La ilustración y las ciencias* (Valencia: PUV), pp. 179–237.

Bertucci, P. (2013) Enlightened secrets: silk, intelligent travel, and industrial espionage in eighteenth-century France, *Technology and Culture*, 54(4), 820–852.

Bulmer, M. (1996) Edward Shils as a sociologist, *Minerva*, 34(1), 7–21.

Candolle, A. (1862) *Mémoires et souvenirs de Agustin-Pyramus de Candolle écrits par lui-même et publiés par son fils* (Geneva).

Carneiro, A., Simões, A. and Diogo, M. P. (2000) Enlightenment science in Portugal: the *Estrangeirados* and their communication networks, *Social Studies of Science*, 30(4), 591–619.

Carvalho, R. (1959) *História da Fundação do Real Colégio dos Nobres, 1761–1772* (Coimbra: Atlântida).

Carvalho, R. (1978) *História do Gabinete de Física da Universidade de Coimbra (1772–1790)* (Coimbra: Universidade de Coimbra).

Carvalho, R. (1981) *A Actividade Pedagógica da Academia das Ciências de Lisboa nos séculos XVIII e XIX* (Lisboa).

Carvalho, R. (1982) *A Física experimental em Portugal no século XVIII* (Lisboa: ICALP).

Carvalho, R. (1985) *A astronomia em Portugal no séc. XVIII* (Lisboa: ICALP).

Carvalho, R. (1996) *Actividades científicas em Portugal no século XVIII* (Évora: Universidade de Évora).

Caswell, L. R. and Daley, R. W. S. (1999) The Delhuyar brothers, Tungsten and Spanish Silver, *Bulletin for the History of Chemistry*, 23, 11–19.

Clark, W., Golinski, J. and Schaffer, S. (eds.) (1999) *The sciences in Enlightened Europe* (Chicago: University of Chicago Press).

Cohen, D. and O'Connor, M. (eds.) (2004) *Comparison and history: Europe in cross-national perspective* (New York, London: Routledge).

Davis, R. B. (1993) *The Abbé Correa in America, 1812–1820. The contributions of the diplomat and natural philosopher to the foundations of our national life* (Providence: Gávea-Brown).

Diogo, M. P., Carneiro, A. and Simões, A. (2001a) The Portuguese naturalist Correia da Serra (1751–1823) and his impact on early nineteenth-century botany, *Journal of the History of Biology*, 34(2), 353–393.

Diogo, M. P., Carneiro, A. and Simões, A. (2001b) Ciência portuguesa no iluminismo. Os estrangeirados e as comunidades científicas europeias, in: J. A. Nunes and M. E. Gonçalves (eds.) *Enteados de Galileu? A semiperiferia no sistema mundial de ciência* (Porto: Edições Afrontamento), pp. 209–238.

Elshakry, M. (2010) When science became Western: historiographical reflections, *Isis*, 101(1), 98–109.

Finnegan, D. A. (2008) The spatial turn: geographical approaches in the history of science, *Journal of the History of Biology*, 41(2), 369–388.

Gago, R. (1988) The new chemistry in Spain, *Osiris*, 4, 169–172.

García-Belmar, A. and Bertomeu-Sánchez, J. R. (2001) Viajes de cultivadores de la química españoles a Francia (1770–1830), *Asclepio*, 53(1), 95–139.

García-Belmar, A. and Bertomeu-Sánchez, J. R. (2003) Constructing the centre from the periphery: Spanish travellers to France at the time of the chemical revolution, in: A. Simões, A. Carneiro and M. P. Diogo (eds.) *Travels of learning: a geography of science in Europe* (Dordrecht: Kluwer Academic Publishers), pp. 149–196.

García-Belmar, A. and Bertomeu-Sánchez, J. R. (2010) Louis Jacques Thenard's chemistry courses at the Collège de France, 1804–1835, *Ambix*, 57(1), 48–64.

Gavroglu, K. (2012) The STEP (Science and Technology in the European Periphery) initiative: attempting to historicize the notion of European Science, *Centaurus*, 54(4), 311–328.

Gavroglu, K., Patiniotis, M., Papanelopoulou, F., Simões, A., Carneiro, A., Diogo, M. P., Bertomeu-Sánchez, J. R., García-Belmar, A. and Nieto-Galan, A. (2008) Science and technology in the European periphery. Historiographical reflections, *History of Science*, 46(2), 153–175.

Harris, J. R. (1998a) *Industrial espionage and technology transfer. Britain and France in the eighteenth century* (Aldershot: Ashgate).

Harris, S. J. (1998b) Long-distance corporations, big sciences, and the geography of knowledge, *Configurations*, 6(2), 269–304.

Kikuchi, Y. (2013) *Anglo-American connections in Japanese chemistry. The lab as contact zone* (New York: Palgrave).

Leitão, H. (2003) A periphery between two centers? Portugal on the scientific route from Europe to China (sixteenth and seventeenth centuries), in: A. Simões, A. Carneiro and M. P. Diogo (eds.) *Travels of learning: a geography of science in Europe* (Dordrecht: Kluwer Academic Publishers), pp. 19–46.

Leitão, H. and Martins, L. (eds.) (2008) *Sphæra mundi: a ciência na aula da esfera. Manuscritos científicos do Colégio de Santo Antão nas colecções da BNP* (Lisboa: Biblioteca Nacional de Portugal).

Livingstone, D. (2003) *Putting science in its place: geographies of scientific knowledge* (Chicago: University Press).

Macedo, J. B. (n/d) *Estrangeirados: um conceito a rever* (Lisboa: Edições do Tempo).

Martínez Ruiz, E. and Pazzis Pi Corrales, M. (2008) *Ilustración, ciencia y técnica en el siglo XVIII español* (Valencia: PUV).

Nieto-Galan, A. (2003) Under the banner of the catalan industry. Scientific journeys and transfer of technology in 19th century Barcelona, in: A. Simões, A. Carneiro and M. P. Diogo (eds.) *Travels of learning: a geography of science in Europe* (Dordrecht: Kluwer Academic Publishers), pp. 189–212.

Observatorio Real da Universidade de Coimbra (1803) *Ephemerides astronomicas calculadas para o meridiano do Observatorio Real da Universidade de Coimbra: para o uso do mesmo observatorio, e para o da navegacao portugueza*, Vol. I. Para o anno de 1804 (Coimbra: Real Imprensa da Universidade).

Orlans, H. (1996) Edward Shils' beliefs about society and sociology, *Minerva*, 34(1), 23–37.

Patiniotis, M. (2003) Scientific travels of the Greek scholars in the eighteenth century, in: A. Simões, A. Carneiro and M. P. Diogo (eds.) *Travels of learning: a geography of science in Europe* (Dordrecht: Kluwer Academic Publishers), pp. 49–78.

Patiniotis, M. (2007) Periphery reassessed: Eugenios Voulgaris converses with Isaac Newton, *The British Journal for the History of Science*, 40(4), 471–490.

Patiniotis, M. (2011) Eclecticism and appropriation of the new scientific methods by the Greek-speaking Scholars in the Ottoman Empire, in: F. Günergun and D. Raina (eds.) *Science between Europe and Asia: historical studies on the transmission, adoption and adaptation of knowledge* (Dordrecht, Heidelberg, London, New York: Springer), pp. 193–206.

Patiniotis, M. (2013) Between the local and the global: history of science in the European periphery meets post-colonial studies, *Centaurus*, 55(4), 361–384.

Paty, M. (1999) Comparative history of modern science and the context of dependency, *Science Technology & Society*, 4(2), 171–204.

Pelayo, F. and Rebok, S. (2002) Fausto de Elhuyar y la Societät der Bergbaukunde. Un proyecto científico de red europea para la difusión pública de las prácticas minero-metalúrgicas, *Cronos*, 5-6, 69–90.

Pyenson, L. (2002) Comparative history of science, *History of Science*, 40(1), 1–33.

Raj, K. (2007) *Relocating modern science: circulation and the construction of knowledge in South Asia and Europe 1650–1900* (Hampshire: Palgrave Macmillan).

Raj, K. (2010) Introduction: circulation and locality in early modern science, *British Journal for the History of Science*, 43(4), 513–517.

Raj, K. (2013) Beyond postcolonialism … and postpositivism: circulation and the global history of science, *Isis*, 104(2), 337–347.

Raminelli, R. (2008) *Viagens ultramarinas. Monarcas, vassalos e governo a distância* (São Paulo: Alameda Casa Editorial).

Renn, J. (ed.) (2012) *The Globalization of knowledge in history* (Max Planck Research Library for the History and Development of Knowledge) Studies 1, Edition. Available online at: http://www.edition-open-access.de/studies/1 (accessed 24 February 2014).

Roberts, L. (2009) Situating science in global history: local exchanges and networks of circulation, *Itinerario*, 33(1), 9–30.

Sabra, I. (1987) The appropriation and subsequent naturalization of Greek science in medieval Islam: a preliminary statement, *History of Science*, 25, 223–243.

Schaffer, S., Roberts, L., Raj, K. and Delbourgo, J. (2009) Introduction, in: S. Schaffer, L. Roberts, K. Raj and J. Delbourgo (eds.) *The brokered world: go-betweens and global intelligence, 1770–1820* (Sagamore Beach: Watson Publishing International – Science History Publications), pp. ix–xxxviii.

Secord, J. (2004) Knowledge in transit, *Isis*, 95(4), 654–672.

Selles, M., Lafuente, A. and Peset, J. L. (1987) *Carlos III y la ciencia de la ilustración* (Madrid: Alianza Editorial).

Simões, A., Carneiro, A. and Diogo, M. P. (1999) Constructing knowledge: eighteenth-century Portugal and the new sciences, *Archimedes*, 2, 163–197.

Simões, A., Diogo, M. P. and Carneiro, A. (2012) *Citizen of the world: a scientific biography of the Abbe Correia da Serra* (Berkeley: Institute of Governmental Studies Press).

Simon, J. and Herran, N. (eds.) (2008) *Beyond borders: fresh perspectives in history of science* (Newcastle: Cambridge Scholars Publishing).

Sivasundaram, S. (2010) Focus: global histories of science – Introduction, *Isis*, 101(1), 95–97.

Sousa, M. (1983) *A abertura de Portugal à cultura europeia: os bolseiros de Pina Manique* (Lisboa: Instituto Português de Ensino à Distância).

Withers, C. W. J. (2007) *Placing the enlightenment. Thinking geographically about the age of reason* (Chicago: University of Chicago Press).

Withers, C. W. J. (2009) Place and 'spatial turn' in geography and history, *Journal of the History of Ideas*, 70(4), 637–658.

Δημαράς, Κ. Θ. (1993) *Νεοελληνικός Διαφωτισμός [Neohellenic enlightenment]*, Sixth edition (Athens: Ερμής).

Καράς, Γ. (1991) *Οι θετικές επιστήμες στον ελληνικό χώρο (15ος-19ος αιώνας) [The positive sciences in the Greek space (15th–19th c.)]* (Athens: Δαίδαλος, Ι. Ζαχαρόπουλος).

Κατσιαρδή-Hering, Ό. (2003) Η Ελληνική Διασπορά: Η γεωγραφία και η τυπολογία της [Greek diaspora: its geography and its typology'], in: Σ. Ι. Ασδραχάς (ed.) *Ελληνική Οικονομική Ιστορία, ΙΕ'-ΙΘ' αιώνας [Greek economic history, 15th to 19th centuries]*, Vol. 1 (Athens: Πολιτιστικό Γδρυμα Ομίλου Πειραιώς), pp. 237–247.

Κοραής, Α. (1833) *Υπόμνημα περί της παρούσης καταστάσεως του πολιτισμού εν Ελλάδι, συνταχθέν μεν Γαλλιστί και αναγνωσθέν εις την εταιρίαν των ανθρωποτηρητών (τη 6 Ιανουαρίου 1803),* μεταφρασθέν δε υπό *Αναστασίου Κωνσταντινίδου [Memoire sur l'etat actuel de la civilisation dans la Grece, lu a la Societe des Observateurs de l'homme, le 16 Nivose, an XI (6 Janvier 1803)]* (Athens: Printing House of X. N. Philadelpheos).

Κούμας, Κ. Μ. (1832) *Ιστορία των Ανθρωπίνων πράξεων [History of human affairs]*, Vol. 12 vols (Vienna: Printing House of Anton von Haykul).

Πατηνιώτης, Μ. (2013) *Στοιχεία Φυσικής Φιλοσοφίας: Ο ελληνικός επιστημονικός στοχασμός τον 17ο και 18ο αιώνα [Elements of natural philosophy: the Greek scientific thought in the 17th and the 18th centuries]* (Athens: Gutenberg).