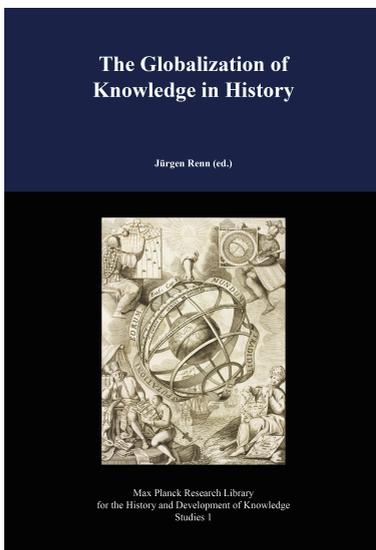


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Studies 1

Manolis Patiniotis and Kostas Gavroglu:

The Sciences in Europe: Transmitting Centers and the Appropriating Peripheries



In: Jürgen Renn (ed.): *The Globalization of Knowledge in History*

Online version at <http://edition-open-access.de/studies/1/>

ISBN 9783844222388

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Printed and distributed by:

Neopubli GmbH, Berlin

<http://www.epubli.de/shop/buch/17018>

The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available in the Internet at <http://dnb.d-nb.de>

Chapter 14

The Sciences in Europe: Transmitting Centers and the Appropriating Peripheries

Manolis Patiniotis and Kostas Gavroglu

14.1 Introduction

It has been commonly the case that while discussing the transmission of the sciences to regions outside Europe there is ample reference to “European science,” implied as a unified whole of ideas and practices from more or less the seventeenth century. If what is meant by European in this expression is a purely—and, yet, ill-defined—spatial reference, then there is not much one can disagree with. But if European signifies or encapsulates the historicity of a specific stage in the development of the sciences, then to consider “European science” as something unified is grossly misrepresenting what happened during the eighteenth and part of the nineteenth centuries in many localities of what has been constituting geographical Europe: Spain, Portugal, Russia, the Scandinavian countries, the western regions of the Ottoman Empire including Greece, Bulgaria, Serbia, Romania and so forth. What we would like to argue in this paper is that a study of the globalization of knowledge cannot be properly understood without the study of the Europeanization of knowledge—especially for part of the seventeenth, all of the eighteenth and part of the nineteenth centuries. And a crucial aspect for the comprehension of the processes involved in the Europeanization of knowledge is a methodological/historiographical shift: to move away from considering these processes as processes of transmission/transfer of ideas and practices from the “center” to the “periphery,” and adopt, instead, the view of appropriation of ideas and practices *by* the “periphery.” Hence, realizing a shift from the view of a relatively passive “emitter” whose preoccupation is the transmission of ideas and practices—more or less intact—over short or long distances, to the view of an active “receiver” whose problem is how to appropriate new knowledge to the local context.

The history of the transmission of scientific ideas from the “center” to the “periphery,” especially during the last five centuries, is a subject that has drawn the attention of historians long ago. In recent years Europe went through profound transformations and these changes created a new context for the re-examination of a host of issues, some of which have been associated with the transmission of the sciences. New nation states came into being, new borders emerged, new institutions appeared, and old institutions have been restructured. These changes have

induced many scholars to look again at Europe's past, and the history of science is one of the subjects to be systematically examined. The work that has already been done, as well as newly available sources combined with a more open intellectual environment and increases in funding for transnational and transcultural contacts offer an unprecedented opportunity for a critical re-examination of the historical character of science and its institutions in European regions and societies for which little or no work has been done. And it is in this context that historians have been able to articulate a number of new questions: How should we try to study the long-standing question of the tension between particular local practices and the progressive homogenization of an international scientific community? How was this tension particularized within the framework of a Europe aiming to dictate global policies, while at the same time facing the shifting of boundaries among its nations and cultures? To what extent was each local society willing to receive the new sciences and provide them with the appropriate institutional background? To what extent were local scholars willing to adopt the particular corpus of ideas and to organize their collective intellectual activity on its basis? To what extent did scholars, philosophers or scientists originating in a specific society participate in the formation of scientific ideas in the respective scientific centers? And, in addition, how should we deal with the old problem of the transfer of scientific knowledge in a historiographic context offering a great variety of approaches?

The attempts to answer these questions set a new framework for the discussion of the "local" in history of science. How does the "local" integrate into the "universal"? Through which processes were local intellectual and institutional contexts incorporated into the dominant scientific ideal? What was the role of the local cultural traditions in the building of a uniform European scientific culture? Historians dealing with these questions aim at promoting the study of local issues avoiding the pitfalls of the received heroic accounts. They also aim at exchanging information and methodological contemplations in order to examine to what extent the "view from the periphery" might bring a new perspective to the history of science in general.¹

In what follows we shall present the development of "Greek science" during the eighteenth century, as a characteristic case reflecting many of the issues involved in the above questions. At the same time, we shall try to show how a shift from

¹Such recent undertakings are STEP ("Science and Technology in the European Periphery") and the "Tensions of Europe." The former is a group of historians of science from many European countries (Belgium, Denmark, Sweden, Finland, Russia, Turkey, Greece, Italy, Spain, Portugal and Hungary) who study the circulation of scientific knowledge between European centers and peripheries from the sixteenth to the nineteenth centuries. See www.uoa.gr/step and (Gavroglu et al. 2008) for a historiographic review. "Tensions of Europe" is a network of historians from seventeen countries who explore transnational European history with a focus on the roles of technology as forces of change. Their main tenet is that examining the European integration through the lens of technology will make visible a bottom-up "hidden integration" and provide a deeper and richer historical understanding of the process. See www.tensionsofeurope.eu. Concerning the scope and the historiographic perspective of the group, see (Misa and Schot 2005; Schot et al. 2005).

the dominant approach of “reception studies” toward a historiography focusing on the processes of appropriation might offer us a clearer view of some important aspects of the Europeanization of knowledge.

14.2 Historical Background

In the eighteenth-century Balkans various social formations started coming into existence as a result of the intricate historical process prompted by the decline of the Ottoman Empire. Modern Greek society was one of these formations (Mazower 2000). Demographically this society consisted of many different populations dispersed within and outside the borders of the Ottoman Empire. The elements that played the most prominent role in unifying these populations were basically cultural and ideological: Christian Orthodox faith and Greek-speaking education. This was a result of the political arrangements that followed the Ottoman conquest of Constantinople three centuries earlier.

Immediately after the fall of the city in 1453, Sultan Mohammed II appointed Georgios Gennadios (ca. 1400–1472) the new Patriarch of the Orthodox Church and provided him with a written “privilege” that granted the Christian authorities jurisdiction over many aspects of the religious and civil life of the Christian populations of the Balkans and Asia Minor. The Sultan’s decision was a highly symbolic gesture aiming to respond to the complications related, on the one hand, to the administration of a continuously expanding empire with a progressively increasing Christian population and, on the other, to the threat from Christian Europe: At a time when “nation” meant an aggregation of people who shared the same religious beliefs and attended the same rituals, the Orthodox Patriarchate was the only institution which was in a position to present a more or less unified expression of the various Christian populations to the Ottoman administration. At the same time, Mohammed took advantage of the deep animosity between the Orthodox and the Catholic Churches, which progressively strengthened after the schism of 1054. The choice of the Orthodox Patriarch as the *de facto* political representative of the Christian populations of the Balkans, and his favorable disposition toward those who opposed the reunification of the Churches (in contrast to many influential Byzantines who were in favor) was a shrewd decision aiming to undermine any prospective alliance of the Christians in the Ottoman Empire with those in Europe. In the course of time, it turned out that Mohammed’s arrangements contributed to a long-lasting social stability in the eastern Mediterranean and the Ecumenical Patriarchate was integrated into the Ottoman administration as a state institution, exerting power over a great number of Christians dispersed throughout the vast territory of the Ottoman Empire. Thus, the power of the Patriarchate was not only religious but also political and economical.

One of the most important consequences of this arrangement was that it allowed the Patriarchate to ascertain control over the educational activities of these populations. For a long time, however, education was very poor, since its basic

aim was the (re)production of medium rank clergy. According to all (but to be sure, quite limited) extant evidence (Psimmenos 1988, 174), the school curricula of the sixteenth century included Aristotle's logic and rhetoric, and the patristic tradition of the Eastern Church. The first significant revival of philosophical thought took place in the years of the Patriarch Kyrillos Loukaris (1570–1638), who appointed the Neoaristotelian philosopher Theophilos Korydaleus (1563/74–1646) director of the Patriarchal Academy. Loukaris' aim—triggered by the activities of the Jesuits in the Eastern Mediterranean—was to promote the shaping of an intellectual identity for the Orthodox populations of the Ottoman Empire, which would render them a discreet cultural entity between the Muslim East and the Catholic West (Hering 1968). Korydaleus was the first scholar after the fall of Constantinople, who introduced a systematic interest in Aristotle's physics and brought forth the works of the Greek-speaking commentators of the past. He wrote extensive commentaries of his own on *Physica* and *De generatione et corruptione* drawing upon the commentaries of Alexander Aphrodisieus and the views of the Italian Alexandrists of the sixteenth century (Tsourkas 1967; Schmitt 1984). His work was not favorably received by some of his contemporaries, since such views expressed a covert materialism, but it enjoyed the protection of the Church as it was the only available antidote to Catholic scholasticism. As a result, it formed the core of higher philosophical education for more than 150 years and had a long-lasting impact on Greek intellectual life.

The physiognomy of education and the respective features of intellectual life were further defined by the subsequent social developments in the Ottoman Balkans. The early eighteenth century witnessed the emergence of the Phanariots, a group of Greek-speaking noblemen who simultaneously served at the court of the Ecumenical Patriarchate (situated in the Phanari region of Constantinople, hence the name Phanariots) and of the Ottoman administration. From the end of the seventeenth century, the Phanariots acquired an increasingly important role in the administration of the Ottoman state. At the outset of the next century, representatives of the Phanariots were appointed by the Sultan as governors of Wallachia and Moldavia. The Phanariots would soon take the lead among all the other Orthodox groups of the Balkans. As administrators and diplomats they adopted the line of enlightened despotism. Their political dominance reinforced the already strong influence of the Greeks in the economic and cultural sphere of these regions. The Phanariots played a significant role in the secularization of education by promoting the establishment of schools and by favoring the introduction of contemporary European trends in education, as well as in social life. Especially in Constantinople, Bucharest and Jassy, their presence was rather emphatic, but they also intervened in educational matters elsewhere either by offering protection to particular scholars who built their careers on modern philosophy or by contributing to the building of new schools, which aimed at the wider public.

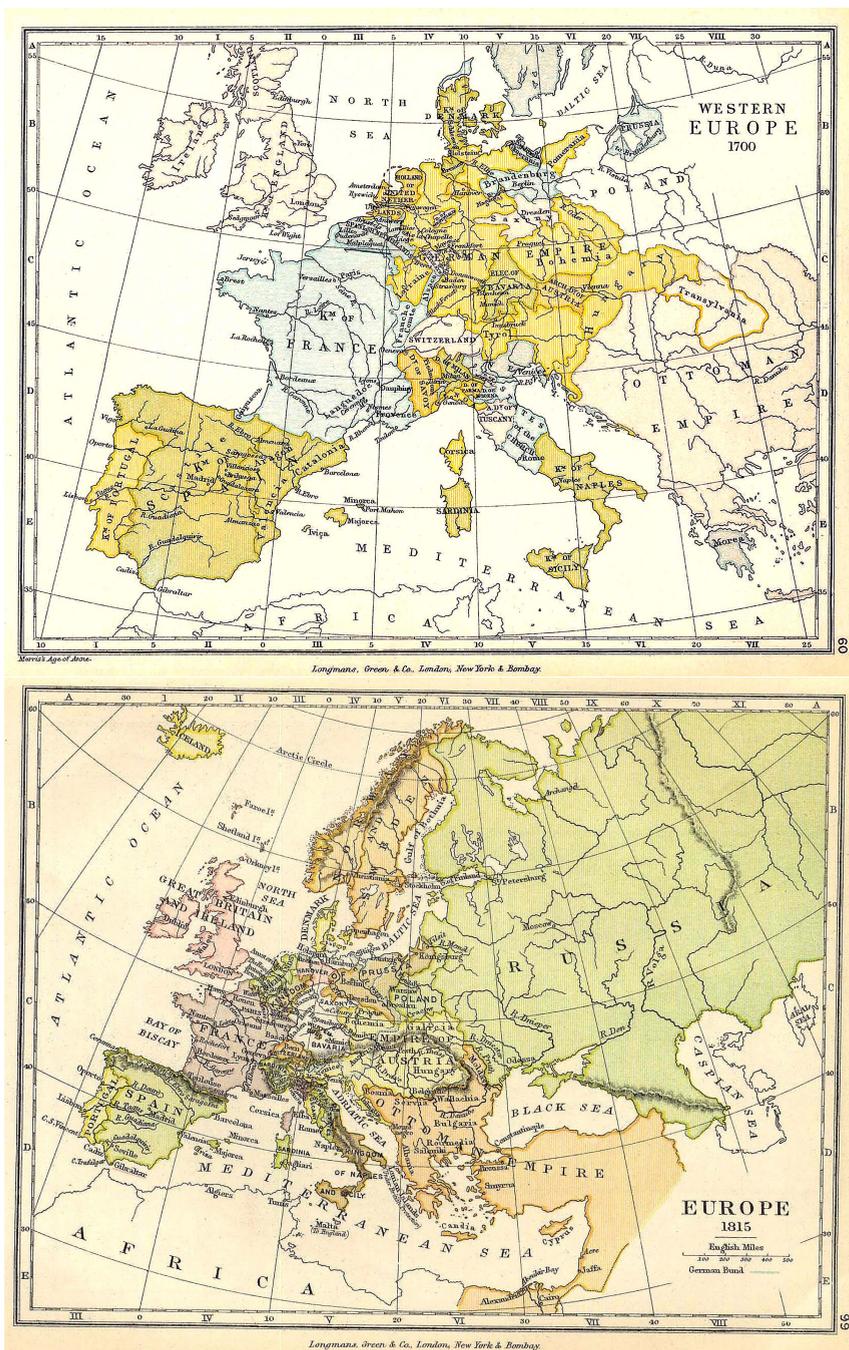


Figure 14.1: Europe has always been a changing landscape. So too were the flows of knowledge that shaped “European science.” University of Texas Libraries.

At the same time, another social group sought to secure its share in the distribution of social and economic power among the Orthodox populations of the Balkans. It was the group of wealthy craftsmen and merchants of Epirus, western Macedonia and Thessaly. The area had a long tradition in commercial and handicraft activities, but it also comprised the most important migration center of the Ottoman Empire. In fact, it was the gate that connected the Ottoman territories with the European commercial routes. The populations of the area traditionally served as intermediaries in this communication, and many people over many generations immigrated to central Europe in order to establish or maintain the links of this commercial network (Stoianovich 1960; Cicanci 1986). The area gradually became an educational center, since the wealth and the size of the local communities allowed them to establish many new schools. Moreover, in the course of their self-assertion and due to the distance from the traditional political and educational centers, the communities encouraged the creation of an intellectual atmosphere, which was quite receptive to the new educational and philosophical trends of European thought. It is important to stress that most Greek-speaking scholars who dealt with the sciences and the new natural philosophy during the eighteenth century originated in this narrow area of the south-western Balkans (Patiniotis 2003).

All these developments did not alter, of course, the basic features of educational activities and, most importantly, the predominance of the Church in educational matters. Both Christian faith and Greek-speaking education, the two elements that unified such different groups as the Phanariots of Constantinople, the Vlach merchants of Epirus, the Greek fraternity of Venice, the Greek-speaking immigrants of central Europe and the administrative elite of the semi-autonomous Danubian regions, were under the jurisdiction of the Ecumenical Patriarchate of Constantinople; but, in light of the developments that took place in the eighteenth century, both elements were now also heavily tinged by the particularities of the various local communities. This was particularly important for education, because due to the lack of other (state) institutions, Greek-speaking education became the main intellectual space that hosted all kinds of fermentation, negotiations and collective pursuits concerning the political and intellectual identity of the emerging society. This was also the context wherein the assimilation of the new natural philosophy took place, during a long period, which spans from the late seventeenth century until Greece won its independence in the late 1820s.

From the outset of the eighteenth century, Greek-speaking scholars began to disperse throughout Europe, and Padua ceased to be the almost exclusive place to study. They also began to travel to the German states, the Low Countries, Russia, the Habsburg Empire, and—to a much lesser extent—to France and England. They were thus acquainted with a multitude of intellectual traditions and schools, related mainly to the recent developments of the various movements of Enlightenment in Europe. When these people returned to their homelands, after having spent from four to ten years in the European educational centers, they

strove to gain social recognition corresponding to their intellectual qualifications. The quest for modernization of certain local societies formed the ground upon which their social aspirations could flourish. The young (or not so young) scholars perceived themselves, and were also perceived by others, as agents of a new spirit in Greek intellectual life. Far from serving a homogeneous program 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 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. The textbooks they wrote and the philosophical discourses they elaborated reflected their aspirations in this ambiguous situation (Patiniotis 2003).

14.3 Newtonianism in the Greek Intellectual Context

The introduction of Newtonian ideas into the Greek intellectual space took place basically in the second half of the eighteenth century. During that period, a great number of textbooks were written and published for the use of students in higher education. Many of them were devoted to such practical issues as arithmetic, geography and “commercial science.” But a significant number was also devoted to more theoretical and contemplative issues, like metaphysics and natural philosophy. With only one unique exception, all these works could be more or less characterized as “Newtonian.”² Naturally enough, the training and the resources of the authors played a decisive role in the character of their intellectual production.

Many eighteenth-century Greek-speaking scholars spent a significant period of time in important European universities. As already mentioned, since the seventeenth century, the dominant tradition was to attend the university of Padua and, to a much lesser extent, other Italian universities. As the decades went by, though, one can observe a shift toward German universities, as well as a turn of the intellectual focus toward German-speaking centers: Vienna, Leipzig, Jena and Halle. In either case, Greek-speaking scholars had the opportunity to be actual witnesses of various discussions and disputes concerning a number of issues in Newtonian philosophy. They also seem to have been well acquainted with the bibliography and the published sources of the time. This broad view over the Newtonian natural philosophy is clearly reflected in their works. Some directly translated renowned treatises, which promoted the spread of Newtonian ideas in Europe, like Benjamin Martin’s *Philosophical Grammar* (Gazis 1799), Petrus van Musschenbroek’s *Elementa physicae conscripta in usus academicos* (Theotokis 1766, 1767), Joseph Jérôme Lalande’s *Astronomie* (Philippidis 1803) and Francesco

²The unique exception is the two polemical books written by Sergios Makraeos, one criticizing the introduction of the heliocentric system (Makraeos 1797) and the other—twenty years later—attempting to restore Aristotelian physics (Makraeos 1816). Interestingly enough, the former employs a certain interpretation of the Newtonian concept of central forces in order to prove the instability of the heliocentric system.

Soave's *Instituzioni di logica, metafisica ed etica* (Konstantas 1804). Others translated older texts bearing a relevance to the main themes of their contemporary natural philosophy, like Fontenelle's, *Entretiens sur la pluralité des mondes*, whose translator appended a long list of notes turning the originally Cartesian text into a Newtonian confession (Kodrikas 1794). But most of them used a great number of sources—often without mentioning them—in order to select views, findings, proofs and information to build their own natural philosophical accounts. In such cases, the Greek-speaking scholars would enter a dialogue with some of the most widespread resources of the Newtonian trend: Samuel Clarke's publication of his *Correspondence* with Leibniz and his famous annotated translation of Jacques Rohault's *Physics*; Willem Jacob van 'sGravesande's *Physices elementa mathematica* and his *Introductio ad philosophiam*; Émilie du Châtelet's, *Institutions Physiques*; and, of course, Voltaire's, *Éléments de la philosophie de Newton*. There is significant evidence that some of the authors might have read Newton's own original texts,³ but most of them contented themselves with treatises elaborating on various aspects of Newtonian philosophy. In this respect, an important resource for their scholarship was the *Encyclopédie*, which provided them with concise and comprehensive accounts on the latest developments in the field (Rigas 1790; Kodrikas 1794).

How is one to assess the receptiveness of Greek intellectual life toward the Newtonian philosophy of the time? Most Greek historians concentrate on an attempt to record the various Newtonian doctrines, which occur in the works of the Greek-speaking scholars, taking them as signs of a changing attitude toward modern science. According to these historians, the reference of a number of Newtonian tenets or the subscription to the mechanical worldview indicates the willingness of the scholars to break with the dominant Aristotelian tradition and embrace the new natural philosophy. Thus, taking "Newtonian physics" as a more or less coherent synthesis, they organize their research around the examination of how fully and how faithfully the various aspects of the Newtonian worldview were represented in the Greek books of the time.⁴ Very often, however, the conclusion they reach is that, notwithstanding the ideologically favorable attitude of many Greek-speaking scholars toward the new natural philosophy, the degree of "scientific" sophistication of their works is rather limited!

One issue that has actually puzzled historians about the intellectual attitude of eighteenth-century scholars is their views on experiment. In the eighteenth century, Newtonian philosophy was almost synonymous with experimental philosophy and many proponents of the new natural philosophy, like Benjamin Martin,

³Especially *Optics*. See, for example, (Voulgaris 1805b, part 2, 155, Voulgaris 1805a, 38–41), where the description of the atomic system closely follows "Query 31." The same author, who was one of the most erudite scholars of the time, also cited some important passages from the *Principia*. In (Voulgaris 1805a, 98–99), he quoted the laws of motion directly from the first book of the *Principia*, while a few pages earlier (41–42), when discussing the hypothesis of ether, he cited Newton's views directly from the *General Scholium*.

⁴Indicatively: (Kondylis 1988; Vlachakis 1996; Karas et al. 2003).

Petrus van Musschenbroek and Wilhelm Jacob van 'sGravesande worked to spread Newton's reputation on this front.⁵ In consonance with this trend, Greek philosophical and scientific books contained a great number of references either to specific experiments or to the value of experimental study of Nature in general. Moreover, through explicit references to Newton's "rules of philosophizing," they invited their readers to endorse the experimental method as the proper way to conduct empirical investigations.⁶ Beyond such an acknowledgment, however, we have no evidence about actual experiments conducted by Greek-speaking scholars. They mentioned experiments made by others, they commented on remarkable observations made in European laboratories and observatories, they argued for the acquisition of experimental devices to be used in Greek schools and they declared their adherence to the new empirical method of investigation as opposed to the infertile scholastic explanations; but, as far as we know, they did not seem to have systematically conducted actual experiments (Karas et al. 2003, 514–555). At most (and according to scarce evidence) they organized some experimental demonstrations for the elucidation of their students or maybe of a wider learned public. The heuristic role of experiment and its instrumental use in the quantitative investigation of the external natural world was outside their scope and it did not appear to be part of the discourse they attempted to form.

Similar things hold concerning the mathematization of natural philosophy. Newtonian mechanics (in the beginning, a part of mathematics itself) marked the convergence of natural philosophy with mathematics. Especially due to the fact that Newton's major intention was to study the generation of celestial trajectories, mechanics was prompted to cross the border of pure quantification and enter the realm of dynamics. Geometry could not accompany natural philosophy along this venture; the redefinition of space, time and motion went hand in hand with the introduction of calculus as the backbone of rational mechanics (Cohen and Whitman 1999, 382; Patiniotis 2005, 1634–35). This characteristically Newtonian approach is totally absent from the eighteenth-century Greek scientific treatises. Greek-speaking scholars were well versed in mathematics and had produced a number of treatises on Euclidean geometry, the conic sections and the modern developments in algebra. In neither case, though, did they link the developments in mathematics with the developments in mechanics that had fueled them. On the contrary, the treatment of the fundamental notions of the new natural philosophy retained a high degree of metaphysical sophistication in their works. Quite a few scholars ventured into novel syntheses, crossed multiple traditions and employed a highly technical vocabulary, but they persistently avoided getting involved with the mathematical technicalities of rational mechanics. The instances of clear mathematical treatment of dynamics were scarce and even these very soon turned to the trivial problems of Archimedean or Galilean mechanics. On the other hand, the emphasis put on the elucidation of the readers through empirical examples

⁵See, however (Schaffer 1989).

⁶See (Theotokis 1766, 7–10; Voulgaris 1805a, 6; Koumas 1807, Vol. 4, 230–231).

drawn from everyday life is significant, indicating the authors' desire to handle the new natural philosophy in a primarily qualitative way.

The ambiguous relationship of Greek-speaking scholars with experimental philosophy and mathematics forms part of a broader historiographic discussion concerning the kind of natural discourse developed by these scholars. According to many historians, Greek science lacked originality and creativity. It was a vague reflection of the developments that took place in the centers of the Enlightenment, used in the Greek context primarily for ideological purposes. However, due to the Ottoman rule over the Greek-speaking populations of the Balkans, even the mere attempt to bring Greek education in contact with Enlightened Europe is considered a heroic endeavor. Against this background, some historians have developed the argument that the assumedly low level of the philosophical and scientific production of the time reflects the real conditions of the specific society, and thus the question of originality is literally and metaphorically untimely (Psimmenos 1988, 31). Others consider that Greek-speaking scholars might not be the kind of natural philosophers who could be met at the time in Western Europe, but when they decided to convey the new knowledge to their particular intellectual space, they went through a selection process, adapting this knowledge for educational use (Karas 1991, 89). The fact itself that, irrespectively of the degree of sophistication, specific scholars assimilated and spread the new scientific spirit in the Greek intellectual space, countering popular ignorance on the one hand, and the established authorities on the other, was not only important for the revival of the Greek intellectual life, but also determined the subsequent political and ideological developments until the Greek war of independence.⁷ Indeed, a most characteristic aspect of the historiography holding these views is that it persistently links the introduction of the sciences with the enlightenment of the "nation" in anticipation of national emancipation (Karas et al. 2003, 48 (esp. n. 9), 49–50, 74). In any case, however, the latent premise behind such considerations is that Greek-speaking scholars were, at best, enlightened teachers. Due to particular historical circumstances, their intellectual activity was confined to the limits of education, and this confinement marked decisively the character of their scientific and philosophical production. For reasons that did not depend on their will or their capabilities, Greek-speaking scholars were unable to share the creativity of modern European thought, but one should properly appreciate the pedagogical and ideological consequences of their work.

14.4 Centers and Peripheries

The agenda of most historians who study eighteenth-century Greek intellectual life draws heavily upon the idea of *transfer*. "European science" is an idealized entity and the study of the Greek scientific and philosophical activity primarily focuses on how successfully the attainments of European thought were transferred to a

⁷See the introduction in (Henderson 1970).

culturally underdeveloped and scientifically uninformed context. Greek historians are not alone in this. For the last thirty years, the distinction between centers and peripheries has been widely applied in history of science, and Greek historians, like many other historians in the “periphery,” became part of this general trend. Most of the studies produced in this area aimed at the investigation of the cultural aspects of the receiving environments, which *facilitated* or *undermined* the expansion of the sciences, or even *distorted* the scientific ideas in their way from the “original” source to the final recipient. Notwithstanding the problematic aspects of the center-periphery dipole, pointed out by many scholars, the leading idea in most of these accounts was that real science was produced in specific scientific centers and, subsequently, thanks to its indisputable truthfulness and its widely appreciated usefulness, it forcefully imposed its presence on the rest of the civilized world.

The center-periphery model was first introduced in 1954 on the occasion of the United Nations economic survey of Europe (Despicht 1980). The model was used in order to depict the differences in economic and political structures between the industrialized and the less or non-industrialized countries of Europe. According to this model, the countries that constituted the center have been the suppliers of capital and technology, while at the same time, they functioned as providers of tourists and absorbers of migration. As a result, a major characteristic of the periphery has been its dependence upon the center (Selwyn 1979). Critical decisions related to the economic potential of the former have been taken in, or entirely influenced by, the latter. Moreover, because of the lack of local innovation, peripheries have been presented as importers of “new products, new technologies, new ideas,” which emanated from the centers and were transferred to the periphery by means of migration.

The above scheme conveniently served for many years the fields of economic and political theory. Serious problems emerge, however, when it is used as a *historiographic* scheme. The last thirty years history of science witnessed the emergence of a whole thematic area, which is known as *reception studies*. The purpose of most works produced in this area has been to examine the spread of the scientific and technological attainments in areas that did not originally participate in the shaping of the respective ideas and practices. The term “reception studies” is often used to denote that there is something (a science, a scientific theory, a technological innovation) which was formed in a certain social and intellectual environment (a center of scientific or technological production) and, thanks to its inherent dynamics (its explanatory efficiency, its emancipating power, its undeniable usefulness), spreads in other environments, very different from the one where it first appeared. A significant number of historical works have been produced according to this model: The spread of the scientific ideas of the Enlightenment in the periphery of Europe, the introduction of modern astronomy in China, the

reception of Darwinism in various cultural contexts, and, of course, the intricate relations of science and technology with imperial and colonial policies.⁸

In most of these studies, the factors that define the character of the exchange between center and periphery are two: The *way* in which the representatives of a certain intellectual milieu came into contact with the “other”—be it Newtonian physics, steam technology or the Darwinian theory—and their *attitude* to it. Concerning the former there is a huge variety of means: Missions, which traveled to China bringing new scientific and technological knowledge; scholars from the periphery of Europe who traveled to the countries of the center in order to participate in the new scientific developments; colonial invasions, which established scientific elites in the countries they controlled; networks of scientific correspondence, which connected remote places across the European continent; even an emperor traveling around Europe to get acquainted with the fruits of modern science and to enroll the most brilliant natural philosophers, mathematicians and engineers to his peripheral court in Saint Petersburg. Concerning the latter, however (the attitude of the local actors toward the new ideas), the variety of means is significantly smaller: There were always those who adopted the new scientific ideas and were willing to back the changes resulting from their social incorporation, and those who reacted to their adoption upholding the social and intellectual values related with the locally dominant beliefs and practices.

The kind of scientific activity that was eventually established in the receiving environment is usually described as the outcome of such confrontations. In many cases the confrontation was resolved either through institutional initiatives—the establishment of academies, universities or laboratories, which accommodated the new scientific activity—or thanks to certain social developments that favored the establishment of the scientific community and the respective interest groups, which took advantage of the new science.⁹ In other cases, the confrontation spanned a long period of social imbalance and came to an end only thanks to a deep social transformation.¹⁰ In almost all cases, however, the stake is the same: The extent to which the particular confrontation favored or inhibited the establishment of a new science or the extent to which it resulted in the distortion of its principles during the transfer from the place of its birth to the receiving environment.

⁸Indicatively: (Basalla 1967; Goodman 1988; Cueto 1989; Polanco 1989; Lindqvist 1993; Todd 1993; Santesmases and Muñoz 1997; Lértora Mendoza et al. 2000; Ihsanoğlu 2004).

⁹This was, for example, the case of Coimbra University and of the Royal Academy of Science in eighteenth-century Portugal (Simões et al. 1999), of the scientific and educational reforms of Peter the Great in eighteenth-century Russia (Rieber 1995), and of the Shanghai Polytechnic School, established in the second half of the nineteenth century (Wright 1996).

¹⁰This is to some extent the case of late eighteenth-century Spain (for the diverse views over this period, see (Nieto-Galan 1999)) and of nineteenth-century Italy (Cerruti 1999). Also of special interest to our analysis is the case of the Ottoman Empire, which first came into contact with the Western sciences at the beginning of a long social transformation, which started in the mid-eighteenth century and culminated with the movement of Tanzimat, between 1839 and 1856. On this issue, see (Ihsanoğlu 2004) and its review (Patiniotis 2006).

It is clear that the above scheme is an immediate outcome of the center-periphery distinction: The “center” produces science and technology and the “periphery,” more or less willingly, embraces it in order to consume it; accordingly, the historians’ task is to trace the venture of transfer and establishment of the new sciences and technologies from “center” to “periphery.” The seeming plausibility of this view provided a kind of legitimization for the historiography which produced it. Had we attempted to apply this approach to the arts the result might have been absurd (Baxandall 1985, 58–62). But concerning science, according to those following this particular approach, things seem to be quite different. The sciences are not subjective expressions of the aesthetic insights of a number of individuals. They represent what exists outside and independently of the individuals, and the role of those dealing with the sciences is to disclose the truths derived from this external reality to the rest of the humanity. According to this particular view, once scientific knowledge has been extracted and formulated, it comprises a kind of commodity which can be distributed by means of the various (mainly intellectual) networks. As a result, scientific centers and scientific peripheries are defined on the basis of the *separation of the production from the distribution of scientific knowledge*.

14.5 New Trends in the Historiography of Science

Recent developments in history of science, however, prompted the shaping of a new frame for the historical study of the sciences in the periphery, which transcends the traditional polarizations. In the context of the new *problematique* the sciences are not perceived as closed systems of ideas and practices responding to the needs of a certain society, nor as self-contained enterprises of natural investigation, to which the various social circumstances simply serve as incentive or interceptive factors. They are mostly treated as cultural phenomena deeply affected by the civilizational patterns of each local context. In this respect, the cognitive traditions and the technical skills are of equal importance to the shaping of a certain scientific discipline as all the other social factors affecting the activity of its agents. Therefore, an important task of a historian who studies the formation of modern scientific discourse is to take into account all the cultural traditions and social conventions which contributed to this process. The purpose of such an approach would not be to show how these factors prompted or prohibited the *discovery* of an indisputable natural truth, but to describe how the inscription of the local traditions and conventions on the structure of the scientific discourse *shaped* natural truth in different places.¹¹

Apparently, these methodological developments set a new ground for the study of modern science in the European periphery. The idea that the sciences are not

¹¹Probably the most influential study of this historiographic trend is (Shapin and Schaffer 1985). See also (Biagioli 1993). The respective bibliography is quite extensive and displays many differentiations. For a comprehensive overview see, among others (Biagioli 1999).

closed systems, which have been unalterably established in different receiving environments, helps disengage the historiography of science from the pattern of “transfer” of scientific ideas. The questions that arise from this new view of science’s history in the periphery predominantly aim at examining the processes through which the new scientific ideas were assimilated by intellectual environments permeated by cultural traditions and social priorities significantly different than those of the environment, which initially gave birth to these ideas and practices. In this respect, the subject matter of historical research should not be the investigation of the factors that favored or prohibited the establishment of the “original” scientific ideas in the periphery, but rather the study of the means employed by each receiving environment in order to incorporate the new ideas and practices into its established social, cultural and educational structures.

The notion of *appropriation* is crucial to this approach. The purpose of a historiography employing this notion is to articulate the particularities of the discourses that were developed and eventually adopted within the appropriating cultures as a result of the scholars’ active endeavor to incorporate new scientific ideas in their particular intellectual and social context.¹² Many historians take it for granted that when peripheral scholars introduce new scientific ideas they simultaneously adopt the scientific discourse related to the formation or at least the application of these ideas. But this is not actually the case. The entire enterprise of appropriation of new ideas can be achieved through the formation of a new discourse as the best way of overcoming local constraints. These constraints have to do with the fact that the new ideas usually provide alternative methods and responses to questions to which peoples and cultures *already had adequate answers*. In other words, new ideas are not introduced to be placed in any kind of void; they are always asked to displace other, usually strongly entrenched systems of thought. As a result, the assimilation of the new ideas could not be achieved without the formation of an appropriate legitimizing context (Gavroglu 1995).

It would thus be interesting to see historians direct their attention less to listing which ideas and theories were successfully transmitted to the local intellectual context, and more to the metamorphoses these ideas underwent through the various stages of assimilation. The specific approach is further justified by the fact that when one refers to the early modern period, the homogeneity of such cognitive enterprises as “Scientific Revolution,” “science,” “physics,” or “Newtonianism” is extremely vague. However, the broad discussion about the historiography of Scientific Revolution, for example, as well as the discussions on the multiple aspects of Newtonianism during the eighteenth century have been quite convincing in moving away from the notion of “scientific center” *as a place where a well-defined and uniform scientific enterprise had been consensually agreed upon*.¹³ In this respect,

¹²Indicatively: (Ragep et al. 1996; Hard and Jamison 1998; Mazzotti 1998; Rupke 2000; Gavroglu and Patiniotis 2003; Ben-Zaken 2004; Misa and Schot 2005; Patiniotis 2007).

¹³See, for example, (Cunningham and Williams 1993; Cohen 1994; Henry 2002). On the multiplicity and the diversity of interpretations making up the eighteenth-century European image of

the scholars of the periphery were never asked to deal with a homogeneous set of established scientific ideas; they were rather prompted to select from a broad spectrum of scientific and philosophical views of nature those which better expressed their personal preferences. And the scientific discourse they eventually produced was not a poor reflection of an unequivocal conceptual and methodological framework, but an original synthesis, informed by the cultural affinities and the philosophical priorities of their local intellectual context.

Would it be possible, in light of the above *problematique*, to develop an alternative interpretation of eighteenth-century Greek scientific thought? And would such an interpretation be of any use to history of science in general? No doubt, Greek-speaking scholars honored the new celestial mechanics and the new experimental philosophy stemming from Newton's synthesis; they also recorded their findings and praised their cognitive dynamics in their works. But how did they assess the cognitive enterprise of the new natural philosophy? What value did they attach to, and to what extent did they perceive themselves as part of it? The picture one draws from their various statements is that, beyond the manifest praise of the moderns, they perceived themselves as seekers of a deeper kind of natural truth, which would transcend the level of mere appearances and would drive to the heart of Nature's secrets. Theophilos Kairis (1784–1853), one of the most erudite scholars of the early nineteenth century, ventured to give the definition of knowledge. Although this is one of the clearest statements of its kind, one can find a great deal of similar theoretical declarations in the philosophical works of the time:

Knowledge is the perspicuous understanding of the beings. *Partial* or *individual* knowledge results from individual observations or experiments; *empirical* knowledge results from many such experiments and observations; *scientific* knowledge, finally, is the knowledge which [on top of these] also includes the *reason* of the being and can be combined with other such pieces of scientific knowledge.¹⁴

Hence, according to this definition, what the moderns did was, at best, “empirical” knowledge, while the goal of Greek-speaking scholars was proper “scientific” knowledge.

Undoubtedly, the Greek-speaking scholars shared with other European scholars the desire to inaugurate an intellectual enterprise that would meet the current condition of philosophy. The question they faced, though, was not about the acceptance or rejection of a new philosophical system about Nature, but about the way they would revive and broaden the scope of their contemporary philosophy. Some European philosophers took groundbreaking initiatives for setting up the new edifice of philosophy: They conducted experiments aiming to unveil

Newtonianism, see (Patiniotis 2005). For the great variety of social, cultural and symbolic uses of the Newtonian heritage, see (Fara 2002).

¹⁴(Karas et al. 2003, 77); translation and emphasis are the authors' own.

the laws of Nature, which would disclose to them important aspects of the divine design, but only those that God would allow man to get acquainted with. Others formulated mathematically the discovered regularities and expected geometry, algebra and, above all, calculus to lead them to 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 fit 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 basically intended was to upgrade their traditional philosophical context through the incorporation of the most precious pieces of modern knowledge. Apparently, they never intended to incorporate “Newtonianism” as an integrated whole comprising both actual findings and methods of inquiry. Most probably, they did not even perceive it as serious philosophy at all. However highly they esteemed Newton’s contribution, new natural philosophy was for them a mode of investigation, which enriched philosophy with new findings, but was in severe need of further philosophical guidance, which would properly accommodate these findings in the traditional (and honored by the ancients) metaphysical discourse about Nature. Thus, they focused on the selection of theories and facts, they even praised the fresh air brought in by the novel methods of inquiry, but they predominantly kept for themselves the role of supervisor, who would lead the road to the final *philosophical* synthesis, *par excellence*. Their philosophical training and the good command of ancient sources, coupled with the knowledge of new scientific attainments rendered them particularly suitable for this intellectual task.

Taking this perspective may significantly change our idea about the intellectual attitude of eighteenth-century Greek-speaking scholars toward Newtonianism. As already mentioned, many historians believe that, although Greek-speaking scholars didn’t really embrace the new scientific method, they did their best to propagandize it and, under the specific historical circumstances (Ottoman rule, poor material conditions, lack of proper educational and political institutions), this suffices to offer them a kind of historical vindication. In light of the above discussion, however, it becomes clear that it was not their difficulty, inability or unwillingness to properly *transfer* the new developments that kept them in the periphery of modern scientific discourse. Quite the opposite, they even assumed a *patronizing* role for themselves and it was, actually, this role that resulted in their marginalization as, in the course of time, the claim for a *systematic organization of natural philosophy* yielded to the claim for a *formal organization of empirical knowledge*. In order to understand the relationship of eighteenth-century Greek-speaking scholars with Newtonianism, thus, it is not enough to enumerate the instances of the various Newtonian ideas in the works of the period. This should rather be the starting point for a more comprehensive historical investiga-

tion about how the scholars dealt with these ideas, how they *appropriated* them into their familiar philosophical context and what kind of philosophical syntheses they eventually produced.

14.6 Conclusions

Scientific periphery did not preexist the developments in science and technology like an empty receiver waiting to be filled by the attainments of the center. It is rather the outcome of an intricate process, which resulted in the predominance of a certain form of knowledge over other forms of knowledge and cognitive priorities. Thus, historical research should not seek to examine the dynamic confrontation of antithetical pairs like science-metaphysics or center-periphery in the course of history, but to investigate the simultaneous *construction* of such notions and of the respective evaluative indices. Thus, to problematize the category of European periphery in the sciences means to problematize the “self-evident” process that led to the construction of *both* the culture of modern science and the culturally dependent scientific periphery.

Working on the history of science in the periphery does not mean that one should, primarily, aim to do justice to the unsung heroes of the periphery or to restore the contribution of the peripheral countries to the building of the glorious edifice of modern science. Apparently, an important dimension of the work of historians who deal with local issues relates to the unearthing of unknown sources, and to the discussion of the historical circumstances under which modern science and technology were established in the particular context. At the same time, though, periphery is something more than a historical and geographical demarcation: Periphery is also a *historiographic standpoint*. For a long time, the standard narrative in history of science and technology used to take the distinction between center and periphery for granted and to focus primarily on the conditions that contributed to the formation of “original” ideas and practices in the centers and, subsequently, on the conditions that boosted or impeded their spread in the peripheries. Recent studies seem to indicate the obsolete character of such approaches and suggest a more detailed investigation into the circumstances that rendered science and technology a global validity. Starting from the periphery—or better, *standing* on the periphery—might offer a clearer view over the intricate ideological constructs, which accompanied the establishment of science and technology and obscured their socio-political grounding. In many cases, what looked like a complete synthesis when seen from the point of view of the center, was entirely disassembled when it reached the peripheries to become the object of intense philosophical and political consideration.

What did Newtonianism actually mean for eighteenth-century Greek-speaking scholars? Was it a novel philosophical exegesis of Nature? Was it a new method of natural investigation? Was it a set of new findings enriching the traditional philosophical discourse about Nature? Was it a new context for the discussion of

such crucial theological issues as God's design of Creation? Was it metaphysics, theology, philosophy, science? Irrespectively of the answers Greek-speaking scholars articulated (and, as expected, they articulated a variety of answers), the study of their work may contribute to further elucidate a period when neither the prevalence of Newtonian philosophy nor the character of the final synthesis could be taken for granted. After all, the story of Newtonianism is not about the spread of Newton's "original" ideas, but about a series of intellectual exchanges, which took place around an original body of ideas, and only after a long and intricate process resulted in what we nowadays understand as Newtonian science. Thus, taking periphery as a historiographic standpoint might help historians bring forward important interactions between different socio-political contexts, which led to the shaping of modern science, as well as the role played by the scientific and technological discourses in the establishment of current cultural distinctions. In this sense, to problematize the category of European periphery in the sciences is neither about periphery itself nor about science and technology *in* the periphery; it is rather about the history of science and technology as part of the globalization of knowledge.

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