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NEW STUDIES IN THE HISTORY AND PHILOSOPHY OF SCIENCE AND TECHNOLOGY

VOLUME 2

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Archimedes

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New Studies in the History and Philosophy of Science and Technology

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The Sciences in the European Periphery During the Enlightenment

edited by

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INTRODUCTION

What has been known as the Scientific Revolution of the 16th, and especially the 17th century was an exclusively European phenomenon. While the social, ideological, conceptual, theological, economic, and political repercussions of the new ideas developed during the Scientific Revolution have been systematically studied within the setting of the countries where that revolution originated, only few historical works have dealt with the issues related to the introduction of these ideas to the countries in the periphery of Europe (that is, the countries of the Iberian Peninsula, the Balkans, the Eastern European and the Scandinavian countries). How did the ideas of the Scientific Revolution migrate to these countries? What were the particularities of their expression in each country? What were the specific forms of resistance to these new ideas and to what extent did they display national characteristics? What were the legitimising procedures for the acceptance of the new ways of dealing with nature? Did the discourse used by the scholars for writing and discussing scientific issues share the same features as the discourse developed by their colleagues in the countries of Western Europe? Any attempt to understand the assimilation of the ideas of the Scientific Revolution in these regions and to assess the characteristics of the resistance to such an assimilation—especially during the Enlightenment— cannot omit discussion of at least some of these questions.

In this paper we shall discuss some of the issues related to the introduction of the new sciences to the Greek speaking regions during the 18th century.* Necessarily, we will also have to refer to developments in the 17th and 19th centuries. Such a discussion calls for a contextual approach: it cannot be conducted independently of an

* All the scholars wrote and taught in Greek. The regions where they lived and worked were quite often of a rather complicated ethnic composition. In any case, we should stress that the regions we are referring to are by no menas the same as those forming part of modern Greece. In many instances Greek scholars lived and worked in societies where there was a dominant element of Greek speaking merchants, e.g. Vienna, Leipzig, Venice, etc.

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overall historical assessment of what it means for ideas that originated in a particular cultural and historical setting to have been «transmitted» into a different cultural milieu with different intellectual traditions and different political and educational institutions.

We find the concept of the «transfer» of ideas to be ultimately inadequate in contextualizing the dissemination of the new sciences in the Greek speaking populations, and in this paper we hope to indicate that «appropriation» can be a more coherent and fruitful analytic instrument. Appropriation directs attention to the measures devised *within the appropriating culture* in order to shape the new ideas within the local traditions which form the framework of local constraints –political, ideological, as well as intellectual constraints.

A historiography based on the concept of transfer can easily degenerate into an algorithm for keeping tabs on what is and what is not [«successfully»] transmitted. A historiography built around the concept of appropriation is more comparable to the procedures of cultural history; acceptance or rejection, reception or opposition are intrinsically cultural processes. Such an approach also permits the newly introduced scientific ideas to be treated *not* as the sum total of discrete units of knowledge but as a network of interconnected concepts. The practical outcome of a historiography of appropriation is to be able to articulate the particularities of discourse that is developed and eventually adopted within the appropriating culture.

Undoubtedly the concept of transmission of ideas is of some use to the historian of ideas. This, however, is apparent only when the transmission of ideas is used for certain specific cases within a wider context of the *appropriation* of multiple cultural traditions by the Greek speaking societies during a specified period of their history. In these occasions the intellectual and institutional framework for the reception of the new ideas is, to a large extent, conditioned by the cultural and religious traditions of the Greek speaking societies together with the role and structure of their educational institutions.

The purpose of the present inquiry, then, is not to examine the success of a process of transfer, but to study the production of a distinctive scientific discourse through the reception of the Western ideas within the Greek speaking regions during the 18th century. Members of a national community which was under occupation and had no state institutions of its own were able to appropriate new scientific ideas in forms that could function within a specific cultural milieu. A synthesis of elements of ancient Greek thought with christian Orthodox tradition had already emerged by the 18th century as a strong cohesive element in the intellectual identity of the Greek nation; the legitimation of the new scientific ideas ran parallel with economic and political restructuring, both assisting in the formation of a new coherent ideology and political stand, connecting the past of the Greeks with their future prospects as independent nation.

The history of ideas of the Greek speaking regions in the Ottoman Empire from the fall of Constantinople in 1453 to the Greek Revolution of 1821 is invariably linked with the educational policies articulated by the Orthodox Church and the Ecumenical Patriarchate. Simply put, the sciences in the educational institutions — which were under the jurisdiction of the Church throughout this period — were introduced as part of a modern curriculum which also (re)introduced ancient Greek thought as the precursor of all the glorious developments in Europe. The introduction of the sciences served both to "enlighten" the youth as well as to help create a national consciousness through the establishment of an intriguing continuity: from the ancients through Byzantium to the present leading to a future when "glory" will be re-established again in Greece. Thus, from the early years of the 17th century, the introduction of the sciences was subservient to the political and, to a certain extent, ideological reorientations of the Church and of the newly emerging social groups.

In this paper we would like to argue the following points.

1. Most analyses of the Scientific Revolution and the establishment of the new sciences in the various countries in Europe take into consideration a host of questions related to the formation of state institutions. Issues, for example, concerning patronage, the establishment of academies and the usefulness of the new sciences for economic production are couched within the context of the formation of state institutions. The situation was radically different in the Greek speaking regions and the Balkans which were under the Ottoman domination. Quite naturally, apart from the Church, the Greeks did not have any centrally administered institutions. In the study of the introduction and reception of the sciences a series of complicated issues enter the picture, especially since the Ottoman administration had granted to the Greek Orthodox Church the responsibility for the education of the Christian population. The content, however, of what was taught was not solely determined by the Church. It was, rather, the confluence of largely similar but at times conflicting aims of the religious hierarchy, of the social groups with significant economic activity and of the scholars themselves. And in order to comprehend what appeared to be a unified educational policy of the Church, it becomes necessary to articulate the relatively autonomous agendas of each of these religious and social groups.

2. In introducing the new sciences, the Greek scholars did not attempt to introduce natural philosophy *per se*, but, rather, they sought a new way of philosophising. This discourse lacked the constitutive features of the discourse of natural philosophy as it was being articulated and legitimised in Western Europe: it was primarily a philosophical discourse. Even while writing about the recent scientific developments, the Greek scholars of the Enlightenment thought of themselves first and foremost as philosophers. They did acknowledge the uniqueness of the developments in Western Europe concerning the new sciences; but they did not perceive these developments as a break with the approach of the ancient Greek philosophers.

The new sciences were, on the whole, interpreted as an expected corroboration of the programmatic declarations of ancient Greek philosophers. In introducing the new scientific ideas, they were reluctant to adopt the discourse used by the natural philosophers in the academic centres of Western Europe. It is only within such an interpretative framework that one can comprehend the *absence* of any discussion concerning the character of the rules of the new ways to study nature, the processes of legitimising the new viewpoint, and the initiation of consensual activities to consolidate the new attitude about the ways of dealing with natural phenomena.

3. Most of the books on science written by Greek scholars in the period of the Enlightenment were intended for use in education, and it has been the case that they seldom present scientific theories with the rogor expected of pedagogical texts written in the same period in Europe. Such discrepancies with respect to European norms have often been attributed to uneven scientific competence, a «watering down» of science at the periphery. We argue that this interpretation is uncalled for; it arises as a more or less direct consequence of the explanatory concept of «transfer», which locates the agency on the side of the culture in which the ideas originated. If one adopts the notion of transfer, this implies a kind of filtering process: there is a selective procedure in the transferring since it depends on who transfers the ideas, when and for what purpose they are transmitted. The study, then, of the introduction of the sciences is often reduced to accounts of what is held by the filter. But, such a viewpoint undermines the specificity of the sciences in the Greek speaking regions, that is, the subtle transformations of the scientific ideas during their process of appropriation.

4. In the centre, the main role of scientists was to produce scientific knowledge whereas their role in the periphery — perhaps with the exception of the Scandinavian countries — was entirely different. It was to disseminate this knowledge through the educational structures. Thus the predominantly *productive* role of the scientists in the centre has to be contrasted with the predominantly *educational* role of the scholars in the periphery. The educational agenda of the scholars played a rather decisive role since the discussion and the dissemination of the sciences was being exclusively realised within the educational institutions and many a times in reference to issues pertaining to education.

THE YEARS AFTER THE FALL OF CONSTANTINOPLE.

The last century of the Byzantine Empire witnessed works in astronomy, mathematics, alchemy and, of course, philosophy by scholars who formed the intellectual elite of a society fraught with religious disputes and political struggles. The exodus of these scholars and their migration, mainly to Italy and France, had started quite some time before the fall of Constantinople in 1453. In most instances, these scho-

lars found their new environments quite congenial and in most cases they adopted a rather sympathetic position towards Catholicism. In the decade preceding the Fall, the dominant political forces had come to favor between the Eastern and Western Churches — even though Rome would clearly have the upper hand — as holding out the only hope of rescuing Eastern Christendom from the Ottomans. It was a move aimed at convincing the Catholics — nearly two centuries after the catastrophic siege and occupation of Constantinople by the forces of the fourth crusade between 1204 and 1261 — to rally for the rescue of Eastern Christianity. In contrast, the scholars who remained in Constantinople and initiated the re-establishment of the educational institutions, were, as a rule, carriers of an anti-western attitude.

Immediately after the fall of Constantinople, the Sultan Mohammed II — Mohammed the Conqueror — allowed the Patriarchate to continue its function. The Patriarch was recognised by the Sultan as the legal head of the Orthodox *millet* (nation). Most importantly, the Patriarchate was granted full jurisdiction over the education of the Orthodox Christian populations in the Ottoman Empire and, eventually, the right to develop mechanisms to collect some form of taxation from the parishes, while at the same time it was set free of tax obligations towards the Ottoman state. The Sultan's decision was, partly at least, a response to the contingencies of the new era of the Ottoman Empire. The serious difficulties relating to the administration of a continuously expanding Empire with a progressively increasing Christian population and the threat from Christian Europe could be eased by granting this limited political autonomy to the Patriarchate as well as by taking advantage of the deep animosity between the Orthodox Church and Rome. The Orthodox Church was at the time the only organised institution which could represent Christian nations of the Balkan Peninsula in their dealings with the Ottoman administration. Furthermore, the Patriarchate had already created a structured ecclesiastical hierarchy which allowed control of even the smallest Christian community in the area. Moreover, the choice of the Patriarchate as the *de facto* political representative of the Christian populations of the Balkans would contribute to the consolidation of the Ottoman Empire's newly acquired lands in the West. During that period, the idea of a European crusade against the Ottoman Empire under the aegis of the Papacy was a strong element of political coherence in threatened Europe. By setting up the Patriarchate as an autonomous political institution, as well as strengthening the forces contrary to the union of the Churches, Mohammed intended to minimize the possibilities for the realisation of such plans.

The Sultan appointed as the new Patriarch Gennadios Scholarios (1400-1460). It should be noted that since 1450 the Patriarchate had been in effect headless, while the nominal Patriarch Gregory III was in Rome. Gennadios Scholarios was a well-known jurist, rhetor and philosopher, and played an important role in political life during the last years of the Byzantine era. As a philosopher, he was of aristotelian

orientation, a follower of Aquinas and an opponent of Pletho's platonism. Among his writings we note the *Synopsis of Aristotle's Physics with Simplicio's Commentaries* and *Against Pletho's Queries of Aristotle.* He was an officer of the Byzantine state, and a member of the delegations that represented the Orthodox Church during the negotiations with the Catholics. Though at first an advocate of the union of the Churches, soon afterwards, he became a fierce opponent, attacking the attempts of the emperor Constantinos Paleologos to come to terms with Pope Nicholas V. Historians agree that the Emperor's motives in agreeing to the union of the Churches were based less on religious grounds and more on the hope of securing the military support of the western countries against the Ottoman threat. Especially during the siege of Constantinople, Gennadios Scholarios made an intense propaganda against the Catholic Church. When Mohammed conquered Constantinople he saw in Gennadios the person to become the first Patriarch. Gennadios undertook the task of reviving the intellectual life of the city. He founded the first official school, the Patriarchal Academy, which was the continuation of the Pandidakterion of the Byzantine era, and appointed Mathaeos Kamariotis as its first director.

The exact date of Kamariotis' birth is unknown; he remained director of the Patriarchal Academy up to his death in 1489 or 1490. There is no information concerning the curriculum of the Academy. However, it is reasonable to suppose that it was similar to the standard Byzantine curriculum, since Kamariotis had been a well-known teacher for many years before the fall. From the part of his work that is known to us today we can see that he had then included in the curriculum ancient Greek literature, rhetoric and theology, while he was an opponent of Pletho's ideas.

By the end of the 16th century and within the context of counter-reformation after the Council of Trent (1545-1563), Rome defined a new policy towards the Greek population of the Ottoman Empire, designed to prevent any rapprochement between the Protestants and the Orthodox. In the beginning of the seventeenth century, the Patriarchates of both Constantinople and Jerusalem became fields of contention between the Catholics and the Protestants. The Jesuits attempted to create Catholic zones in the eastern Mediterranean basin and to this purpose they cooperated with the Ottomans, attempting at the same time to bribe several officers of the Orthodox Church.

The College of Saint Athanassios (Collegio Greco), in Rome, where many Greek scholars — who later in their lives became quite eminent — attended classes, played an important role in the development of the political influence of the Catholics. This College was founded in 1577 and its main mission was to offer higher education to the Greeks of the Ottoman Empire through study and acquaintance of the world of the Catholic Church. Theology according to the teachings of Aristotle and Thomas Aquinas was the basis of the curriculum. The doctrines of the Catholic Church, ancient Greek and Latin literature, Aristotelian philosophy and

advanced theological education were included in the curriculum. Graduates before returning back to their country of origin, were asked to propagandise Catholicism, to cultivate Greek letters, and to support anti-Ottoman ideas, since the Ottomans were still viewed as the main enemy of the Christian world.

During the same period, the Protestants were trying to increase their influence in the eastern Mediterranean, especially through the activity of the ambassadors of England, Holland, Germany, and Sweden. Not unexpectedly, they offered support to the Patriarchates of Constantinople and Jerusalem. Their shared hostility to Catholicism brought the Protestants and the Greek Orthodox close to each other. In 1620 Kyrillos Loukaris (1572-1638) became Patriarch of Constantinople. During the early stages of the 30-year war, Loukaris planned a series of political moves to consolidate the survival of the Orthodox Church. He felt that there were unmistakable signs of an impending alliance between Catholic France and the Ottomans. He saw such an alliance as the main danger against the Orthodox Church, and he sought supporters among the Protestants, especially the Dutch. The ambassador of Holland to the Ottoman Court turned out to be a very co-operative ally. Loukaris, also, proceeded to write a notorious leaflet arguing for the common theological grounds between Calvinism and Orthodoxy. Many serious theologians — and not only his adversaries — accused him of adopting Protestantism.

Being convinced that the Catholic propaganda was effective because of its educational institutions, Loukaris upgraded the Patriarchal Academy and introduced what came to be known as «religious humanism». He himself had studied at the Greek School of Venice, under Maximos Margunios, from 1584 until 1588 and he had completed his studies at the University of Padua in 1593.

Religious humanism was an attempt to synthesize the teachings of ancient Greeks with the teachings of the Orthodox Church fathers, considering the intellectual traditions originating in Greek antiquity and those of Christianity as a unity. Religious humanism became the means for moulding a kind of national consciousness by reclaiming hellenistic roots through Greek Orthodox Christian teaching. In the prevailing conditions of intense national reorientations and regroupings in Europe, such a strategy aimed at upgrading the political role of the Patriarchate by providing an institutional expression to the ties between orthodoxy and hellenism. Such initiatives led not only to the establishment of new educational institutions, but, eventually, to the furthering of the Church's dominance through the articulation of a new ideological and political agenda. The idea that the Orthodox Church must safeguard the great intellectual tradition of the nation and protect Hellenism from the "Ottoman despot *and* the propaganda or the contrivances of Catholicism" was given a theoretical justification and an institutional expression.

The strong and systematic reference to the ancients eventually created a rather restricted space for lay theology and this was to prove quite important for the way

the Greek scholars would collectively decide to promote the new scientific ideas. Establishing new schools with new curricula had a very specific purpose: to keep alive and modernize a national culture whose constitutive domains were both the ancients and Orthodox Christianity. In this context, the new scientific ideas were, at least partly, introduced as a means of underlining the success of the ancients' ideas.

In 1622 Kyrillos Loukaris appointed a renowned neo-Aristotelian, Theophilos Korydalleas (1570-1646), to the directorship of the Patriarchal Academy. The latter had studied in Italy during the first decade of the seventeenth century. In 1604 he attended classes at the Greek College in Rome. He went on to study at the University of Padua, at a time when Cesare Cremonini was the dominant figure and the articulate defender of Aristotelianism, especially against the new science introduced by his colleague there, Galileo Galilei. Korydalleas received his doctorate in Philosophy and Medicine, around 1608. In the Patriarchal Academy Korydalleas reorganised teaching along the ways practised in Padua. A central place was assigned to philosophy — as distinct from theology — and to the interpretation of the commentaries on the main works of Aristotle. Korydalleas' humanistic brand of philosophy contained the potential for a rupture with a strictly theological approach to nature and to human affairs. But at the same time, there was a conscious policy to contain and develop this new approach *exclusively* within the framework of neo-Aristotelianism, during a period when such a framework was being undermined and redefined elsewhere in Europe.

Theophylos Korydalleas, even though he was well acquainted with Descartes' philosophical and scientific works and he had, undoubtedly, come into contact with the ideas and the debates about heliocentrism during his stay in Italy, promoted the Aristotelian worldview. Nowhere in his works did he mention the heliocentric system, not even in order to criticize it. In 1626 he is thought to have written his *Global Geography According to Ptolemy.* This work was never published but references to it from his students indicate that it was a piece which revived the interest of the Greek scholars in the work of the Alexandrian astronomer, fifteen centuries after its first presentation. Korydalleas, however, held a viewpoint different from Ptolemy's. While the latter sought a mathematical description and modelling of the celestial movements, Korydalleas focused on physical, qualitative description, pointing out the Aristotelian features of the Ptolemaic cosmography. The Earth was at the centre of the universe because, as Aristotle taught, heavy bodies tended to fall towards the centre. The celestial spheres moved around the earth, depicting the celestial hierarchy. He also insisted on the main Aristotelian separation between the eternal and perfect world beyond the Moon and the world of change below it. At the end of the text, Korydalleas provided a brief descriptive account of the Ptolemaic theory of epicycles.

Korydalleas, through his teachings, contributed decisively to the gradual fusion between the Orthodox Christian theology and aristotelianism. The new methods of mathematical physics and the quantitatively oriented study of nature are nowhere to be found among his works. Against the unified, homogeneous, deterministic, and infinite universe of the newly articulated cosmology, he juxtaposed the finite and closed aristotelian world, as well as a geocentrism inspired by theology. His writings continued to exert a strong influence for a long time even though some of the later scholars were not eager to endorse all of his views, especially since he had also been accused of Calvinism and atheism. Nevertheless, Korydalleas was the first teacher after the fall of Constantinople who provided a frame of reference to be available to Greek educators in the coming years; and, despite the criticism directed against him, he continued to teach under the aegis of the Church.

INTRODUCING THE NEW SCIENTIFIC IDEAS

Most of the second half of the 17th century and a large part of the 18th century was a period of educational and economic rejuvenation of many sectors of Greek society. In this period the Fanariots — basically the Greeks who lived in Constantinople — would play a dominant role. The beginning of this period is characterized by the completion of the Ottoman expansion and the creation of some of the prerequisites for the economic development of a new Hellenism. From the end of the 17th century, the Fanariots acquired an increasingly important role in the administration of the Ottoman state. At the outset of the 18th century, representatives of the Fanariots were appointed by the *Sublime Porte* as governors and hospodars in Wallachia and Moldavia. The Fanariots would soon take the lead among all the other Greeks dispersed in the Balkans; their political dominance would reinforce the already strong influence of the Greeks in the economic as well as cultural spheres in these regions, while at the same time as administrators and as diplomats they would take the line commonly referred to as the enlightened despotism.

This period is characterised by three interdependent developments. First, the increasing involvement of this group of Greeks in the administrative affairs of the Ottoman Empire undermined the almost exclusive role of the clergy in mediating the relations of the Christians with the Court. The second characteristic of this period is the increasing receptivity to the new ideas coming from Europe by the Fanariots, whose relative autonomy from the Patriarchate was further strengthened by an agenda of «europeanization». The third characteristic is related to the rise of a new social group. In addition to the Fanariots, the merchants started to assert themselves socially and played a rather significant role in the intellectual orientations of the period. The symbiotic relationship between the merchants and the quasi-administrative group of Fanariots was not always without conflict. Often, for exam-

ple, they were at odds concerning the exertion of influence on the Patriarchate. The social and economic prominence of these groups slowly led to the weakening of the absolute control the Church had on the schools and in their curricula. The Fanariots, for example, took many initiatives for the establishment of new schools.

At the same time, the Greek scholars started moving all over Europe. Italy ceased to be the almost exclusive place for their studies. Greek scholars started travelling to the Germanic countries, Holland, and Paris. They were, thus, intellectually influenced by a multitude of traditions and schools — and that was true for their training in the natural sciences as well. Interestingly, it was during that period that we witness a strong tendency of the scholars to return home after the completion of their studies abroad.

There were, basically, two reasons favouring the return of the scholars. The first was the growing need for scholars and teachers in the schools which were being founded as a result of the economically thriving Greek communities dispersed in various regions within the Ottoman Empire and outside it. Especially after the mid-1700s there was a upsurge in the establishment of new centres of "higher education" in the Greek communities in great mercantile centres like Venice or Vienna, in Wallachia and Moldavia, in cities containing sizeable Greek administrative communities, like Bucharest and Iasi, in the Ionian Islands and in cities with large Greek communities, like Ioannina, or cities on the coast of Asia Minor. Individuals or groups of people, very often expatriates, gave money or bought books and equipment for these schools. In some schools, like in Chios and Milies, these endowments resulted in remarkable libraries. These schools, as centres of intellectual activity and as expressions of educational and patriotic philanthropy became paradigmatic of the Greek Enlightenment.

The second reason for the return of the scholars had to do with their gradual marginalization with respect to the established community of natural philosophers in Europe. Almost all of the scholars who went to Europe were churchmen having the blessings of the Patriarchate. They were among the best who had mastered the amalgamation of the ancient thought together with the teachings of the Church. In their travels to Europe, however, they found Europe quite different from what the narratives and experiences of the scholars of the preceding generation had led them to expect. During the early part of the eighteenth century they found a Europe dominated by the ideas of the Scientific Revolution, with flourishing scientific communities involved in the production of original scientific work. The institutions where the Greek scholars could indulge in the all-embracing studies of philosophy, continuing the kind of education they had already acquired, were progressively decreasing. The scholars were faced with a paralyzing dilemma: if they were to become part of the community of the natural philosophers in the places where they were studying, the Greek scholars had to abandon their own tradition of religious

humanism. *Being ideologically unwilling and intellectually unable to proceed to such a break, they immersed themselves in the study of the new sciences with a view to returning home and assimilating them into the curriculum of religious humanism.* A characteristic example of this attitude was the increasing desire to teach the new sciences in a manner that harmonized with the conceptions of the ancients. No wonder that almost all the books on the new theories written by Greek scholars in the eighteenth century reflected, and very often explicitly expressed, their "debt" to their ancient predecessors. This conception of an uninterrupted continuity and the perfection of ancient knowledge — a conception that was essentially adopted and promoted by the Church — was one of the basic characteristics of the Greek scientific culture during the Enlightenment.

The writings of the Greek scholars reflected three traditions, at times in conflict with each other, at times complementing each other. These were the scholastic-Aristotelian tradition, the neo-Aristotelian tradition and the tradition of the European Enlightenment. The introduction and teaching of the sciences necessarily reflected a synthesis of traditions which, quite often, obeyed ideological and political aims rather than complying with the dominant problematic of the natural philosophers of Western Europe. Of course, the Greek scholars were fully conscious of the deep influence exerted by natural philosophy on political philosophy and this was not a secondary factor in their intellectual itineraries. Finally, such an interpretative framework helps us to understand why almost every one of the scholars who had played a significant role in the introduction of the new scientific ideas in the Greek speaking regions, had written a book in philosophy or logic *before* publishing a scientific book. Physical, astronomical and cosmological writings give us an additional probe into the character of this idiosyncratic discourse that Greek scholars developed in their attempts to introduce the new scientific ideas.

During that period the main pursuit of the Greek scholars remained the articulation of a philosophical discourse, within which the new ideas of the scientific revolution would be fused with the aristotelian tradition and the Orthodox Christian ontology. In 1716, almost a century after the appointment of Theophylos Korydalleas as the director of the Patriarchal Academy, Chrysanthos Notaras (1663-1731) published his work *An introduction to the Spheres and Geography.* At the time, Chrysanthos Notaras was Patriarch of Jerusalem, succeeding to his uncle Dositheos. Both had been particularly active in consolidating the economic and political presence of the Orthodox Greeks in the Holy Lands and in opposing the claims of the Catholic Church. Chrysanthos Notaras had started his studies at the Patriarchal Academy and, later on, in 1696, he was sent to Vienna and later to Venice and to Padua. In 1700 he visited Paris where he made astronomical observations at the Paris Observatory for several months. Though he never practised as a teacher, in 1707

he proposed a program of reform for the Academy of Bucharest, which later was also used for the reforms instituted at the Academy of Iasi (1714).

Ancient Greek literature, philosophy, and the natural sciences were the main courses of that program. However, Chrysanthos Notaras proposed the teaching of philosophy according to Korydalleas' neo-aristotelian model, though he himself had already studied at European universities almost a century later. Chrysanthos' astronomy followed in Korydalleas' footprints and his aim was to advocate the geocentric system as opposed to the current theories of heliocentrism. Though he exhibited some tolerance towards Copernicus and discussed his ideas, Chrysanthos Notaras, as a staunch follower of religious humanism, pointed out that Copernicus' ideas were nothing more than a reproduction of the cosmological model proposed by Aristarchos of Samos. In the first part of his book he briefly described the main schema of aristotelian cosmology, while in the third he developed in detail the arguments in favour of geocentrism and against the rival heliocentric system. His conclusive argument had to do with the absence of any internal or external cause that could *account for* the «circular or straightforward movement of the Earth». The absence of any possible cause was sufficient proof that the Earth remained still in the centre of the universe. Chrysanthos Notaras' conclusion was philosophico-theological rather than scientific in nature: *since the Ptolemaic system could describe the celestial phenomena at least as adequately as the Copernican system could, the adoption of the former was necessitated by its agreement with the Scriptures and the senses.*

This situation changed radically after about the middle of the 18th century, when a great number of the Greek scholars became supporters of the heliocentric system. That heliocentrism found quite a few adherents was not independent of the fact that the polemics against heliocentrism were no longer particularly intense. Those who were against the heliocentric system presented the alternative cosmological systems to their pupils, and came out in favour of the geocentric system, based either on the Scriptures and/or Aristotle or, as Evgenios Voulgaris did, on recent observations which could not find evidence of stellar parallax. We should also note that the Copernican system had a peculiar affinity to the Greek thought: many authors presented the heliocentric system as originating in Pythagorean ideas. Hence, heliocentrism could be considered as part of a national spiritual heritage —a reminder that the Church continued to be the guarantor of the traditions of the Greek nation. For that reason it was not strange to see both systems often accepted as valuable hypotheses: though geocentrism was to be preferred, heliocentrism —to the extent that it had its origins in the ancient Greek thought— did not *necessarily* undermine the ontological contentions of religious humanism.

One of the adherents of heliocentrism was Iosipos Misiodax (1725 - 1800) who appears to have been fully conscious of the fact that the traditional model of the

cosmos by Aristotle had not been simply subjected to some minor changes, but had been displaced by a new and dramatically different system. In his works he presented the claims of Copernicus and he also discussed the invention and role of the telescope, the discovery of the solar spots as well as Newton's gravitational theory. Iosipos Misiodax was born in Cernavoda, Bulgaria. He studied at the School of Mount Athos between 1754 and 1755 when Evgenios Voulgaris directed the school. Towards the end of the same decade he visited Venice, Padua, Hungary, and Vienna. In 1761 he translated and published Muratori's *Moral Philosophy,* in Venice. In 1765, he started his career as a teacher in the regions around the Danube where the Ottoman Court had appointed Greek governors. A committed educational reformer, his ideas were considered to be in opposition to the theology of his days; to defend himself from the attacks of his opponents, he published in 1780 his *Apologia,* in Venice. Though his most forceful contributions were in the field of political and social philosophy, his works contained extensive references to the recent attainments of the sciences.

The following year, Misiodax published the *Theory of Geography,* where among other topics he presented the various theories concerning the motion of the Earth. Though it was obvious that he was a strong defender of heliocentrism, he tried to safeguard himself: while he was in general agreement with the beliefs of most of the natural philosophers in the West, he continuously scrutinized the logical structure of their arguments. In the same text, and in trying to moderate reaction against the presentation of heliocentrism, he wrote that heliocentrism was put forth so as «to invent new means to imitate the Pythagoreans», thus attempting to dress the new theories with the respectable cloth of antiquity.

Misiodax recognized that the place of man within the cosmos had been altered, and as a result, the order of values had changed as well. At the same time, he was aware of the course which the newer sciences had charted in modifying the traditional world-view. Though Copernicus was the «glorified rejuvenator of real Astronomy», the breakdown of the aristotelian universe was caused by the use of the telescope, the discovery of sunspots, and the study of comets, which showed that the universe was uniform and homogeneous, and that there was no physical distinction between the world above and below the Moon. The culmination of his ideas was considered to be the combination of new mathematical thought with the experimental tradition within the framework of the Newtonian synthesis.

Misiodax ascribed to mathematics an educational merit which he had not ascribed to logic and metaphysics. In fact, he had accused Aristotle for undermining the interest in the study of mathematics and expressed his admiration of Galileo, Descartes, and Newton because, in his opinion, they restored the ancient respect for mathematics; he thus considered the teaching of mathematics together with experimental physics to be of great value for a modern educational curriculum.

In his work *Theory of Geography* he presented the arguments for the heliocentric system together with the claims of the adherents of geocentrism. Although he claimed to keep equal distance from both views, his way of organizing and presenting the arguments clearly indicated his preferences. He started his analysis with a programmatic distinction between science and the Holy Scripture, and he was led to the rejection of all theological arguments concerning the structure of the universe. He, then, reconsidered the issue of the absolute reliability of the senses, which was a strong cognitive bulwark of the aristotelian thought; at the same time, he rejected the premise that phenomena which take place below the Moon are distinguished from the ones which occur above it, and he expressed his agreement with the idea that nature is homogeneous. His arguments for the Earth's motion were completed with an appeal to Kepler and Newton, whose laws, as he stressed, confirmed and validated the heliocentric hypothesis. Misiodax adopted the ideas of the new sciences without having to devise detailed arguments against aristotelianism. He considered the break with the aristotelian cosmology to be the end of a whole era and established his proposals for educational reform upon the undisputed acceptance of the new image of the cosmos as put forth by contemporary science.

Another eminent scholar of the time was Evgenios Voulgaris (1716-1806), one of the more intriguing personalities of the Greek Enlightenment. He was born in Corfu and died at the age of ninety at the court of Catherine the Great. He studied in Corfu under Vikentios Damodos, an important scholar of the period. He continued his studies in the School of Ioannina (a wealthy commercial town of western Greece) under Athanassios Psalidas. After he became a priest, in 1737 or 1738, he went to Italy in order to study theology, philosophy, european languages and natural sciences.

In 1742, he became director of an important school in Ioannina. There he was involved in a public dispute with Balanos Vassilopoulos, who was the director of another high level school of the district, regarding their respective curricula – Voulgaris arguing for the introduction of natural philosophy. From 1753 to 1759 Voulgaris was director of the School of Mount Athos, where he worked to upgrade the level of studies. There he taught philosophy as well as mathematics. Though he was considered to be one of the most eminent teachers, his strong adherence to the new ideas provoked reaction from the religious hierarchy of Athos, and he was forced to abandon the school in early 1759. He then moved to the Patriarchal Academy, and in 1761 he permanently abandoned his educational career. The presence of Voulgaris in the various schools of the Greek speaking regions gave rise to antagonisms because of his adherence to the new scientific ideas and his self-asserting personality.

Voulgaris wrote and translated many books on a wide variety of subjects, mainly for use in his own teaching. Most of these books remained unpublished or were pu-

blished many years after the end of his educational career, while he was living in Russia. Like most scholars of his time he launched his intellectual activity with a book on *Logic* (Leipzig, 1766). He continued with the publication of *Elements of Metaphysics* (Venice, 1805), *What Philosophers Prefer* (Vienna, 1805) —an amalgam of the recent ideas of the sciences and Philosophy— and *About the Universe* (Vienna, 1805) where he discussed the contemporary astronomical theories. It is interesting to note that he also translated —though not published— works of Locke, Wolff, Du Hamel, and Pourchot.

Although Voulgaris, an ordained priest, was one of the most systematic initiators of the new scientific ideas into the Greek speaking world, he remained throughout his life an adherent of the idea that the gnoseological authority of the Scriptures was much more valid than any other cognitive approach to the world. In this sense, Voulgaris typified the case of a Greek scholar who assimilated the attainments of the Enlightenment by incorporating them in a discourse within the restricted framework of religious humanism. Voulgaris seems not to have recognized the radical reorientations in the study of nature brought about by the introduction and legitimation of experimental procedures. He was trying to combine the new theories with the teaching of the ancients, which he strongly believed to be the foundation for any modern knowledge. He refused to acknowledge the crucial role of experiment and mathematics in the new scientific *discourse* developed among the natural philosophers in Europe. In Voulgaris' view physics should derive its conclusions mainly through reasoning. It is true that in his translation of Segner's *Elements of mathematics* he underlined the necessity of algebraic knowledge for the study of the world and for the proper understanding of physics. His perception of the proposed connection of mathematics with physical inquiry, however, was restricted to a mentalist context, and in his subsequent work he tended to connect the use of mathematics with philosophy, following the exemplar of the ancient Greeks. As will be discussed later, the case of Veniamin Lesvios —another eminent scholar of the Greek Enlightenment— was similar to that of Voulgaris: Lesvios suggested that the application of geometry in astronomy gave the latter the quality of a science; but, although he acknowledged the contribution of analytic geometry in the formation of the modern scientific discourse, he considered it to be difficult as well as lacking in elegance and he advocated Euclidean geometry as appropriate for the education of young people.

Voulgaris' work *About the Universe* was written for teaching purposes and contained his main astronomical views. Though it was published in 1805, it is presumed to have been completed before 1761, the year he abandoned his educational activities. When the book was published, the 89 year-old Voulgaris was a recluse at a monastery hardly communicating with anyone and, thus, it was not at all clear whether he was even asked to acquiesce in the publication of the book. It was

mainly an amalgam of the work of various European philosophers. Voulgaris did not hesitate to recognize that the Ptolemaic system was obviously contrary both to observations and common sense. That, however, did not mean that he espoused the truth of heliocentrism. He mentioned a number of arguments expressing the lack of any sense-experience for the revolution of the Earth. His main argument, however, was of gnoseological nature and had to do with the validity of the Scriptures: though their main target is the salvation of the human soul, they also accommodate some natural truths which are able to reinforce moral teachings and reveal Divine Providence; and though the movement or stillness of the Earth is irrelevant for the salvation of the soul, we are obliged to accept the divine assurance of the Earth's stillness as the most reliable.

The Ptolemaic system was inadequate and heliocentrism involved cognitive obstacles that prevented Voulgaris from accepting it; he thus preferred a third interpretation as the most reliable, namely the system proposed by Tycho Brache. Voulgaris was the only scholar in the Greek speaking world who embraced the Tychonic system in the middle of the eighteenth century. His argumentation, however, was not simplistic; he was fully acquainted with the issues involved. His main objective was to confirm that the Tychonic system was in accordance with astronomical observations, that it interpreted a host of phenomena that Ptolemy's system could not adequately explain, and that it was technically at least as valid as the heliocentric system. Then, since it kept the unmoving Earth at the center of the universe, the Tychonic system was consistent with the Scriptures and, on that ground, preferable.

In 1794, the Fanariot Panagiotis Kodrikas translated Fontenelle's *Entretiens sur la pluralité des Mondes.* This semi-popular book discussed the idea of an infinite universe and the plurality of worlds. The translation included many notes by Kodrikas. One would not have expected that a translation of a book written nearly a hundred years earlier would be a high priority. Yet, Kodrikas chose to translate it so that he could include his extensive "explanatory" notes which in fact amounted to a parallel text. The translation provoked a strong attack against the followers of heliocentrism, and finally was condemned by the Church — not because of the ideas of Fontenelle, but because of the translator's comments which were in explicit conflict with the traditional values of religious humanism: he did not hesitate to write against "those who due to superstitious ignorance do not acknowledge the established truths of the Copernican system." With Kodrikas' translation we have, for the first time, definite recognition of the role of the founders of modern physics (with the exception of Galileo who does not seem to be so dear to the Greek scholars of the time): it is noted that while Copernicus had, in fact, put the Sun in the centre, he had not changed the structure of the cosmos, and that Descartes had broken away from the Aristotelian world-view; finally, the significance of Newton's synthesis is brought to surface.

The French Revolution did not sit well with the Fanariots' political agenda. Many of them considered the Revolution and its consequences as endangering their prospects of increasing influence within the Ottoman Empire. As the French Revolution was more and more projected as the realization of the political and social ideas of the Enlightenment, the Fanariots' belief in and attachment to the ideas of the Enlightenment started to weaken. Also, as the anticlericalist positions of the Revolution were associated with the spirit of the Enlightenment, many scholars — who, as we stressed, were men of the Church — became less and less willing to be identified with the ideas of the Enlightenment. Naturally, we are not talking of a radical change which was adopted by all concerned: quite a few scholars, especially teachers, continued to remain strong adherents of the new scientific ideas. However, we do stress a change of heart among many scholars in their strong backing of the ideas of the Enlightenment, which, as a result, allowed a greater leverage to those in the Church who were strong opponents of these ideas from the very beginning.

This rather mixed situation and change in the mood of the scholars was quite evident in attempted changes in school curricula. That is displayed in a very typical way at the *Megali tou Genous Scholi* (a continuation of the Patriarchal Academy). During 1778-1801, the director of the school was Sergios Makreos, who remained faithful to the traditional educational system of the school. He reacted against the proposed reforms and was not even willing to include in the curriculum the books of Voulgaris, who was Makreos' teacher and for whom he felt great respect.

Makreos was born around 1740 and died in 1819. His education was entirely within the Greek speaking areas of the Ottoman Empire. He attended classes at the School of Agrafa (a mountainous region of central Greece) and then he went to the School of Athos under Voulgaris. He completed his studies under Voulgaris at the Patriarchal Academy in Constantinople. During his directorship he taught Aristotle according to Korydalleas' system, and though he was proud of being Voulgaris' student he refused to bring into the curriculum the new sciences and philosophy, because he believed that they would lead to the breakdown of traditional social values.

In 1797 he published *A Trophy from the Greek panoply against the followers of Copernicus.* Makreos seems not to have been acquainted with the course of events and conceptual changes which led to the final Newtonian form of the heliocentric theory. By attacking Copernicanism he attacked all the new astronomical theories —among them the infiniteness of the universe and the inhabitation of the stars. Makreos' arguments against heliocentrism were not predominantly "scientific"; instead he stressed the social repercussions of each model: the overthrow of the traditional hierarchical and static world expressed by geocentrism would entail the downfall of social hierarchy.

Makreos attempted through a number of syllogisms to discredit Newton's theory of gravitation. He considered that the motion of every body was determined by the outcome of two forces, the centripetal and the centrifugal. He discussed two cases. The first was when both forces are applied to the same body specifically to the Earth. According to the Aristotelian viewpoint centripetal force is natural whereas centrifugal motion is violent. But again according to Aristotle it is impossible for a body to execute natural and violent motion at the same time. Hence there is a contradiction. In the second case one of the forces is applied to the Earth and the other to the Sun. The net result of this situation would be for the Earth to be attracted and repelled by the Sun at the same time. According to Makreos this has the following consequences. Either the Earth will move in a straight line and there will be no reason for it to revolve or, if the two forces are equal in strength, then the Earth will be motionless for ever. Makreos concludes that the law of universal attraction cannot justify the heliocentric system. It is important to underline the qualitative character of his arguments as well as his disregard of the law of inertia. Of course, Makreos had a rather shrewd strategy: he used the most «quantitative» of Newton's laws and showed that on Aristotelian premises it is self-contradictory and cannot lead to what Makreos considered as unquestionabe qualitative characteristics of the cosmos.

The way he developed his arguments clearly shows his intention to work within a pre-determined cosmological schema. At the same time, he presented an analysis of the gnoseological preconditions for heliocentrism, which, in effect, comprised the main part of his book. He adopted the main points of the Aristotelian world-view and rejected the image of an infinite, homogeneous world implied by the new astronomy. He tried to restore the validity of sensory experience and proposed simplicity as the criterion for the correctness of astronomical theories. Furthermore, he questioned the validity of astronomical observation together with the reliability of "mathematical instruments". He claimed that we cannot determine what is happening in the sky from what we observe from beneath the Moon, because these are two different realms with two different classes of phenomena.

Makreos was committed to defending the aristotelian world-view within the context determined by the Orthodox Christian faith. A difficulty here was that Aristotle's views on the eternity and self-motion of matter could be interpreted as rendering the act of Creation unnecessary. For this reason, part of Makreos' task was attempting to explain that matter is created and it is passive. Creating it and putting it into movement demanded the mediation of the highest power and of the eternal energy of God. By placing cosmology within this context Makreos was stressing, at the same time, the cognitive limits of man. There is no way for knowledge to surpass the limit imposed by the relationship between humans and their Creator. Therefore, knowledge should always be subjected to the truth of the

sacred Scriptures. Almost two hundred years after Galileo and his telescope, Makraios remained an aristotelian by totally rejecting the possibility of even a partial updating of traditional cosmology.

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From the middle of the 18th century, economic well being of the Greek communities within the Ottoman Empire with the accompanying social transformations brought about a number of changes in the educational system. The reception and appropriation of the new scientific ideas went on within an environment of social unrest and ideological confrontations. One cannot talk about educational reform, since the attempts were local initiatives rather than a centrally dictated policy to be applied to a homogeneous educational system. While in the seventeenth and at the beginning of the eighteenth centuries all schools were religiously oriented, the coming years saw the emergence of schools whose curriculum could cater for the social and political agendas of the merchants or the Greeks involved in the administration of the Ottoman state. The systematic introduction of the sciences was reinforced by renewed faith in man's ability to acquire knowledge of the world with his own means, and all these found support in the expectations of the assertive merchants and in the political ambitions of the Greek officers of the Danube region.

Within this context, there was a gradual re-definition of the teachers' role. The image of the teacher-priest whose work was a religious mission gave way to another kind of scholar: the great majority of these teachers were priests, but their educational agenda became more secular and their actual work tended to be more «professional». The scholastic and grandiloquent teaching of the works of the Fathers of the Orthodox Church, of ancient Greek literature and of Aristotle, gave way to a curriculum determined through negotiations with the community which had established and catered for the schools. Teaching began to serve the social, political, and ideological «priorities» of these communities. These changes strengthened the relative autonomy of the scholars from the Patriarchate and reinforced their role as independent scholars.

At the end of the eighteenth century, the introduction of Enlightenment ideas in the schools became the subject of social negotiation. For many Greek scholars the European nation states represented a model, while at the same time they provided the ideological background for a new political discourse in the Greek speaking world. The methods for the introduction of knowledge were changing, because, as the scholars were progressively realizing, the knowledge to be introduced was of a new kind. Teaching had to become pleasant and attractive in order to cultivate curiosity and independent thinking. Visual means supplemented texts: maps, globes, experimental instruments, experimental demonstrations themselves became the pri-

de of teachers. Constantinos Koumas (1777-1831) claimed to be the first teacher who conducted physical and chemical experiments at the Philological Gymnasium of Smyrna, in 1812. Philosophy became part of the educational process as a source of social ethics and good reasoning. Thus, observation, experience, the cultivation of good reasoning, and the fight against superstition became the main educational objectives, necessary for combatting ignorance and bringing progress according to the promises of the new sciences.

The cultivation of the sciences was aiming at the integration of the Greek speaking populations into the group of European nations, its other objective being the strengthening of the secular power to counterbalance the Church. At the same time, the natural sciences appeared to be the answer to the social demand for craftsmen-technicians, and for improving the efficiency of the merchants' dealings with their counterparts in Europe. The publication of commercial handbooks and the establishment of progressive schools were also expressing that trend, with the clear objective, at least of some merchant groups, of undermining and discrediting the traditional educational system.

During the whole of the eighteenth century and until the Greek Revolution of 1821, there was no branch of the natural sciences —with the exception of medicine— organised into a distinctive cognitive field with institutional autonomy. The scholars who were dealing with the newest scientific ideas were differentiated on the basis of their general ideological and political affinities; only medical doctors tended to become a separate profession. The work of the rest of the Greek scholars had social aims within the framework of the interests of various social groups and this is the reason why scientific discourse appeared in the context of a more general political agenda. The ideas that had originated during the scientific revolution were viewed more as an educational activity responsive to certain social demands or contemplative quests, and less as a method for practical research. They were knowledge to be acquired, not a method for producing new knowledge. In the Greek speaking regions, we cannot trace a trend whereby scientific practice is transformed into a socially structured activity having as its main element the empirical—let alone experimental—study of nature.

Nevertheless, towards the end of the eighteenth century the number of published scientific books began to increase. Greek scholars started writing and translating a large number of scientific works to be published in cities like Venice and Vienna. A common practice was the dedication of the works to eminent persons of the Greek speaking world. Dedication was part of the politics of patronage. On the part of the writer this politics aimed at legitimating his work and his ideas expressed through it. The most important element of this practice, however, was the promotion of specific social values: the cultivation of literature and the arts, of virtue and piety, as well as the dissemination of political visions for the benefit of the nation.

A point to be stressed is that the scholars seemed equally interested in legitimating the content of their own work and in a more general social programme within which their work would find its place.

The readership for these scientific works became progressively more diversified. In the middle of the eighteenth century, scholars like Nikiforos Theotokis and Evgenios Voulgaris were writing for specific cultivated audiences. Their books published in the decade of 1760 addressed their readers as «friends of the sciences». Towards the end of the eighteenth century, however, the authors started addressing their readers in a more general way, without attributing specific qualities to them. The phrases «to the Greeks» or «Philhellenes» also appeared at this time. The word «Greek» together with a reference to «nation» still retained the meaning of «learner of (ancient) Greek» or «educated person» as it had in the middle of the century; a widening of the meaning, however, was now taking place; the word acquired cultural connotations related to the collective consciousness of the Greek speaking Orthodox Christians of the Balkans. This widening brought about changes in the idea of science, its role, and its cultivation. «To the reader» was a common address in the prefaces of scientific books of the time suggesting that expectation of the «uprising of the nation» could also be helped through scientific education. Such an address implied the idea of education as a key element in the concept of *citizen.* In this situation, the «development» of science meant its spread to as many people as possible: Though not everybody was capable of practising science —since that was a matter of specialization— everyone did have the potential to acquire scientific knowledge for the enlightenment and happiness of the nation. At the beginning of the nineteenth century, when the question was raised as to who would have the authority to decide about the soundness of the different scientific conclusions, Greek scholars gave an answer characteristic of the way they had perceived the ideas of the scientific revolution: While in the West the newer scientific discourse was already formulated as a network of regulatory principles handled by a structured scientific community, the Greek scholars considered the general literate public to be a legitimate judge of scientific knowledge. The «*principles* of science» were considered to be sufficient knowledge for anyone to take part on an equal basis in a discussion with the natural philosophers in the west, since exploration of natural issues demanded nothing more than good reasoning and common sense.

The ambivalent attitude towards the Enlightenment after the French Revolution was registered in the various schools of the Greek speaking areas of the Ottoman Empire. One example was the school at Kydonies in Asia Minor. The man who played an important role there was Veniamin Lesvios (1762-1824), who studied Mathematics and Physics at Pisa and Paris during 1789-99. In Paris, Lesvios met Adamantios Korais (1748 - 1833) —the «theoretician» *par excellence* of the Greek Enlightenment— and was deeply influenced by his views. Lesvios proceeded to a

number of reforms and during his directorship (1802/3-1812), the school acquired the reputation of the best school for science. There, Lesvios taught the new Physics and —something quite unique— the heliocentric system *per se*; he also taught Philosophy and Mathematics. However, during his years at Kydonies, Lesvios was accused of introducing dangerous innovations through his scientific teaching, and rejecting divine incarnation. He was, thus, forced to defend his own religious orthodoxy to the Patriarchate, though he was not asked to deny his scientific beliefs. Living, however, in a period in which the Ecumenical Patriarchate had officially expressed its opposition to the new ideas of natural philosophy —because of their ideological and political implications— he did not succeed in defending the orthodoxy of his beliefs, and he was condemned by the Holy Synod. In 1819, he left Kydonies and went to the Peloponese, to take part in the uprisings of the Greek Revolution.

Before proceeding with the examination of Lesvios' physical philosophy, we should note the emergence of a distinct anti-European trend in the early years of the 19th century. Athanassios Parios was the most characteristic representative of this trend. Parios had spend some years at Mount Athos and had then become a teacher of Greek. He taught at the school of Chios, an island near the coast of Asia Minor, in the same years that Veniamin Lesvios was teaching at the school of Kydonies. Because of his extreme conservatism, many scholars of that period attacked him and students gradually started to abandon the school, moving to the school of Kydonies. Parios had some general knowledge of physics which he had acquired from the classical treatises and the commentaries on Aristotle's physics. He was the writer of a polemical book called *Response* published in Trieste in 1802. The full title of this work speaks for itself «Response to the frenetic zeal of the philosophers who come from Europe; exposing the vanity and folly of their lamentable efforts exerted upon our Race and teaching which is the real and true philosophy. To which is added a salutary admonition to those who recklessly send their sons to Europe on business». The Christian, declared Parios, should not examine the secrets of the creation of the material world, because in this way we are able to reach only hypotheses and not proven conclusions. For that reason the mathematical sciences are the source of godlessness because they create an illusion of certitude.

Let us now discuss the work of Lesvios and especially his *Πανταχηκίνητον* (The All-Mover). This «theory» is a paradigmatic case in support of our main contention. It is a work whose structure and argumentation is incommensurate with the dominant scientific problematic of the period and, at the same time, a characteristic example of an attempt to form an alternative scientific discourse. It was never published but was systematically taught; Lesvios' manuscript, in which he developed the theory and discussed physics and astronomy, dates from a few years before 1800.

Lesvios had serious objections to the validity of Newton's first law. He could not accept that bodies, left to themselves, would continue to preserve their kinetic identity. He maintained that the motion of bodies left to themselves would run down. In other words, he disagreed with what had been accepted as the constitutive aspect of the new physics: The principle that force is necessary *to change the direction* of motion. For Lesvios, it was the initiation of motion that required force. He went on to explain the revolution of the planets through the assertion of an effluvium (*Πανταχηκίνητον*) which is emitted from and absorbed into the bodies in proportion to their mass. From this schema it followed that the body with the largest mass (the sun) must be at the centre. The equilibrium of forces as a result of absorbed and emitted effluvia maintains the stability of the distance of the planets from the sun, the rotation of the sun on its axis guarantees the revolution of the planets around the sun, and the difference in intensity between the effluvium of the sun and that of a planet, when these «meet» and create a kind of vortex near the planet, gives the latter a rotation on its axis.

Newton's first law was not merely a synthesis of the various issues related to inertia. Equally important, it formed part the context of consensus about the ways the new physics would be practised. The first law dictates the study of the changes in the direction of motion and precludes the search for the causes of motion. Even if at the beginning of the 18th century natural philosophers did not all agree on the range and the character of the legitimate questions to be asked within the framework of the new physics, by the time Lesvios was formulating these ideas there was no doubt about the kind of questions natural philosophers were allowed to ask. Lesvios' problematic and his methodology made up a program for understanding the metaphysical foundations of physics; in this respect, Lesvios' agenda was much closer to the programs of Leibniz and Kant. Certainly his difficulties in accepting action-at-a-distance were quite decisive in formulating his theory of *Πανταχηκίνητον*. But he must have been also influenced by the generally favourable climate in Europe concerning the heuristic value of the imponderable fluids. But even if we grant that Lesvios' belief in these fluids may not have been undermined by the developments in chemistry and the recent explanation of oxidation, the way he developed his theoretical schema was qualitative, and aimed at explaining what was already known and observed; nowhere did he indicate the possibility of either a new phenomenon to be associated with his schema or a quantitative prediction which could be measured.

Lesvios had been educated in Europe and in his writings we witness a quite systematic knowledge of what the state of science was. How are we to understand what he was attempting to do? How can we understand the rejection of Newton's laws and his theory of gravitation and, at the same time, the adoption of the heliocentric system? What should we make of his preference of demonstrations rather than of

experiments? And how are these to be contextualized when we know that he was one of the ablest teachers, by no means a charlatan with this idiosyncratic universal theory?

Lesvios attempted to articulate a form of discourse with the following characteristics. Based on metatheoretical elements of the dominant schemata in physics (the imponderable fluids and/or heliocentrism) and on a still unanswered difficulty about Newton's theory of gravitation (action at a distance) he proceeded to the formulation of a philosophical system where the foundational principles would lead to the explanation of as many phenomena as possible. Thus it is *not* strange that he rejects Newton and adopts heliocentrism. It is, also, *not* strange that he, and especially his student Kairis, extend his theory to include human feelings as well —in fact, such a theory must be able to be extended in such a direction. Lesvios developed his theory of *Πανταχηκίνητον* within a framework of what *he considered* as physics and astronomy and not as part of his metaphysics. In other words, Lesvios' physics is neither a popular or didactic presentation nor a piece whose purpose is to inform about the developments in the west. Viewed as an alternative theory *within* the framework of the scientific discourse as formed in the west, Lesvios' agenda has no legitimation whatsoever. But if it is seen as an attempt to propose an *alternative to* the (western) scientific discourse — a philosophical rather than a scientific discourse — then his whole program appears considerably less idiosyncratic.

Lesvios' work is a typical case of *appropriation* of the new scientific ideas into the cultural milieu of the Greek speaking regions. His work cannot be interpreted if the dominant methodological tool and historical category we use is that of *transmission*. It is, no doubt, the case that many ideas had been introduced into the Greek speaking regions by ways which can be perfectly well understood through the use of the concept of transmission. These are the easy and straightforward cases. However, the effectiveness of a methodological tool is measured by the possibilities it provides for the understanding of what appears to be exceptional — in this case, what appears to be a capricious, superficial and «less than scientific» theory by a well educated scholar. Thus, during this period a number of issues were reformulated in order to be appropriated within a context determined by a number of philosophical needs, ideological outlooks, and political imperatives. The appropriation of the new scientific ideas called for the formation of the necessary discourse which appeared to reflect the *network of constraining localities*.

During the time that Veniamin Lesvios was teaching at Kydonies, another eminent scholar was the director of one of the most famous schools in the Greek speaking regions. This was Constantinos Koumas, director of the Philological Gymnasium of Smyrna in the western coast of Asia Minor. As director, he was responsible for the teaching of scientific courses. The Philological Gymnasium of Smyrna was one of the most important educational centres of the Greek speaking regions in the

last period of the Ottoman Empire; thus, it is interesting to see how the role of sciences in the social context of the time was reflected in the curriculum of the school.

Constantinos Koumas was born in 1777 and was one of the Greek scholars who practised teaching as a profession and not as a part of their religious vocation. He was very interested in mathematics from his early years. After a short period of teaching, he went to Vienna, in 1804, where he completed his studies and published various scientific works. Koumas had a doctorate in Philosophy and Fine Arts at the University of Leipzig and was a member of the Royal Academies of Berlin and Munich. In 1809 he was invited to Smyrna to take over the Philological Gymnasium; he remained there up to 1814, and then went to Constantinople to take over the directorship of the Patriarchal Academy.

Under his directorship, the school in Smyrna became famous, especially because of his methods of teaching the physical sciences: the «mysterious instruments» used in classes attracted a great number of wealthy Greeks, who sent their children to study at the Philological Gymnasium of Smyrna, while the Evangelic School, another important school in Smyrna with theological orientation, gradually declined. Nevertheless, in the Philological Gymnasium itself, a current of opposition to the introduction of scientific ideas and the secular orientation of the curriculum gathered momentum, especially after Koumas' departure. The scholars who advocated the conservative policy of the Patriarchate reacted to the liberal policy of the merchants, who continued to support the introduction of the innovative ideas in the intellectual life of the Greek speaking populations. As a result, in 1819, during a major political disturbance in Smyrna, a violent crowd set fire to the Philological Gymnasium.

The teaching of the sciences remained the main axis of the curriculum at the Philological Gymnasium of Smyrna. A key argument for the introduction of scientific courses was the need for scientific knowledge to return to its birthplace. Koumas in his translation of Pierre August Adet's *Chemistry*, in 1808, defined chemistry so broadly, and made such an *ad hoc* interpretation of Aristotle's texts, that he was able to conclude that the ancient Greeks were the real initiators of current chemistry. For Koumas, in fact, it was impossible for ancient Greeks, who had developed every other science and art, not to have developed chemistry as well.

In 1812, Koumas published *A Synopsis of Physics* in which he also developed his educational program: «According to the ancients, Philosophy was divided into three parts, Logic, Ethics, Physics. Every kind of science and art is reduced to these three genres of Philosophy. Whoever intends to lead a good life in society should not ignore any of these parts». In defining Physics, however, he was more interested in the development of a visual teaching method than in teaching a method for scientific research. Physics was the science «that teaches us about the phenomena,

as well as the reasons or forces which cause them». Though experiment and observation were considered as the key methods of research, the whole concept was closer to an Aristotelian qualitative interpretation of the phenomena than to the quantitative study of nature and the derivation of mathematically formulated conclusions. It should be pointed out that the school in Smyrna acquired its fame — among other things— because of the physical and chemical demonstrations that were conducted by Koumas, who also supplied the school with maps and globes. But these were not experiments related to any kind of original scientific research; they were rather repetitions of the demonstrations of phenomena, which had already been studied by the natural philosophers in the west. Thus, though Koumas stressed the usefulness of experimental research, in his pedagogical practice the separation of experimentation from mathematics, and from the quantitative evaluation of its results, dissociated it from its specific heuristic role within the scientific discourse developed in Europe.

At the time that Koumas published *A Synopsis of Physics,* Constantinos Vardalachos, another important scholar, published his *Experimental Physics.* This work consisted of a collection of his analytic notes for the courses he had been teaching in the sciences at the Academy of Bucharest. Vardalachos makes a distinction between mathematical physics, «which is proven by geometry and calculation» and experimental physics «which is proven by the phenomena [i.e. observations]» —justifying, in a way, the elimination of mathematics from his teachings. In the beginning of the nineteenth century, even though the introduction of physics in the curricula of the modern Greek schools was considered one of the main intellectual innovations, the almost exclusive use of qualitative interpretations allowed it to be kept within an aristotelian context. The notion of experiment and observation was unrelated to the way experiments were being conducted by the scientific community in the West during the same period. For Greek scholars, experiments were demonstrations intended to motivate students and to convince them of the validity of the qualitative interpretations concerning the origins of various phenomena. The use of experiment for the discovery of new phenomena and/or for the quantitative survey of the natural world, as was the case with the western natural philosophy, was outside their scope.

FINAL COMMENTS

Let us summarize some of the salient aspects of these developments.

It appears that a standard approach, with the emphasis on understanding the formation and function of social institutions such as patronage and the academies, is inadequate in the case of the Greek speaking populations during the 17^{th} and, especially, the 18^{th} century. We want to understand the ways the new scientific

ideas were introduced and established in a region which was part of the Ottoman Empire. The jurisdiction of the Church over educational matters, its initiatives for sending scholars to Europe to be educated and the kind of dynamics created as the intended and, most interestingly, the unintended result of their scholarly work — whether by writing books or teaching — all need to be assessed within the overall particularities of the Greek case. A number of complicated issues will also have to be taken into consideration. The ambivalence of the Church towards the shifting philosophical allegiances and the ideological orientations of the scholars; the relations of the Church with the Ottoman administration; the relations between the ecumenical Patriarchate of Constantinople and the other (autonomous) Patriarchates each facing different problems of their own (e.g. the Moscow Patriarchate and the initiatives for modernization by the new ruling classes of the 18th century); the relations of the Orthodox Church with the Holy See and the Protestant world; the interests of the prominent and rich laymen at Constantinople, often in conflict with those elsewhere in the Balkans.

It was accepted by all that the Patriarchate had absolute responsibility in formulating the long term educational policies and articulating the ideological agenda for a synthesis between hellenism and Orthodoxy. This did not mean that the ensuing developments went smoothly as implementations of the original programmatic directions. There appeared many different trends, each claiming ideological or political leadership of this process aimed at preserving religious identity and inspiring national consciousness. These trends were at times in conflict with each other and at times complementary. Scholars following the scholastic aristotelian tradition coexisted with neo-aristotelians. Scholars adopting the ideas of the Enlightenment came into conflict with those who viewed these ideas as undermining the conditions for religious and ideological survival. The introduction of the sciences and their subsequent teaching necessarily reflected a confluence of all these trends. The glorious developments of the new sciences in western Europe became an interesting but expected corroboration of the programmatic declarations of Aristotle. Social groups who found confidence in the ideas coming from Europe for their political future, turned against the ideas of the Enlightenment after the French Revolution. Issues related to national consciousness of the Hellenic population became separable from issues related to theological questions; religious humanism could no longer contain the antagonisms. The Patriarchate reflected and conditioned these changes. Progressively it became less receptive to ideas and policies that it had welcomed about two centuries earlier. But there again, it had mostly achieved what it had set out to do.

One of the difficulties in trying to analyse the newly emerging community of scholars in the Greek-speaking regions has to do with the relative lack of consensus among the scholars as to the *constitutive discourse* of the community. The study of

the emergence of the scientific community in the various countries of Western Europe deals with the ways a group of people managed to reach a *consensus* as to the discourse they were to use in discussing, disputing, agreeing and communicating their results in the new field. In the Greek speaking regions, from the first decades of the eighteenth century until well into the nineteenth century, the discourse that the scholars developed was substantially different from that of their colleagues in Western Europe. The (expected) social role of the scholars and their ideological prerogatives legitimated a discourse which was predominantly philosophical. Furthermore, there appear to be additional reasons for the emergence of such a discourse. Firstly, there were neither internal nor external factors to precipitate a crisis with aristotelianism and, therefore, no need to reformulate, let alone initiate, a break with aristotelianism. Secondly, the dominant mode the scholars wished to establish was a kind of logic with had strong ethical implications related to the rules of correct argumentation. Thirdly, although these scholars appeared quite sympathetic to experiments, what they considered to be experiments was hardly different from demonstrations. The emphasis, usually indirect but often explicit, was about the use of the new material for (re)shaping philosophical arguments. Most importantly, there was a lack of emphasis concerning the crucial relation between theory and experiment. It is quite remarkable that in almost all the books where there is mention of experiments the emphasis is on observation and (qualitative) results, rather than on the process of measurement and dealing with numbers. In more than one place one finds passages to the effect that "rational thought is not less effective than experimental results".

The introduction of the new scientific ideas in the Greek speaking societies was a process almost exclusively directed to their appropriation for educational purposes. The apparent aim was to modernize the school curricula, but this did not mean a neutral attitude as to the possible ideological uses of these new ideas —especially the need to establish contact with the heritage of ancient Greece. The appropriation of the new scientific ideas necessarily involves a remade discourse which reflects the *network of local constraints.* As we have attempted to show, the appropriation of ideas refer to the ways devised to overcome cultural resistance and make the new ideas compatible with local intellectual traditions. Hence, understanding the *character of the resistance to the new scientific ideas* becomes of paramount importance. In the case of the Greek speaking regions the issue of resistance cannot be discussed independent of the character of the break with the ancient Greek thought. The ideological and political contingencies of Christian societies under Ottoman rule during the Enlightenment, together with the dominance of the Greek scholars in the Balkans, called for an emphasis not on the break with the ancient modes of thought, but rather, on *establishing* the continuity with ancient Greece. The Greek scholars saw the new developments in the sciences in Europe as evidence of the tri-

umph of the programmatic declarations of the ancient Greek thought with its emphasis on the supremacy of mathematics and rationality, rather than a break with the ancient mode of thinking and the legitimation of a new way of dealing with nature. The developments in the sciences were not viewed as an intricate process which among other things involved a break with Aristotle, but rather, as developments which came to verify the truth of the pronouncements of the ancients. In addition, there were differences resulting from the respective overall social functions of the scholars in the centre and the periphery. But the development of such a discourse was also suitable for supporting the overall political agenda. The problem under consideration here was the introduction of the new scientific ideas to a national community which was under occupation and which had no national state institutions of its own. This is a very unusual situation: in the absence of national state institutions, the community lacked the conditions which would allow the effectiveness of the educational system and of the training of students in these sciences to be socially assessed. Lacking such a corroborative framework where the usefulness of these sciences would be under continuous vigilance, ideological and, in fact, philosophical considerations became the dominant preoccupation of the scholars. Hence, the embedding of all these new ideas within a philosophical context strongly at variance with that of the European scholars became an aim in itself; there was no other sense in which the new ideas could be legitimated.

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SELECTIVE BIBLIOGRAPHY

Argyropoulou Roxane D., "Traductions en Grec moderne d' ouvrages philosophiques (1760-1821)" *Revue des etudes sud-est Europeennes*, X, 1972, 363-372.

Cavarnos C., *Modern Greek Thought*, Belmont, Mass., 1969. The emphasis is on the philosophical ideas of the 17th and 18th centuries.

Batalden Stephen K., Catherine II's Greek Prelate. *Eugenios Voulgaris in Russia, 1771-1806*, East European Monographs, Boulder, NY, 1982.

Demos Raphael, "The Neo-Hellenic Enlightenment (1750-1821). A general Survey", *Journal of the History of Ideas* 19, 1958, 523-541.

Dimaras C. Th. *La Grece au temps des Lumieres,* Geneve, Librairie Droz, 1969.

Henderson G.P. "Greek Philosophy from 1600 to 1850", *The Philosophical Quarterly* 5, 1955, 157-165.

Henderson G.P., *The Revival of Greek Thought 1620-1830*, State University of New York Press, Albany, 1970.

Herig Gunnar, *Okumenisches Patriarchat und europaische Politik 1620-1638*, Franz Steiner Verlag, Wiesbaden, 1968.

Kitromilides, P.M., *Enlightenment, Nationalism, Orthodoxy: Studies in the culture and political thought of south-eastern Europe,* Variorum, Aldershot, 1994.

Pallis A.A., *The Phanariots. A Greek Aristocracy under Turkish Rule*, London 1951.

Papaderos Al., *Metakenosis. Das kulturelle Zentralproblem des neuen Griechenlands bei Korais und Oikonomos*, Mainz 1962.

Tsourkas Cl., *Les debuts de l'enseignement philosophique et la libre pensee dans les Balkans. La vie et l'oeuvre de Theophile Corydalee (1570-1646)* 2nd ed. Thessaloniki, 1967.

Voumvlinopoulos G.E., *Bibliographie Critique de la Philosophie Grecque depuis la chute de Constantinople a nos jours 1453-1953*, Athens, 1966.

BIBLIOGRAPHY IN GREEK

Αγγέλου Α., *Πλάτωνος Τύχαι (Η λόγια παράδοση στην Τουρκοκρατία)* [Wanderings of Plato. The scholarly tradition during the Ottoman occupation], Αθήνα 1963.

Αγγέλου Α., "Το χρονικό της Αθωνιάδας" [The chronicle of the school at Mount Athos], *Νέα Εστία*, Χριστούγεννα, Αθήνα 1963.

Αποστολόπουλος Δ. Γ., "Για την προϊστορία του Νεοελληνικού Διαφωτισμού. Στοιχεία Φυσιολογίας τον 17ο αιώνα στην Κωνσταντινούπολη" [About the prehistory of the Neohellenic Enlightenment. Elements of physiology in Constantinople during the 17th century], *Ο ερανιστής*, 11, 1974, 296-310.

Γαβρόγλου Κ., "Οι επιστήμες στον Νεοελληνικό Διαφωτισμό και προβλήματα ερμηνείας τους" [The sciences during the Neohellenic Enlightenment and problems in their interpretation], *Νεύσις*, 3, 1995, 75-86.

Γεδεών Μ., *Η πνευματική κίνηση του Γένους κατά τον ιη' και ιθ' αιώνα* [The intellectual activities of the nation during the 18th and 19th centuries], editors A. Αγγέλου - Φ. Ηλιού, Ερμής, Αθήνα, 1976.

Γεδεών Μ., *Χρονικά της Πατριαρχικής Ακαδημίας* [The chronicle of the Patriarchal Academy], Constantinople 1883.

Γριτσόπουλος Τ. Α., Πατριαρχική Μεγάλη του Γένους Σχολή, [The Patriarchal Academy], 2 volumes, Αθήνα 1966.

Δημαράς Κ.Θ., *Νεοελληνικός Διαφωτισμός* [The Neohellenic Enlightenment], Ερμής, Αθήνα 1989.

Καράς Γ., *Φυσικές και θετικές επιστήμες στον ελληνικό 18ο αιώνα* [The physical and positive sciences during the Greek 18th century], Gutenberg, 1977.

Κονδύλης Π., *Ο Νεοελληνικός Διαφωτισμός - Οι φιλοσοφικές Ιδέες* [The Neohellenic Enlightenment –the philosophical ideas], Θεμέλιο, Αθήνα 1988.

Κριμπάς, Κ., "Ο Δαρβινισμός στην Ελλάδα. Τα πρώτα βήματα" [Darwinism in Greece. The first steps] , in *Θραύσματα Κατόπτρου*, Θεμέλιο, Αθήνα 1993, pp. 81-108.

Μπενάκης Λ., "Από την ιστορία του μεταβυζαντινού αριστοτελισμού στον Ελληνικό χώρο. Αμφισβήτηση και υπεράσπιση του φιλοσόφου στον 18ο αι. Νικόλαος Ζερζούλης-Δωρόθεος Λέσβιος", [From the history of the post-byzantine aristotelianism in the Greek region. Doubting and defending the philosopher in the 18th century. Nikolaos Zerzoulis –Dorotheos Lesvios], *Φιλοσοφία*, 7, 1977, 416-454.

Νικολαΐδης Ε., Διαλέτης Δ., Αθανασιάδης Η., "Τυπολογία των βιβλίων των θετικών και φυσικών επιστημών του προεπαναστατικού αιώνα (1750-1821)" [Typology of the books of

physical and positive sciences during 1750-1821], *Τετράδια Εργασίας*, 8, Κέντρο Νεοελληνικών Ερευνών, Αθήνα 1986.

Παπαδόπουλος Θανάσης, *Η νεοελληνική φιλοσοφία από τον 16ο έως τον 18ο αιώνα* [The Neohellenic philosophy from the 16th to the 18th century], Ι. Ζαχαρόπουλος, Αθήνα 1988.

Παπανούτσος Ε.Π., (editor) *Νεοελληνική Φιλοσοφία* [Neohellenic philosophy], Βασική Βιβλιοθήκη, Αθήνα, 2 volumes 1953, 1957.

Παρανίκας Ματθαίος, *Σχεδίασμα περί της εν τω ελληνικώ έθνει καταστάσεως των γραμμάτων από της αλώσεως της Κωνσταντινουπόλεως μέχρι της ενεστώσης εκαντοετηρίδος* [Outline of the situation concerning the state of letters from the fall of Constantinople to the present century], Constantinople 1867.

Σάθας Κ., *Νεοελληνική Φιλολογία. Βιογραφίαι των εν τοις γράμμασι διαλαμψάντων Ελλήνων ...(1453-1821)* [Neohellenic literature. Biographies of Greeks who have excelled in the letters 1453-1821], Αθήνα 1868.

Στεφανίδης Μ., *Αι φυσικαί επιστήμαι εν Ελλάδι προ της Επαναστάσεως. Η εκπαιδευτική επανάστασις* [The physical sciences in Greece before the revolution. The educational revolution], Αθήναι 1926.