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Periphery reassessed: Eugenios Voulgaris converses with Isaac Newton

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Abstract. In the last three decades many historians of science have sought to account for the emergence of modern science and technology in sites that did not participate in the shaping of apparently original ideas. They have extensively used a model of the transfer of scientific ideas and practices from centres of scientific activity to a passively receptive periphery. This paper contributes to the discussion of an alternative historiographic approach, one that employs the notion of appropriation to direct attention towards the receptive modes and devices of a local culture. A historiography built around the notion of appropriation deals less with the question of the faithful transfer of scientific ideas than with the particular features of the discourse produced by local scholars as the best way to overcome or conform to the constraints of the receptive culture. The case examined to describe this culturally and intellectually intricate process is the profound transformation undergone by the Newtonian concept of *vis inertiae* in the work of Eugenios Voulgaris (1716–1806), one of the most important Greek scholars of the eighteenth century.

The concept of transfer of ideas has been extensively used by historians of science to study the spread of various scientific ideas in the periphery – that is, in sites that did not originally participate in the formation of these ideas.[1] Yet a historiography based on

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1 G. Basalla, 'The spread of Western science: a three-stage model describes the introduction of modern science into any non-European nation', *Science* (1967), **156**, 611–22. See also T. Glick (ed.), *The Comparative Reception of Darwinism*, Austin, TX, 1974; P. Casini, 'Les Débuts du newtonianisme en Italie, 1700–1740', *Dix-huitième Siècle* (1978), **10**, 85–100; T. Glick (ed.), *The Comparative Reception of Relativity*, Dordrecht, 1987; A. Pagden, 'The reception of the "new philosophy" in 18th-century Spain', *Journal of the Warburg and Courtauld Institutes* (1988), **51**, 126–40; D. Goodman, *Power and Penury: Government, Technology and Society in Phillip II's Spain*, Cambridge, 1988; C. de Pater, 'The textbooks of 'sGravesande and van Musschenbroek in Italy', in *Italian Scientists in the Low Countries in the 17th and 18th Centuries* (ed. C. S. Maffioli and L. C. Palm), Amsterdam, 1989, 231–41; X. Polanco (ed.), *Naissance et développement de la science-monde*, Paris, 1990; L. Diaz Molina, 'La ciencia moderna en Cuba a principios del siglo XIX: Las

this concept often degenerates into a mere mechanism to trace what was and what was not successfully transmitted. In this approach, generic terms ('Europe', 'the West', 'science' or 'technology'), as well as somewhat more specific notions ('physics', 'Newtonianism', 'Darwinism' or 'experiment'), are taken to be unproblematically clear. The contact of the so-called periphery with such entities is typically taken to be limited to the selection of more basically useful items of knowledge in order to meet the periphery's specific needs. How did local societies interact with such knowledge, beyond the superficial level of necessary adaptation? How did scholarly communities actively modify and appropriate specific theories and technologies? How did actors make the new knowledge an organic part of their distinctive cultural setting? More importantly, what were the particular features of the intellectual syntheses that emerged from these interactions? Such issues usually fall outside the scope of such a historiography, thus limiting investigation of the cultural interactions which preceded present established certainties.[2]

The notion of appropriation can help us formulate more coherent and fruitful analytical tools. Appropriation directs attention to measures devised by the agents of the appropriating culture in order to shape new ideas according to local traditions or constraints. A historiography built on the concept of appropriation is more pertinent to cultural historical methodology. Acceptance or rejection, reception or opposition, are intrinsically cultural processes.[3] Such an approach also permits newly introduced scientific ideas to be treated not as the sum of discrete pieces of knowledge but as a network of interconnected concepts open to modification under local conditions. The practical outcome of a historiography based on the notion of appropriation can produce historical accounts that go beyond geographical demarcations and examine the

fuentes de la "Fisica" de Felix Varela', *Asclepio: Archivo Iberoamericano de Historia de la Medicina y Antropologia Medica* (1990), **42**, 393–412; D. Wright, 'John Fryer and the Shanghai Polytechnic: making space for science in nineteenth-century China', *BJHS* (1996), **29**, 1–16; C. A. Lértora Mendoza, E. Nicolaïdis and J. Vandersmissen (eds.), *The Spread of the Scientific Revolution in the European Periphery, Latin America and East Asia*, Proceedings of the XXth International Congress of History of Science (Liège, 20–6 July 1997), Vol. V, Turnhout, 1999.

2 E. Ihsanoğlu, *Science, Technology and Learning in the Ottoman Empire: Western Influence, Local Institutions, and the Transfer of Knowledge*, Aldershot, 2004. For further discussion of the historiographic issues involved in this approach see M. Patiniotis, review of Lértora Mendoza, Nicolaïdis, and Vandersmissen, op. cit. (1), *Annals of Science* (2003), **60**, 455–8.

3 For characteristic instances of a historiography explicitly or implicitly employing the notion of appropriation see F. J. Ragep, S. P. Ragep and S. Livesey (eds.), *Tradition, Transmission, Transformation: Proceedings of Two Conferences on Pre-modern Science Held at the University of Oklahoma*, Leiden, New York and Köln, 1996; M. Hård and A. Jamison (eds.), *The Intellectual Appropriation of Technology: Discourses on Modernity, 1900–1939*, Cambridge, MA, 1998; M. Mazzotti, 'The geometers of God: mathematics and reaction in the Kingdom of Naples', *Isis* (1998), **89**, 674–701; N. Rupke, 'Translation studies in the history of science: the example of *Vestiges*', *BJHS* (2000), **33**, 209–22; M. Abattouy, J. Renn and P. Weinig, 'Transmission as transformation: the translation movements in the medieval east and west in a comparative perspective', *Science in Context* (2001), **14**, 1–12; K. Gavroglu and M. Patiniotis, 'Patterns of appropriation in the Greek intellectual life of the 18th century: a case study on the notion of time', in *Revisiting the Foundations of Relativistic Physics: Festschrift in Honor of John Stachel* (ed. A. Ashtekar, R. Cohen, D. Howard, J. Renn, S. Sarkar and A. Shimony), Dordrecht, 2003, 569–91; A. Ben-Zaken, 'The heavens of the sky and the heavens of the heart: the Ottoman cultural context for the introduction of post-Copernican astronomy', *BJHS* (2004), **37**, 1–28.

character of what might be called a culture's receptive modes and devices. Many historians assume 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 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. Historians should thus direct their attention less to listing successful transmissions, and more to the metamorphoses the new ideas underwent through various stages of assimilation. This paper examines such a culturally and intellectually intricate process through the example of the Newtonian concept of *vis inertiae*, and how such a concept was dealt with by Eugenios Voulgaris, one of the leaders among eighteenth-century Greek-speaking scholars.[4]

The historical background

In the Balkans in the eighteenth century, various social formations came into existence through processes prompted by the decline of the Ottoman Empire. Modern Greek society was one such.[5] This society was still in its earliest demographic stages. It consisted of many different populations dispersed within and beyond the empire's borders. The most prominent elements unifying these populations were fundamentally cultural and ideological: the Christian Orthodox faith and Greek-speaking education. This was a result of the political arrangements that had followed the Ottoman conquest of Constantinople three centuries earlier. Immediately after the fall of the city in 1453, Sultan Mohammed II appointed Georgios Gennadios (*c.*1400–72) as new patriarch of the Orthodox Church and provided him with a written privilege granting the Christian authorities jurisdiction over many aspects of the religious and civil life of the Orthodox populations of the Balkans and Asia Minor. The Sultan's decision was a highly symbolic gesture responding both to the complexities of the administration of a continuously expanding empire with a progressively increasing Christian population and to the threat from Christian Europe. When 'nation' meant an aggregation of people who shared the same religious beliefs and followed the same rituals, the Orthodox Patriarchate was the only institution in a position to present a somewhat unified expression of the various Christian populations with respect to the Ottoman administration. At the same time Mohammed exploited the deep animosity between the Orthodox and the Catholic Churches after their schism of 1054. The choice of the

4 This paper tries to avoid the terms 'Greek' and 'Greece' as misleading if one is unaware of their different and rather ambiguous connotations in the eighteenth-century Balkans. The term 'Greek-speaking' instead of 'Greek' is used to denote the scholars of the time. The Greek language was one of the strongest elements of these actors' cultural (but not yet national) identity. There is an extensive secondary bibliography discussing the formation of the Greek national identity both before and after the Greek war of independence. The proceedings of the Fourth International Congress of History, P. M. Kitromilides and T. E. Sclavenitis (eds.), *Historiography of Modern and Contemporary Greece, 1832–2002*, 2 vols., Athens, 2004, is a very rich collection. See especially 'The construction of national historiography' in Vol. I and 'History of the institutions and of the Greek state' in Vol. II.

5 For a recent and highly comprehensive overview of Balkan history see M. Mazower, *The Balkans*, London, 2000.

Orthodox patriarch as the de facto political representative of the Christian populations of the Balkans and the strengthening of the forces opposing Church unification tended to minimize threats of a European crusade against the Ottoman Empire under the aegis of the papacy. Mohammed's arrangements came to be seen as aiding long-term social stability in the eastern Mediterranean. The Ecumenical Patriarchate was integrated into the Ottoman administration as a state institution.[6] It enjoyed a privileged share in the distribution of power and for the first time in its history became in fact 'ecumenical'.[7] It exerted its power over a vast Christian territory unified by the Ottoman occupation. This power was not only religious but also political and economic.

One of the most important consequences of this arrangement was that it allowed the Patriarchate to gain full control over these populations' educational activities. But education was very poor for a long time it was basically oriented to the reproduction of middle-rank Church officers. According to all (though admittedly limited) extant evidence,[8] sixteenth-century curricula 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 period of Patriarch Kyrillos Loukaris (1570–1638), who appointed the neo-Aristotelian philosopher Theophilos Korydaleus (1563/74–1646) as director of the Patriarchal Academy.[9] Prompted by Jesuit activity in the eastern Mediterranean, Loukaris sought to promote the shaping of an intellectual identity for the Orthodox populations of the Ottoman Empire to render them a discrete cultural entity between Muslim East and Catholic West.[10] Korydaleus was the first scholar after the fall of Constantinople to introduce systematic interest in Aristotle's physics and draw on the works of past Greek-speaking commentators. He wrote his own extensive commentaries on *Physica* and *De generatione et corruptione* using the commentaries of Alexander of Aphrodisias and the views of the sixteenth-century Italian Alexandrists.[11] His work was unfavourably received by some contemporaries due to the Alexandrists' tendency towards materialism. However, it enjoyed Church protection as it was the only available antidote to Catholic scholasticism. As a result, it formed the core of

6 Π. Κονόρτας, *Οθωμανικές θεωρήσεις για το Οικουμενικό Πατριαρχείο, 17ος – αρχές 20ου αιώνα*, Athens, 1998.

7 For further discussion see Π. Μ. Κιτρομηλίδης, *Νεοελληνικός Διαφωτισμός*, Athens, 1996, 25–7.

8 Ν. Ψημμένος (ed.), *Η Ελληνική Φιλοσοφία από το 1453 ως το 1821*, 2 vols., Athens, 1988–9, i, 174.

9 On the revival of Greek philosophical thought see Ε. Π. Παπανούτσος (ed.), *Νεοελληνική Φιλοσοφία*, 2 vols., Athens 1953, i; G. P. Henderson, *The Revival of Greek Thought 1620–1830*, Albany, NY, 1970; Ψημμένος, op. cit. (8).

10 G. Hering, *Ökumenisches Patriarchat und europäische Politik 1620–1638*, Wiesbaden, 1968.

11 For the life and philosophical work of Korydaleus see Cl. Tsourkas, *Les Débuts de l'enseignement philosophique et la libre pensée dans les Balkans. La Vie et l'oeuvre de Théophile Corydalée (1570–1646)*, second (revised) edn, Thessaloniki, 1967; and C. Noica, 'La Signification historique de l'oeuvre de Theophile Corydalée', *Revue des études sud-est européenes* (1973), **2**, 285–306. For a more detailed description of the intellectual environment in which Korydaleus spent his years in Padua see Tsourkas, ibid., 179–95. For the aspects of the Paduan Alexandrism which particularly pertain to Korydaleus's work see C. B. Schmitt, 'Aristotelianism in the Veneto and the origins of modern science: some considerations on the problem of continuity', in *Atti del convegno internazionale su Aristotelismo veneto e scienza moderna* (1983), 104–23; *idem*, 'Cesare Cremonini: un aristotelico al tempo di Galilei', Centro Tedesco di Studi Veneziani, *Quaderni* (1980), **16**, 3–21.

subsequent higher philosophical education and had a long-lasting impact on Greek intellectual life.

The forms of education and of intellectual life were further defined by subsequent social developments in the Ottoman Balkans. The early eighteenth century witnessed the emergence of the Phanariots, a group of noblemen who simultaneously served at the courts of the Ecumenical Patriarchate at Phanari (hence the name) and of the Sublime Porte. From the end of the seventeenth century the Phanariots acquired an increasingly important role in the administration of the Ottoman state. At the start of the next century Phanariot representatives were appointed by the Sultan as governors of Wallachia and Moldavia. The Phanariots would soon take the leading role among all other Orthodox Balkan groups. As administrators and diplomats they followed the line of enlightened despotism. Their political dominance reinforced the already strong Greek influence in these regions' economic and cultural spheres. The Phanariots played a significant role in the secularization of education by promoting the establishment of schools and by favouring the introduction of contemporary European trends in education and social life.[12] Their presence was especially evident in Constantinople, Bucharest and Jassy. 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 aimed at the wider public.

Another social group sought simultaneously to secure its share in the distribution of social and economic power among Orthodox Balkan populations. This 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 also included the most important migration centre of the Ottoman Empire. It offered a link between Ottoman territories and European commercial routes. Its inhabitants were traditionally the intermediaries of this communication and many generations migrated to central Europe to establish or maintain the links of this commercial network.[13] The area gradually became an educational centre since the wealth and size of the local communities allowed them to establish many new schools.[14] Moreover, during their period of self-assertion and due to their distance from traditional political and educational

12 One should not, however, see the Phanariots as a Western form of aristocracy. Their noble status corresponded to the social standards of Ottoman society, where the hereditary aristocracy was limited to the highest ranks of the Ottoman administration. The Phanariots were mostly rich bourgeois groups who gained their wealth through their commercial activities and aimed to secure and expand it through their affiliation with the religious and the political authorities of the time. For the Phanariots' contribution within education and in the intellectual life of their time see K. Θ. Δημαράς, *Νεοελληνικός Διαφωτισμός*, Athens, 1993. For the Phanariots as scholars see, among others, K. Θ. Δημαράς (ed.), *Δημήτριος Καταρτζής, Δοκίμια*, Athens, 1974; and the excellent case study by Dimitris Apostolopoulos, *Η εμφάνιση της σχολής του φυσικού δικαίου στην 'τουρκοκρατούμενη' ελληνική κοινωνία: Vol. I, Η ανάγκη μιας νέας Ιδεολογίας*, Athens, 1980; *Vol. II, Η πρώτη μετακένωση*, Athens, 1983.

13 On this subject see O. Cicanci, 'Le Rôle de Vienne dans les rapports économiques et culturels du sud-est européens avec le centre de l'Europe', *Revue des études sud-est européenes* (1986), **24**, 3–16; and especially the thorough study of territorial expansion in Traian Stoianovich, 'The conquering Balkan Orthodox merchant', *Journal of Economic History* (1960), **20**, 234–313.

14 Κ. Χατζόπουλος, *Ελληνικά Σχολεία στην Περίοδο της Οθωμανικής Κυριαρχίας (1453–1821)*, Thessaloniki, 1991, 88–120 and 264–9.

centres, these communities encouraged the creation of an intellectual atmosphere receptive to new educational and philosophical trends of European thought. Most Greek-speaking scholars who treated the sciences and new natural philosophy during the eighteenth century came from this narrow area of the south-western Balkans.[15]

None of these developments changed the basic features of educational activity or, most importantly, the Church's predominance 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 the light of eighteenth-century developments both were now also heavily coloured by various local communities' particularities. This was particularly important in education because, due to the lack of other (state) institutions, Greek-speaking education became the main intellectual territory for various forms of negotiation and collective pursuit around the emergent society's political and intellectual identity. This was also the context in which the assimilation of the new natural philosophy took place during the lengthy period from the late seventeenth century until the Greek war of independence in the 1820s.[16]

The second half of the eighteenth century and the first two decades of the nineteenth witnessed the publication of many scientific and philosophical books aiming to cross-fertilize Greek intellectual life with the achievements of the European Enlightenment. The protagonists of this initiative were almost exclusively teachers. Their books were meant to serve as textbooks for the schools of the period. The figure of the teacher held a central position in Greek-speaking education throughout the eighteenth century. Although a common curriculum tended to prevail, especially in higher education, the master of every local school remained the ultimate authority over curriculum structure and the textbooks to be used in each thematic area. The master was personally responsible for his students' philosophical instruction, which also included mathematics and natural philosophy. Almost every major scholar of the time had been a schoolmaster. Many of them had published more than one scientific or philosophical textbook.[17]

15 M. Patiniotis, 'Scientific travels of the Greek scholars in the 18th Century', in *Travels of Learning: A Geography of Science in Europe* (ed. A. Simões, A. Carneiro and M. P. Diogo), Dordrecht, 2003, 49–77.

16 For a broad overview of the introduction of the sciences into Greek intellectual life see Γ. Καράς (ed.), *Ιστορία και Φιλοσοφία των Επιστημών στον Ελληνικό Χώρο* (*17ος–19ος αι.*), Athens, 2003.

17 D. Dialetis, K. Gavroglu and M. Patiniotis, 'The sciences in the Greek speaking regions during the 17th and 18th centuries: the process of appropriation and the dynamics of reception and resistance', *Archimedes* (1999), **2**, 41–71. For an exhaustive catalogue of the extant printed and manuscript works compiled by the scholars of the time see Γ. Καράς, *Οι Επιστήμες στην Τουρκοκρατία. Χειρόγραφα και έντυπα*, 3 vols., Athens, 1992–4. Reference can also be made to the digital library *Hellinomnimon* at www.lib.uoa.gr/hellinonmimon. The library, created by the Department of Philosophy and History of Science, Athens University, contains all the philosophical and scientific books written in Greek and printed between 1600 and *c.*1821. For the function of philosophical and scientific textbooks in the Greek intellectual life of the period see M. Patiniotis, 'Textbooks at the crossroads: scientific and philosophical textbooks in 18th century Greek education', *Science and Education* (2006), **15**, 801–22.

These scholars belonged to a transitional generation. Intellectual life was then dominated by the neo-Aristotelian tradition established in the early seventeenth century by Theophilos Korydaleus. From the start of the eighteenth century, however, Greek-speaking scholars started travelling throughout Europe. Padua ceased to be almost exclusively the university where they would go to study. They also began travelling to the German states, the Low Countries, Russia, the Habsburg Empire and, to a much lesser extent, France and England. They were thus acquainted with a multitude of intellectual traditions and schools, related mainly to recent developments of the European Enlightenment. When these travellers returned home after between four and ten years in European educational centres, they sought social recognition matching their intellectual qualifications. The quest for modernization of certain local societies provided the ground on which their social aspirations could flourish. These scholars perceived themselves and were perceived by others as agents of a new spirit in Greek intellectual life. Far from sustaining a homogeneous programme of modernization, far from having gained local authorities' general consent, they were considered the agents upon whom the most dynamic social groups counted for shaping their collective form. But this form's constituents were still in question. 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 exactly reflected this ambiguous situation.[18]

Historiographical remarks

According to many Greek historians a convenient way to account for the philosophical production of eighteenth-century Greek-speaking scholars is to focus on the interplay between progressive and conservative intellectual trends in Greek society of the time. Progressive scholars were those who displayed a positive attitude towards the attainments of European thought, while the conservatives tended to uphold religious authorities' policy as well as the antiquity-oriented educational curricula. The sciences seemingly play a significant role in this approach since they represent the indisputably progressive force in modern society. From the early eighteenth century in particular, when according to these historians the scientific landscape in Europe had already been transformed, the distinction between the scholars who embraced modern science and those who kept at a distance from it became acute. The touchstone for this distinction was the conformity of each scholar to so-called Newtonianism. Progressive scholars were then to be defined as those who endorsed 'Newtonian physics' and its philosophical and political counterparts, while conservative scholars were

18 For the intellectual itineraries and the professional agenda of eighteenth-century scholars see Patiniotis, op. cit. (15), which includes an indicative list of names and lifespans of the most representative (71–2). Concerning the Greek-speaking scholars' preference to study at the University of Padua see ibid., 58–60; as well as G. N. Vlahakis, 'An outline of the introduction of classical physics in Greece: the role of the Italian universities and publications', *History of Universities* (1995–6), **14**, 157–80.

those who rejected the new teachings in the name of a well-established local intellectual tradition.[19]

But this approach reveals little of the nature of these persons' philosophical enterprise. It is instead founded upon two highly disputable assumptions: first, that during the eighteenth century 'Newtonianism' or 'Newtonian physics' was already a well-defined and complete system of scientific knowledge and practice; second, that the only possible attitude of a scholar from the periphery to modern scientific discourses, especially to such emblematic attainments as 'Newtonian science', was either to conform or to abstain.[20] As a result, the historiography that relies upon these assumptions degenerates into a record of the scientific ideas that passed into Greek intellectual space through the agency of enlightened scholars and of those that failed to do so due to the reaction of tradition's representatives. In both cases, most importantly, local scholars' role is absolutely passive. They either adopted or rejected new scientific ideas and treated them as complete structures, hardly capable of alteration or modification.

To be sure, in recent years a number of historians have seemingly realized that a certain degree of adaptation took place during the assimilation of the new ideas by the eighteenth-century scholars. These scholars tried to adjust the new ideas to their local context so that they fitted better into a philosophically undemanding framework:

> The Neohellenic Enlightenment did not produce original philosophical ideas. That is to say, the trends that were formulated during the second half of the eighteenth and the first third of the nineteenth centuries ... and were different or contrary to the prevailing theological

19 Until quite recently accounts of the role of the sciences in modern Greek history formed part of the history of ideas. The man who established the systematic study of the history of ideas from 1600 to the Greek war of independence in the 1820s was K. Th. Dimaras (1904–92). He also introduced the term 'Greek Enlightenment' into Greek historiography, so providing the framework within which the antithesis of 'progressive' and 'conservative' was shaped. His more influential papers from 1951 to 1977 were gathered in the volume K. Θ. Δημαράς, *Νεοελληνικός Διαφωτισμός*, op. cit. (12). The history of modern Greek science as a distinctive discipline appeared for the first time in the context of the Institute for Neohellenic Research–National Research Foundation, thanks to the work of Yiannis Karas. There are now a number of historians active in the Program of History and Philosophy of Science of this Institute as well as in the Department of Philosophy and History of Science, Athens University, in the National Technical University of Athens and in the University of Ioannina. For a review of the historiography of science in Greece see E. Νικολαΐδης, 'Ιστοριογραφία των Επιστημών', in Kitromilides and Sclavenitis, op. cit. (4), i, 527–38. An early discussion on the subject can also be found in G. N. Vlahakis, 'Problems and methodology of exploring the scientific thought during the Greek Enlightenment (1750–1821)', in *Trends in the Historiography of Science* (ed. K. Gavroglu, J. Christianidis and Efth. Nicolaidis), Dordrecht, 1993, 397–404. For a very characteristic depiction of the role 'Newtonian physics' played in the context of contemporary Greek historiography see Γ. Ν. Βλαχάκης (ed.), *Η νευτώνεια φυσική και η διάδοσή της στον ευρύτερο Βαλκανικό χώρο* (proceedings of an international scientific symposium, Athens, 17–18 December 1993), Athens, 1996; and the collective volume Κέντρο Νεοελληνικών Ερευνών, *Οι Επιστήμες στον Ελληνικό Χώρο* (proceedings of a conference devoted to the memory of Michael Stephanides, Athens 2–3 June 1995), Athens, 1997. For a discussion of the 'conservative'–'progressive' dipole and an early attempt to relativize this distinction see Γ. Ν. Βλαχάκης, 'Η άλλη άποψη: Η 'Επιτομή Φυσικής Ακροάσεως' του Σέργιου Μακραίου', in *Οι Επιστήμες στον Ελληνικό Χώρο*, ibid., 249–60.

20 For a slightly different view see G. N. Vlahakis, 'Dissemination and development of non-Aristotelian physics in Aristotle's land', in Lértora Mendoza, Nicolaïdis and Vandersmissen, op. cit. (1), 45–52. Vlahakis suggests substituting the term 'non-Aristotelian' for the term 'Newtonian' to put the emphasis on the eclecticism of Greek-speaking scholars.

> ideology had borrowed their ideas from the corresponding European trends. But even this borrowing was infertile from a purely theoretical point of view, mainly because Greek intellectual needs were rather scant and could be fulfilled … by second- or third-class works. And such were most of the books that were translated and read. The same goes for the profile of the native philosophical output of the Neohellenic Enlightenment, which was of a similar nature: compilations and multifaceted copies, unworthy of philosophical consideration. There were only a few eminences that became visible just because the surroundings were even lower.[21]

Hence, according to this perspective, the involvement of eighteenth-century Greek-speaking scholars with the sciences indicates, at best, an intellectual or cultural disposition but under no circumstances does it indicate active philosophical or scientific pursuits.

Other historians elaborate a more sophisticated argument according to which these Greek-speaking scholars might not have been natural philosophers of the type then to be found in western Europe, but when they intended to address their particular intellectual community they took special care to select, adapt, combine, analyse and produce work proper to educational use:

> Being conscious of the distance between Greek and European scientific and philosophical thought, [the Greek scholar] correctly considered it less important to attempt to compose original texts than to transfer (through translations and compilations) the works of the Europeans …; to transfer the problems of modern European science to a different cognitive space and to elaborate theoretically on these problems with the perceptual tools of this space … We do not think, however, that the emphasis placed on the notion of transfer rather than on 'original' composition reduces the particular value of Greek scholars' work for educational development and more generally of Greek intellectual life, since every copy and every imitation presupposes … a selection, expresses an inclination and reinforces a latent perception, a pre-existing concern, a subject's conscious or unconscious tendency to absorb a certain influence, expressing their own conscious or unconscious demands.[22]

The fact itself that the Greek-speaking scholars assimilated and spread new ideas, countering both popular ignorance and established authorities, was an invaluable contribution to the synchronization of Greek society with contemporary European developments.[23] But at the same time most historians who adopt this approach take the formation of the 'sciences' and the shaping of 'modern European thought' as complete processes and indisputable steps of progress. The historical circumstances under which the various sciences had been shaped, as well as the multifarious interactions leading to the legitimization of a certain way of viewing nature, remain unquestioned.

> The processes of verification, confirmation or rejection of the various philosophical–scientific hypotheses and theories had already been completed, the solutions found, and only a late echo of this struggle would reach the Greek intellectual space and persist as long as and to the extent that the traditional powers kept reacting to the spread of these new views.[24]

21 Π. Κονδύλης, *Ο Νεοελληνικός Διαφωτισμός. Οι φιλοσοφικές ιδέες*, Athens, 1988, 10 (my translation).

22 Γ. Καράς, *Οι θετικές επιστήμες στον ελληνικό χώρο (15ος–19ος αιώνας)*, Athens, 1991, 89 (my translation).

23 Καράς op. cit. (16), 51–3. See also Ψημμένος, op. cit. (8), i, 31; Henderson, op. cit. (9), 'Introduction'.

24 Καράς, op. cit. (22), 138 (my translation).

Hence the purpose of the historian would be primarily to grasp the continuities and the order of Greek societies' historical progress.[25] This would mean that one should be interested in the modifications undergone by various scientific ideas in their adjustment to local intellectual patterns. But at the same time, on this showing, one should be aware that these modifications occur almost exclusively in the sphere of distribution and indicate, at best, Greek society's openness to modernity.[26] This approach has nevertheless produced an impressive volume of historical work recording Greek intellectual life's contact with modern scientific and philosophical developments. These works, however, mainly involve the efforts of the historians who study the construction of the Greek national state and its European integration. In this respect, a most characteristic aspect of this historiography is that it persistently links the introduction of the sciences with the enlightenment of the 'nation' and the anticipation of national emancipation.

The aim of this paper is to indicate and to illustrate the possibility of moving beyond the standard approach. In the light of recent developments in history of science, the distinction between the *production* and the *distribution* of science fades away. As a result, the history of science in the periphery becomes an organic part of a broader perspective that seeks to illustrate the intricate social, cultural and political interactions shaping modern science and legitimizing its respective civilizational patterns. Local agents' attitudes to new ideas were closely related to the fact that these ideas provided alternative methods and responses to questions to which peoples and cultures already had adequate answers. New ideas were not introduced in a void but needed to displace other, usually strongly entrenched, ideas. Thus historical research cannot be limited to questions of which scientific ideas found their way into that period's Greek intellectual life and which failed to do so, or how fully people understood 'Newtonian physics', or even of who resisted and who accepted these new ideas and why. Such questions are not without some interest but can only reveal a relatively shallow layer of the actual historical circumstances. Of 'Newtonianism' in particular it should not be forgotten that even during the late eighteenth century the landscape was still unclear and fluid. Such questions thus do not make much sense. One must first define the aspect of 'Newtonianism' or 'Newtonian science' in question.[27] But, most importantly, in the middle of this highly diversified universe those who considered themselves agents of an active and still efficient philosophical system had in fact no good reason to side with the new and still unshaped philosophy. What they preferred was exploration of the new ideas' potential and assimilation into their own system of whatever they could appreciate as a valid philosophical contribution. What follows is a case study in which Newtonian philosophy's most significant concept, *vis inertiae*, became the object of

25 Καράς, op. cit. (22), 301 and 10. For further elaboration of this historiographic agenda see the introductory essay in Καράς, op. cit. (16), especially 22, 47–50.

26 E. Nicolaïdis, 'Avant-propos', in Lértora Mendoza, Nicolaïdis and Vandersmissen, op. cit. (1), 7–8.

27 On the multiplicity and the diversity of interpretations making up the eighteenth-century European image of Newtonianism see M. Patiniotis, 'Newtonianism', in *New Dictionary of the History of Ideas* (editor-in-chief Maryanne Horowitz), 6 vols., Detroit, 2005, iv, 1632–8. For the great variety of social, cultural and symbolic uses of the Newtonian heritage see P. Fara, *Newton: The Making of Genius*, London, 2002.

subtle management, clearly displaying this particular disposition on the part of eighteenth-century Greek-speaking scholars.[28]

Vis inertiae in the periphery: local perceptions of the new physics

Eugenios Voulgaris (1716–1806) was probably the most representative figure of what G. P. Henderson has called 'the revival of Greek thought'.[29] He was born in Corfu and trained in the University of Padua. For twenty years (1742–62) he was a philosophy professor in the most important Greek schools of the southern Balkans and a protagonist in the attempts of the Ecumenical Patriarchate and the Greek-speaking nobility to reform higher education. After his educational career in the Greek-speaking regions of the Balkans he continued his intellectual activities for some years in Leipzig, where he also became personally acquainted with several members of Saxony's philosophical community.[30] He subsequently placed himself under the patronage of Catherine the Great, became a courtier in Saint Petersburg and culminated his career as archbishop of Slavensk and Cherson, a new diocesan see created by the Russian Orthodox Patriarchate especially for him.[31] In 1788, while still in southern Ukraine, he was elected a foreign member of the Royal Society of London during the presidency of Sir Joseph Banks.[32]

Voulgaris was a typical man of letters. His contributions lay in the fields of theology (like most of his contemporary scholars he was an ordained clergyman), metaphysics, literature, political philosophy and the sciences. The latter especially occupied a central place in his interests throughout his life. He was the first to introduce into Greek education the philosophies of the Enlightenment's important representatives, such as

28 For an early account of the acquaintance of the eighteenth-century Greek-speaking scholars with 'Newtonianism' see G. N. Vlahakis, 'A note for the penetration of Newtonian scientific thought in Greece', *Nuncius* (1993), **2**, 645–56.

29 Henderson, op. cit. (9). The work contains many references to Voulgaris and his philosophical output. It is one of very few works treating Voulgaris as a genuine philosopher.

30 The main source for Voulgaris's biography is the introduction in Γ. Αινιάν, *Συλλογή ανεκδότων συγγραμμάτων του αοιδίμου Ευγενίου του Βουλγάρεως και τινων άλλων μετατυπωθέντων*, 2 vols., Athens, 1838, i, based on the recollections of the author's father through his personal acquaintance with Voulgaris. Other works reporting Voulgaris's presence in the intellectual life of his time are N. Ψημμένος, 'Εκσυρικτέον άρα τα χυδαϊστί φιλοσοφείν επαγγελόμενα βιβλιδάρια. Απόπειρα ερμηνείας', *Ο Ερανιστής* (1995), **20**, 36–46; L. Bargeliotes, 'Aristotle, Philoponus and Vulgaris on the concept of Void', *Πλάτων* (1992), **44**, 135–46; Γ. Κ. Μύαρης, 'Ιχνηλάτηση της παρουσίας του Ευγένιου Βούλγαρη στην κίνηση ιδεών κατά την περίοδο του νεοελληνικού διαφωτισμού', *Πόρφυρας* (1994–5), **71–2**, 84–94; Ά. Αγγέλου, 'Περί αγίων, εικόνων και θαυμάτων', in *Νεοελληνική Παιδεία και Κοινωνία*, Athens, 1995, 59–85; P. M. Kitromilides, 'Athos and the Enlightenment', in *Mount Athos and Byzantine Monasticism: Papers from the Twenty-Eighth Symposium of Byzantine Studies, Birmingham, March 1994* (ed. A. Bryer and M. Cunningham), Brookfield, VT, 1996, 257–72; Μ. Πατηνιώτης, 'Εκλεκτικές συγγένειες: Ευγένιος Βούλγαρης και Θεόφιλος Κορυδαλέας', *Δελτίο Αναγνωστικής Εταιρείας Κερκύρας* (2004), **26**, 27–78.

31 For Voulgaris's years in Russia see S. K. Batalden, *Catherine II's Greek Prelate: Eugenios Voulgaris in Russia, 1771–1806*, New York, 1982.

32 This is new and striking information about Voulgaris's network of contacts. Cf. Γ. Πέτρου, 'Ο Ευγένιος Βούλγαρης (1716–1806) και η Βασιλική Εταιρεία του Λονδίνου', *Νεύσις* (2001), **10**, 181–98. As far as is known Voulgaris was the first Greek elected a member of the Royal Society.

Descartes, Leibniz, Newton and Wolff. He was also well acquainted with the works of natural philosophers, including Samuel Clarke, Willem Jacob van 'sGravesande, Petrus van Musschenbroek and Emilie du Châtelet. He incorporated many elements from their textbooks in his teachings and writings. He translated into Greek many treatises including Voltaire's *Essai historique et critique sur les dissensions des églises de Pologne* (though accompanied by a commentary that questioned the central thesis of the original work),[33] 'sGravesande's *Introductio ad philosophiam*,[34] Antonio Genovesi's *Elementa metaphysicae mathematicum in morem adornata*[35] and John Locke's *Essay*.[36] In many of his philosophical writings Voulgaris dealt with natural philosophy and was one of the most dynamic promoters of the new scientific spirit in Greek intellectual life. At the same time, however, he was a pious Orthodox Christian and a well-educated Aristotelian. In this capacity Voulgaris established an open dialogue with contemporary philosophy primarily aiming at a new and original synthesis that would accommodate the new natural philosophy along with the philosophical and the religious commitments of his own cultural environment. The way he dealt with the Newtonian concept of inertia is one of the most characteristic examples of the strategy he followed to achieve this goal.

In his *Ta Areskonta tois Philosophois* (Philosophers' Favourites), a treatise devoted to natural philosophy that owes its name to, though its content differs from, Pseudo-Plutarch's *Placita Philosophorum*, he meticulously examined the most significant concept of modern physics.[37] However, surprisingly, he built his examination around the claim that Keill, Clarke, 'sGravesande and Musschenbroek, some of the most representative 'Newtonians' of his time, as well as Newton himself, were in deep confusion. Inertia was not one single concept, as they seemed to believe, but three different concepts corresponding to different ontological states and modes of existence. These three concepts were impotence or sluggishness, indifference or passive force, and counteraction.[38]

33 Ε. Βούλγαρης, *Περί των διχονοιών των εν ταις εκκλησίαις της Πολονίας. Δοκίμιον ιστορικόν και κριτικόν. Προσετέθη και σχεδίασμα περί της Ανεξιθρησκείας, ήτοι περί της ανοχής των ετεροθρήσκων*, Leipzig, 1768. The Greek word ανεξιθρησκεία ('religious tolerance') was coined by Voulgaris for this translation. See Γ. Κεχαγιόγλου, 'Βενετική έκδοση του *Περί διχονοιών των εν ταις εκκλησίαις της Πολωνίας* του Ευγενίου Βούλγαρη', *Ελληνικά* (1994), **44**, 453–60.

34 Ε. Βούλγαρης, *Εισαγωγή εις την Φιλοσοφίαν του Γραβεζάνδου*, Moscow, 1805.

35 Ε. Βούλγαρης, *Γενουηνσίου, Στοιχεία της Μεταφυσικής*, Vienna, 1806.

36 Unpublished manuscript. For a historical reconstruction of Voulgaris's Lockean project see Ά. Αγγέλου, 'Πώς η νεοελληνική σκέψη εγνώρισε το 'Δοκίμιο' του John Locke', *Αγγλοελληνική Επιθεώρηση* (1954), 7, 128–49. Reprinted in *idem*, *Των φώτων*, Athens, 1988, 1–22. For the influence of John Locke's thought on the Greek philosophical tradition see P. M. Kitromilides, 'John Locke and the Greek intellectual tradition: an episode in Locke's reception in south-east Europe', in *Locke's Philosophy: Content and Context* (ed. G. A. J. Rogers), Oxford, 1994, 217–35.

37 The book was published in Vienna in 1805, but there is strong evidence that it had been written at least twenty-six years earlier. For this issue see Πατηνιώτης, op. cit. (30). According to Karas's catalogue (op. cit. (17), ii, 78–9) the only extant manuscript dates from 1818, which means that *Ta Areskonta tois Philosophois* was never used in education in its manuscript form (as was in fact the case with most of Voulgaris's other works) but entered the curriculum directly as a printed book.

38 Ε. Βούλγαρης, *Τα Αρέσκοντα τοις Φιλοσόφοις*, Vienna, 1805, 71.

In order to make his point clear, Voulgaris started not from Newton but from Aristotle and common sense. We can perceive matter, he claimed, in two different ways, as matter in its own right and as matter that acts and 'suffers'.[39] Accordingly, we can distinguish the notions of inertia corresponding to each of these perceptions. In the former sense, matter is unable to change its kinetic status or its shape because its nature is absolutely inert. This is exactly what the moderns call *vis inertiae*. However, to avoid confusion, 'impotence' or 'sluggishness' would be more appropriate names. In the latter sense, matter can not only change its own kinetic status and shape but can also affect the kinetic status and shape of other pieces of matter. In all cases, however, the change occurs because matter is, by its own nature, unresistingly receptive to external impacts. The magnitude of a change is proportional to the magnitude of the external impact. Matter, in this specific sense, does not display any resistance to external impacts. So, it does not participate in the determination of the magnitude of the change. The moderns also call this feature inertia, but 'indifference' or 'passive force' would be more appropriate terms.[40] The third notion of inertia relates to material bodies and differs from the two previous notions, which relate to the concept of pure matter. 'Counteraction' is responsible for the resistance a material body displays towards any external impact that tries to change its kinetic status or shape. The magnitude of counteraction is proportional to the quantity of matter the body contains and to the magnitude of the external factor.[41]According to Voulgaris, all these notions relate to what the moderns call under one name *vis inertiae* and, in a certain sense, they are constituents of a single instance. They all simultaneously describe how matter participates in the phenomena of change. Conceptually, though, they originate in different philosophical principles, claimed Voulgaris. That is why he took it upon himself to clarify the confusion.

Before proceeding with Voulgaris's enterprise, it is important to note that Newton himself mentioned a similar triple sense when he first defined *vis inertiae* in the introduction to the *Principia*. Since Voulgaris was an extremely diligent student of the natural philosophy of his time, it may be safely assumed that he had in mind this pertinent passage from the third definition:

> This force is always proportional to the body and does not differ in any way from the inertia of the mass except in the manner in which it is conceived. Because of the inertia of matter, every body is only with difficulty put out of its state either of resting or of moving. Consequently, inherent force [*vis insita*] may also be called by the very significant name of force of inertia. Moreover, a body exerts this force only during a change of its state, caused by another force impressed upon it, and this exercise of force is, depending on the viewpoint, both resistance and impetus [*Resistentia et Impetus*]: resistance insofar as the body, in order to maintain its state, strives against the impressed force, and impetus insofar as the same body, yielding only with difficulty to the force of a resisting obstacle, endeavours to change the state of that obstacle. Resistance is commonly attributed to resting bodies and impetus to moving bodies; but motion and rest, in the popular sense of the terms, are distinguished from each other only by point of view, and bodies commonly regarded as being at rest are not always truly at rest.

39 Βούλγαρης, op. cit. (38), 69–70.
40 Βούλγαρης, op. cit. (38), 70.
41 Βούλγαρης, op. cit. (38), 71.

> [*Vulgus Resistentiam quiescentibus et Impetum moventibus tribuit; sed motus et quies, uti vulgo concipiuntur, respectu solo distinguuntur ab invicem, neque semper vere quiescunt quae vulgo tanquam quiescentia spectantur.*][42]

One interpretation of this passage might permit the disaggregation of the original concept of *vis inertiae* into three different concepts: the inactivity or 'inertia of matter', which represents material bodies' innate tendency (*vis insita*) to preserve their kinetic status; the 'resistance', 'which is commonly attributed to resting bodies' and represents the force a body exerts in order to maintain its status; and the 'impetus', which represents the same force perceived from the point of view of the factor that tries to alter the kinetic status of the body and, as a result, receives a modification of its own kinetic status as well. It is also true that at least two of Voulgaris's concepts, sluggishness and counteraction, could appear under this interpretation and that Newton's reflection itself might have caused Voulgaris to think of a more radical rearrangement of inertia's constituent concepts. But Newton's intention was not to dismantle the concept of inertia, as Voulgaris seems to have been doing, but rather to extricate the particular word from its colloquial connotations. That is why Newton repeatedly stressed that the various alternatives he presented were a matter of perspective. He stated his intention straightforwardly when he wrote that 'motion and rest, *in the popular sense of the terms*, are distinguished from each other only by point of view' but that 'bodies commonly regarded as being at rest are not always truly at rest'. A few pages later he returned to the same issue when he distinguished time, space, place and motion into 'absolute and relative, true and apparent, mathematical and common', in order to avoid 'certain preconceptions' which result from the fact that 'these quantities *are popularly conceived* solely with reference to the objects of sense perception'.[43] Voulgaris apparently tried to articulate a different approach. It is highly revealing of his intention to pursue his own path that he explicitly stated that Newton and his allies were confused as far as the meaning of inertia was concerned since they gave the same name to three virtually different things. They had erred and his task, as he seemed to perceive it, was to put things straight. What would he do, then, to accomplish this aim?

Voulgaris's starting point was of crucial importance to his further philosophical endeavour. Contrary to Newton, who introduced the notion of inertia in order to expel the metaphysical category of matter from his mathematical treatment of motion, Voulgaris described inertia as a feature of matter itself. Thus reference to *vis inertiae* in the context of Newton's *Principia* does not demand further information about the nature of the matter which participates in a certain kinetic phenomenon. Yet when *vis inertiae* is mentioned in the context of Voulgaris's *Ta Areskonta tois Philosophois* it is necessary to specify which perception of matter is in question in order to employ the

42 I. B. Cohen and A. Whitman, *Isaac Newton, The Principia: Mathematical Principles of Natural Philosophy. A New Translation*, Berkeley, Los Angeles and London, 1999, 404–5. Words and phrases in brackets are from the first Latin edition of the *Principia* (p. 2) and are cited to make Newton's point clearer. Note how intensively he used the word *vulgus* in order to distinguish his mathematical account from common perception.

43 Cohen and Whitman, op. cit. (42), 408. The emphasis is mine in both quotations in this paragraph.

appropriate notion of inertia. In Newton's *Principia* inertia is evidence of matter's *presence* while in Voulgaris's *Ta Areskonta tois Philosophois* inertia is evidence of matter's *essence*. In the Aristotelian tradition, every material being consists of a certain combination of matter and form. But matter can also be perceived independently of form. This is *materia prima* and it is the perception of matter that Voulgaris connected with the two former definitions of inertia – that is, with impotence and with passive force. But if *materia prima* is singular, why then did Voulgaris distinguish between inert matter and potentially active matter? This was because this distinction served two different philosophical needs. Matter as an intrinsically inert substance is the first 'principle' of the material world.[44] It is created by God and acquires its active character from Him. As Voulgaris explained when he discussed the causes of motion, every motion emanates, directly or indirectly, from God.[45] An intrinsically active matter would apparently cast serious doubts on the necessity of God's existence. Thus the first definition of inertia (inertia as impotence or sluggishness) was of high priority for the pious Christian philosopher, who wished to secure God as the ultimate active agent of his philosophical system. It is revealing of Voulgaris's attitude that a few pages later he used this specific feature of matter to impugn the Leibnizian idea of matter endowed with an active force.[46]

At the same time, however, Aristotle occupied a pre-eminent position in this philosophical discussion. As Voulgaris diligently explained, the combination of matter with form would be impossible if *materia prima* were not receptive to form. This feature relates to the female character of matter. Voulgaris cited Plato and Aristotle, both of whom spoke of matter in terms such as 'mother', 'nurse', 'land' and 'mould'. The fact that matter is open to receiving any available form (actually, *she* is eager to do so) allows not only the formation but also the transformation of material bodies. To the extent that every change in nature is nothing other than a transition from one combination of matter and form to another such combination, the indifference of matter towards forms makes any potential transformation possible.[47] It is this receptivity of *materia prima*, therefore, that gives birth to the second definition of inertia: indifference or passive force ensures that matter can participate in any formation or transformation without displaying any resistance on its own part.

44 In *Ta Areskonta tois Philosophois* Voulgaris devoted a whole chapter to the discussion of 'The principles of natural bodies' (op. cit. (38), 15–43). There he openly subscribed to 'Newtonian atomism', basically for theological reasons. But at the same time he took special care not to expel the Aristotelian matter–form scheme from his philosophical system. To achieve this he made a very fine distinction. Responding to the objections of an imaginary scholastic interlocutor (op. cit. (38), 42) he explained that matter as the principle of natural bodies must have extension, shape and properties, requirements met only by atoms. On the other hand, though, one may certainly retain the matter–form scheme in order to account for matter per se. The matter–form scheme does not explain anything about the nature of the natural bodies ('as the Aristotelians mistakenly believe'), but it apparently does as far as the metaphysical category of matter is concerned. Thus in the present discussion he implicitly employed this perception to account for *vis inertiae* which, according to his view, is basically a feature of matter per se.

45 Βούλγαρης, op. cit. (38), 98.

46 Βούλγαρης, op. cit. (38), 71–2.

47 Βούλγαρης, op. cit. (38), 70–1.

The third notion of Voulgaris's inertia is, first of all, a matter of logical necessity: counteraction, he remarked, is necessary for the preservation of the stability of the natural world. If natural bodies do not react to the external impacts that seek to alter their kinetic status then every impulse, no matter how small, could produce a perpetual motion, which apparently contradicts common sense and renders the notion of local motion inconceivable.[48] What is important for our discussion, though, is not this statement, which reproduces a trope that occurs in most eighteenth-century treatises of natural philosophy. The important point is that through the notion of 'counteraction' Voulgaris moved from the ground of *materia prima* to the ground of *materia secunda*. As mentioned above, according to Voulgaris 'counteraction' is not a feature of pure matter but of natural bodies. But at the same time the motion of natural bodies in Aristotelian philosophy is not a simple change of place. According to the neo-Aristotelian tradition to which Voulgaris adhered, at least, motion is, like any other kind of change, a process that involves the transition from one combination of matter and form to another. Theophilos Korydaleus, the neo-Aristotelian philosopher of the early seventeenth century who established the tradition that provided Voulgaris's philosophical background, identified motion with the Aristotelian concept of entelechy. The fact that local motion is a special case of entelechy means that even a mere transposition of bodies involves a change of form.[49] This is what Voulgaris had in mind when he introduced the concept of 'counteraction'. The resistance that occurs during the motion of bodies is not a manifestation of matter but the reaction of a specific combination of matter and form that refuses to yield to another such combination.

At this point one might notice that a serious conflict might have emerged in Voulgaris's manipulations. Counteraction is essentially different from the first notion of inertia, namely the intrinsic inertia of *materia prima*, which does not manifest itself as resistance but as mere impotence. But how can counteraction coexist with the second notion of inertia, namely the passive force, which represents the receptivity of matter? In other words, how can matter be at the same time both unresistingly receptive and counteractive to external impacts? The answer rests in Voulgaris's special capacity to draw finely designed distinctions that remain dormant in his text until one questions the basic premises of his account.[50] Thus when one juxtaposes the two notions of inertia it is clear that the actions they represent have different subjects. In the case of indifference or passive force, the subject is *materia prima*. The feature of receptivity applies to the relations between matter and form and makes change possible. In the case of

48 Βούλγαρης, op. cit. (38), 71.

49 According to Korydaleus's commentary on Aristotle's *Physics*, every local motion is a process that connects two different states of being: potential being (δυνάμει ὄν) and actual being (ἐνεργείᾳ ὄν). The former corresponds to the starting point of motion (ἐξ οὗ) and the latter to the terminal one (εἰς ὅν). Motion itself is the transition from one combination of matter and form to another, through which the being accomplishes a potentiality implanted in its nature. In this sense, motion is the 'entelechy of potential being to become [actual]' (ἡ τοῦ δυνάμει ὄντος ἐντελέχεια ᾗ τοιοῦτον). This perception applies both to the moving body and to the efficient cause, and motion in its most refined sense is a synthesis of the entelechies of the two factors. See Θ. Κορυδαλεύς, *Είσοδος Φυσικής Ακροάσεως κατ' Αριστοτέλην, συνερανισθείσα υπό του σοφωτάτου Θεοφίλου του Κορυδαλέως*, Venice, 1779, 329–32.

50 For another such instance see Gavroglu and Patiniotis, op. cit. (3).

counteraction the subject is *materia secunda*. The feature of resistance applies to the interactions between natural bodies and governs the exchange of actual motion according to the quantity of matter each body contains.[51] One might quite plausibly presume that Voulgaris's implicit point was that the former notion of inertia related to matter as a metaphysical category (as is also the case with the notion of impotence or sluggishness) while the latter relates to matter as a natural entity.

Voulgaris clearly elaborated an extremely refined notion of inertia with a well-organized set of philosophical and ontological connotations. Let us now try to set his endeavour in a broader context. Voulgaris was an accomplished philosopher who looked forward to the enrichment of his natural philosophy through modern developments. He appreciated Newton's contribution to natural philosophy. He drew upon a wide variety of 'Newtonian' resources. He was well aware of the philosophical significance of the constitutive concepts of the 'new philosophy'. At the same time, however, he was also well aware of the philosophical discussions throughout Europe about the meaning and the application of these concepts. For this reason he was in a position to understand that Newtonian philosophy was not accepted as a complete synthesis by any protagonist of these discussions. He therefore consciously participated in the philosophical deliberations about the constitutive concepts of Newtonian philosophy. He knew he was not alone in this enterprise. The notion of action at a distance had been the object of much discussion among the greatest philosophers of his time. From the late seventeenth century, debates on the concepts of space and time haunted many as yet inconclusive philosophical debates. Exchanges about the active or passive character of matter, which indeed employed *vis inertiae* and the force of gravity, formed part of the most significant philosophical and theological debates of the seventeenth and eighteenth centuries. These are only a few of many similar examples. As a learned man and as a cosmopolitan scholar, Voulgaris was well informed about all these debates. Moreover, he was in a position to know that each participant in these discussions carried the philosophical and ontological commitments of their own intellectual tradition, just as he did. The deliberate attempt of Marquise du Châtelet to derive Newton's laws of motion from the metaphysical principles of Leibnizian philosophy, the Cartesian tendency of French mathematicians to advance the concept of motion at the expense of the notion of force and the elaborate reformulation of the kernel of Newtonian mechanics by 'sGravesande in the familiar experimental language of his own cultural environment are only a few instances of this situation.[52]

51 Voulgaris gave specific examples of how one may apply the three distinctive notions of inertia to kinetic phenomena when he came to examine the causes of motion in Chapter 7 ('On motion and rest') of his *Ta Areskonta tois Philosophois*.

52 For the role of Mme du Châtelet as a mediator between Leibniz and Newton see G.-É. le Tonnelier de Breteuil, Marquise du Châtelet, *Institutions physiques adressées à Mr. son Fils*, Amsterdam, 1742 (first edn: 1740), especially Chapters 8 ('De la Nature des corps'), and 9 ('Du Mouvement, et du repos en général, et du mouvement simple'). The ontological status of attractive force was the chief eighteenth-century puzzle in Newtonian physics. Several significant mathematicians such as d'Alembert and Lazare Carnot insisted that the notion of force should be expelled from mechanics. Others, including Johann Bernoulli and Euler, suggested that a dynamic factor was, indeed, necessary in mechanics, but they also tried to keep a distance from

At the same time, however, Voulgaris, like most Greek scholars of his time, saw the new developments in natural philosophy as evidence of the triumph of Greek philosophy rather than as an irrevocable break with the ancient mode of thought. This is why he took special care to stress that the first notion of inertia he presented in his treatise originated in ancient philosophy and had been known to the ancients under the name 'plain inertia'. Likewise, when he came to the second notion of inertia, he again took special care to stress that this had also already been known to Plato and Aristotle, who extensively had elaborated on the female character of *materia prima*. So what the moderns had done was simply to complete the synthesis with the third notion of inertia that was 'counteraction'. But they fell into confusion by calling the three different notions of inertia by the same name. Voulgaris thought of his role as that of someone who would clear up the confusion. He did so first by connecting each notion of inertia with the proper notion of matter and, second, by directing the moderns' original contribution (counteraction) towards what he considered the appropriate philosophical ground, the conceptual framework of matter and form.

That someone of Aristotelian origin undertook the clarification of the subtle conceptual perplexities of the Newtonian *vis inertiae* may seem discordant from a modern point of view. But Voulgaris was not then alone in this respect either. Recent studies indicate that after its revival in the European intellectual context around the twelfth century, Aristotelianism had never been a dead body of commentaries insensitive to new philosophical trends. Edward Grant has shown that medieval Aristotelianism involved a wide range of philosophical undertakings capable of adaptation to various environments.[53] In the early modern period the adaptability of Aristotelianism acquired a more productive face. Several Aristotelian scholars established a comprehensive dialogue with the new natural philosophy, resulting in the assimilation of specific aspects of this philosophy within the Aristotelian framework. Scholastic philosophy was certainly not a marginal aspect of early modern European intellectual life. It was also an active participant in the developments of the new natural philosophy until at least the end of the seventeenth century.[54] In this intellectual atmosphere, Voulgaris considered himself legitimately entitled to participate in the general discussion aiming at clarifying the constitutive concepts of Newtonian philosophy. From our perspective, his endeavour might seem regressive. Voulgaris did not see it this way. Inasmuch as he did not see

the metaphysical consequences of such an assumption. The period's major enterprise was the transformation of Newtonian mechanics so that it might work solely on the basis of kinetic laws. See Patiniotis, op. cit. (27). For 'sGravesande's experimental restructuring of Newtonian mechanics see his work *Mathematical Elements of Natural Philosophy Confirm'd by Experiments; or, an Introduction to Sir Isaac Newton's Philosophy*, translated into English by J. T. Desaguliers, 2 vols., London, 1720–21. (The Latin original and another English translation by J. Keill were also published in 1720.)

53 On the use of biological metaphors in the study of Aristotelianism see E. Grant, 'Ways to interpret the terms "Aristotelian" and "Aristotelianism" in medieval and renaissance natural philosophy', *History of Science* (1987), **25**, 335–58 and D. Sperber, *La Contagion des idées*, Paris, 1996. See also comments on the same issue in D. Des Chene, 'On laws and ends: a response to Hattabb and Menn', *Perspectives on Science* (2000), **8**, 144–63, 145.

54 C. Mercer, 'The vitality and importance of early modern Aristotelianism', in *The Rise of Modern Philosophy: The Tension between the New and Traditional Philosophies from Machiavelli to Leibniz* (ed. T. Sorell), Oxford, 1993, 33–67.

the need for a definitive break with ancient thought, he believed he was bringing the fundamental concepts of modern philosophy into accordance with their original philosophical roots. Thus he produced a new synthesis that, according to his philosophical programme, managed to restore the lost continuity between ancient pronouncements and modern achievements.

Conclusions

The use of the notion of appropriation in the historiography of science aims to depart from the diffusionist model, widely applied to the spread of scientific ideas in the periphery. A historiography built around the notion of appropriation does not direct as much attention to the faithful transfer of these ideas from the centres of production to passively receptive peripheries, as to the measures devised by the agents of the receiving cultures to shape new ideas according to local traditions or constraints. One of the main aspects of this approach is that it brings out the conditions under which the creation of legitimizing spaces for the new ideas became possible. This problem is relatively simple in cases where the assimilation of the new ideas took place in the context of established institutions such as universities and academies. But in the countries of the periphery it is frequently difficult to find such institutions. In these cases understanding the creation of legitimizing spaces for the new ideas presupposes comprehension of the nature of expressed resistance to these ideas as well as examination of the features of the discourse produced by local scholars to overcome this resistance. As a result this line of inquiry entails a systematic treatment of the philosophical achievements of a number of scholars whose works, although part of an extremely active and comprehensive 'ferment of knowledge', did not enter the major syntheses of the time.

From the point of view of current taxonomies, Voulgaris was a scholar from the European periphery either simplistic or arrogant enough to assume that he had corrected even Newton himself as to what inertia really was. Yet matters were quite different from the point of view of his contemporaries. Voulgaris did not consider himself a peripheral scholar and in fact was not. He moved freely in a broad Europe-wide network that carried people, ideas and attitudes. Newton's ideas and methods of inquiry belonged to the same network. They were continuously reshaped, revised and recontextualized according to the commitments and the proclivities of the people who adhered to them. Neither the prevalence of Newtonianism nor the character of the final synthesis were given in advance. The story of Newtonianism is not of the spread of Newton's 'original' ideas but rather of a series of intellectual exchanges which occurred around an original body of ideas and that only after a long and intricate process resulted in what we now might understand as Newtonian science.

When Voulgaris encountered Newtonianism his intellectual options were shaped by the priorities and the predispositions of his cultural environment. Above all, he was a well-educated Aristotelian who, like most of his contemporaries, perceived the 'new philosophy' as a natural advance of ancient thought and his own philosophical undertaking as a contribution to the obvious goal of the unity of philosophy. The way Voulgaris worked with the concept of *vis inertiae* clearly illustrates not only the fusion

of the different traditions which met in the context of his work but also the specific features of the new philosophical discourse he produced to fulfil this goal. Voulgaris was not, it seems, among those who marked the intellectual landscape of his time, but he certainly occupies a place in history of science among those who affected the sensitive balance of power between the various intellectual currents that intersected in the basis of Newtonian philosophy.