The Spread of "Chymia" and Lavoisier's Views in the Greek Speaking Regions

Efthymios P. Bokaris; Vangelis Koutalis*

Introduction

The purpose of this paper is to report a study of the spread of new scientific ideas, especially on chemical issues, in the Greek speaking regions of the Ottoman Empire during the seventeenth and eighteenth centuries. It is of great historiographical and educational interest to examine the transmission of scientific knowledge from the "center" to the countries at the "periphery" in Europe.

The way in which the dialectic of new chemical ideas was accepted in the Greek intellectual milieu, in order to formulate a discourse on chemical philosophy, is being researched through the textbooks of the representative scholars participating in the didactic traditions shaped in Greek speaking regions.

Certain modern historians of science have investigated the spread of scientific theories from the center to the periphery of Europe and they have designated education as the main characteristic of Greek intellectual life in the 18th century.[1] Also the writing or the translation of textbooks was oriented to this aim. However, most of them, influenced to a different degree from the sociology of knowledge, treat the multidimensionality of the process in a such a way as to be focused on the "specificity" and the "priority" of the local communities. On the contrary, we try to comprehend the spread of new scientific approaches in a dynamic interactive process between periphery and center, considering the "integrating and unifying power of the Scientific Revolution and its Enlightenment underpinnings taken as a whole".[2] For this reason, we adopt Althusser's thinking according to which the social whole it should be investigated further under the approach of the theory of the complexity of social totality, where elements and levels have an indicator of effectiveness.[3, 4] Finally, we try to investigate the claim of Bensaude-Vincent that the Greek scholars :"selectively picked what was of use for their local purposes"[5] also, we try to investigate if in these textbooks, beyond social, pedagogical and cultural purposes for which they were written, there exist

* Department of Chemistry, University of Ioannina, Ioannina 45100, Greece. *ebokaris@cc.uoi.gr*

also and elements of dialectic rationality that would be possible to constitute a unified corpus of theoretical practice, a philosophize practice of science or a more 'theoretical scientific practice', a 'scientific-theoretical production'. That is to say, why certain scientific theories are preferred in relation to some others or if it can exist any productive compatibility between rival theories, since Europe was in a process of an ongoing evolution of scientific reason. In Europe, as far as chemistry is concerned, there already exists a fluidity of rival theories as BensaudeVincent reports: "the echoes of the chemical revolution in Italian, Spanish and Portuguese textbooks convey the view that Lavoisier's chemistry was perceived as a paradigm shift only by a minority of chemists whereas many chemical communities in Europe rather described and spread it is a partial change that did not affect wholesale".[6] For the above mentioned reasons, the investigation of the constitution of chemistry, as well as the situation of its prescience state, are proved a very fertile field.

It must also be noted that the great majority of the reading material and textbooks concerning the acceptance of chemistry in Greek speaking regions has not as yet been studied exhaustively and this remains a fruitful area for the research which is in progress. The results presented here are the preliminary findings.

The didactic tradition of "Chymia" in the Greek-speaking communities before the coming of Lavoisier

The evolution of knowledge about "*chymia*" emerged in the Greek-speaking regions before the onset of dissemination of Lavoisier's work in these areas, and two different didactic traditions were formed. One was the "*system of chymists*" and the other the *Newtonian tradition*.

In the first half of the eighteenth century in the Greek-speaking communities the first didactic tradition, to be discussed here is the *"system of chymists",*[7] a systematic field, alternative to that of Neo-Aristotelianism, which was emphasising the significance of "*principle*". This didactic tradition was associated with the theory of the five "*chymical principles*" was shaped through the work of Anthrakitis, Damodos and Kavalliotis. This was presented in three handwritten epitomes of natural philosophy, which has only recently come to light. Namely, in the *Philosophical Note Book* of Anthrakitis[8, 9] in the *Physiology of* Vikentios Damodos[10, 11] and in the *Natural Treatise of* Theodoros Kavalliotis [12, 13, 14]. In these three epitomes, regarded as "*chymical principles*" were the following five "*chymical elements*": "*mercury*" ("*ermis*" or "*spirit*"), "*sulphur"* or "*divine*", "*salt*", "*flegma*" or "*water*", and "*earth*" ("*earth tamed*" or "*dead head*" or "*spondos*"(offering).[8, 15, 16] The first three principles were defined as "energetic" or "particular" and the other two as "passive" or "material". Their existence was obtained through experience, which was through the mediation of the senses. "Subject", moreover, of the "chymical art" is *«η ανάλυσις του φυσικού σώ ματος, εις τα αυτού μέρη αισθητώς ανόμοια από το ίδιον αναλελυμένον σώμα»* (the analysis of the natural body into its parts which are observably unlike the body being analysed).[17]

This tradition, named "*the system of chymists*", was close to the Boylean-Cartesian tradition and contrary to Aristotelianism. It accepted, the five "*chymical*" principles and also the analytical ideal, but the crucial issue for this tradition remained the "*mechanical*" principles, which were considered as the "*thinnest molecules*" in the theory of Descartes, were under the influence of the metaphysical nature of the Aristotelian principles. These were: the matter, the species, and the impenetrability. Thus, "*chymia*" was regarded as a particular "*system*", as a distinguishable field of representation of "*elements*", which, however, came under the metaphysics of principles. That is to say, that, even though it is implied, a rupture did not take place with the Neo-Aristotelian tradition (See Voulgaris' case).

A second didactic tradition presented itself some decades later in the framework of Zerzoulis, Voulgaris, Theotokis, and Psalidas. They emphasised a distinct Newtonian orientation, but a relation of continuity or rupture between this tradition and the one previously discussed did not seem to exist. In Theotokis' "Stoicheia Physics" (*Elements of Physics)*,[18] only the *atoms* were defined as "*principles* "and "*elements*". No particular chemical principles were considered to exist other than '*chymical'* processes, which were afforded by physics.

A particular case of the second didactic tradition is seen in the work of Eugenios Voulgaris.[19, 20] He appeared however, to attempt to combine the previous tradition, in which the Boylean-Cartesian characteristics were predominant, in agreement with the Neo-Aristotelian tradition, and the Newtonian thinking, especially in the case of *mixt*, which was under the influence of attractive or repulsive forces of its constituent's parts.

After the publication of Lavoisier's work, Traité Elémentaire

After the publication of Lavoisier's work, *Traité Elémentaire*, was formed the Newtonian chymistry of Psalidas and the chemical texts of Fourcroy, Brisson and

Adet were translated into Greek. At this point, it should be noted that the classical work of Lavoisier, *Traite Elementaire* has never been translated into Greek.

a) The Newtonian chymistry of Psalidas

Athanasios Psalidas (1767-1829), was a major Greek-speaking representative of Enlightenment. The first introduction of modern chemistry established by Lavoisier and his co-workers was presented to Greek speaking regions, by Athanasios Psalidas under the dominance of "*Newtonian dream*". His textbook "*Peri Physikis en Geni* ("*On Physics in General*") was published in 1795, it was an instructional book.[21] Psalidas tried to understand the systematisation of chemistry based on the model of the naturalists' classification. He distinguished Nature in plant, animal and mineral. For his aim expounds certain cardinal themes of Lavoisier's problematics, i.e. the "*oxigène*" theory, and the theory of combustion. In regard, however, of what we now designate as a chemical bond, Psalidas was under the influence of the "*Newtonian dream*" for a unified exact science for chemical and physical phenomena. He maintained a discursive stance in keeping "*chemical attractions*"-"*chemical affinities*" as problematic.[22] Psalidas also introduced the mathematical atomism of Boscovich, according to which the elementary texture of matter could be causally explained within this complex architecture of mathematical "*punkta*".

Psalidas' observations on the "generic principles" and on chemical nomenclature are of great interest:

1. He overthrew the Aristotelian assertion of four elements and he proved that these elements are not *Simple* but *Complex*. The elements, according to Psalidas' classification, were divided in '*metaphysical*' and '*chemical*'. As '*chemical*' he defined those which were products of chemical analysis and '*metaphysical*' were those which are only mentally perceived. With regard to the constitution of elements from atoms he accepts the Boylean thinking.
2. He considered *'fire'* as a "simple element" while Lavoisier treats it as an elastic and weightless matter and he identified it, with the "matters" of heat and light.
3. Water is constituted from *ζωτικό* (zotiko) (oxygen), and phlogiston. *ζωτικό* emanates from the Greek word *ζωή* which means *life*. He also identified "phlogiston" with "hydrogen".

5. Although Psalidas considered phlogiston was identical to hydrogen, he did not accept the alchemical assertion that at the reduction of metals phlogiston was added to the metal calx. To the contrary, he claimed that *ζωτικό* (zotiko) (oxygen) was disengaged during the reduction because this appears to have lower affinity with the combustible body.
6. For acids, Psalidas maintained rather a qualitative definition, based however on questioning of Lavoisier's nomenclature; according to the degree of saturation of oxygen in acidifying substance he characterises acids as "*oxydata*" (rather oxides), "*incomplete acids*" and "*enteli*" (full) acids.
7. Lastly he distinguished salts in "*acids*", "*alkaline*" and "*middle*". Thus in the nomenclature of salts he does not follow the Lavoisier's theory and preferred to use the alchemic nomenclature, such as, the "*salt of Glauber*" etc.

While Psalidas accepted the significance of an element, according to Lavoisier's theory, and realised the role of oxygen in the combustion, he did not adopt the modern nomenclature of chemistry and the question of chemical affinity. Thus, he dealt more with the problem of "*mixing*", the "*solution*" and the "*dissolution*" as given emphatically in the chapters "*on the affinity of bodies*" and "*on analysis and precipitation of bodies*".[22]

b) The translation of Fourcroy's work: "Philosophie Chimique"

The first handbook of chemistry which was translated into Greek, in 1802, was the handbook "*Philosophy of Chemistry or fundamentals truths of modern chemistry (Philosophie chimique ou vérités fondamentales de la chimie moderne, disposées dans un nouvel ordre 1792"* by the French chemist, Antoine Fourcroy. The translator was the Theodosios Iliadis and the editor, Anthimos Gazis. The handbook was printed in Vienna. This work of Fourcroy's adopts the core of Lavoisier's questioning and meanings on the elements, oxygen and caloric, it was however reported that Lavoisier avoided dealing in the *Traite* with the chemical and elective chemical affinity. This handbook as Bensaude-Vincent reports:[23] "exemplifies the systematisation of chemistry on the model of naturalist's classifications" giving the opportunity to the translator, in his comments in the preface of the translation,[24] to focus on its empirical points, stressing the interpretation of concepts concerning the chemical affinity. More specifically, on the concepts of *affinity of cohesion*, *affinity of adhesion, affinity of synthesis, double elective affinity.*

c) The translation of the chemistry of Brisson and of Adet

In 1801, the eminent Greek enlightener, the monk Dimitrios-Daniel Filippidi (1755-1832), translated into Greek, the *Elements or Physicochemical Principles of* Brisson, and that of Adet: "Leçons Elémentaires de Chimie, a l' usage des Lycées" by the heading "*Chemistry Epitome*" from K. Koumas, in 1808. The former also translated the "Logic" of Condillac in 1801. Both of translators, in their comments in the prefaces of their translations focused on the chemical nomenclature. Examining their questioning is a fruitful way to get to the core of their thinking.

(i) The preface of Fillippidis in the handwritten translation of the instructive handbook, "Elements or Phisicochemical Principles" of Brisson, under the title "Origins, progress, top (acme) and decline of sciences in general, and partially of "χυμικη" (chymistry)"[25]

Here, *«χυμική» (chymistry)* was placed in the vanguard of *experimental philosophy*. He adopted and commented on the new chemical nomenclature that was established, on the new chemical truths, and it was shaped as a "*methodical language*", capable of removing each "*hypothesis*", each "*subject irrelevant to the chymical knowledge" …* "*where it should be spoken to all the sciences… to which it should write the philosophers"*.

Consequently, the chemical nomenclature constitutes a means for the establishment of a radically new teaching and at the same time shows the real possibility of total change in the basic education. On this subject Filippidis agreed with Lavoisier, who in the "*Thoughts for the public education",* in 1793, proposed an essential transformation for the instructive regime because it does not strengthen the "*basic human rights of people", "since it provides and repeats prejudices….*" and it must be replaced by another. One, where the dissemination of knowledge will codify the results of its "*natural*" production - via an experimentation that reconstructs the natural order – in such a way that not only ("*human cultivation is achieved*"), but also "*the gradual perfection of mental abilities of human kind is activated*". This proposal was inspired by the more general hope for the completion of political emancipation, for the establishment and stabilisation of Democracy, and it is combined with the aim of national education, which would attribute socially advantageous knowledge, providing, by means of "*large institutions*", a mechanism capable of ensuring "*the extension of economic exploitation for the industry*", and the nation with "*an increasing and permanent supremacy in all its commercial relations with neighbouring nations"*.[26]

(ii) Koumas comments in the preface of the translation of chemistry by Adet[27]

This book of Adet, which was used as a handbook of chemistry in the Lycée of France, was published in 1804 and was translated into Greek in 1808. In the preface of the translation, Koumas elaborated on the chemical affinity with a perception of ancient Greek admiration. Moreover Koumas adopted the Lavoisiers' chemical nomenclature but with rather more grammatical perception than a conceptual criticism. Characteristic of this are:

1. He called gases, bodies according to the new nomenclature. Thus, he called hydrogen, *hydrogen gas* and oxygen, *oxygen gas*. On the contrary, he disagreed with the term *azotic gas* because he considers that in Greek, *azotic* gas means, nothing. For this reason he names the base, *nitrogen* and gas, the name *πανσιζωο* (pafsizoo), which means that it stops life.

2. Koumas was also in opposition to Lavoisier for the name of oxygen. Lavoisier had named it *oxigine* (from οξύς, acidum and γίνομαι, gignor) and Fourcroy *oxigene*. Specifically he reports: "*The first is a caricature, because a Greek name oxigine never existed,….from which Lavoisier could have translated it into his language as oxygine· the term of Fourcroy also, if it is translated from oxygenes, has a contrary meaning to what it should have in the framework of the new theory of chemistry · oxygenes means this which is made by acids and not this from which acids are made"*. He supported that the correct name was "οξυγονο" as the word oxygen is called in Greek today. Koumas also calls oxygen as "*ζείδωρο*", a word from Homer word, which means gift of life.

Conclusions and questions

In accordance with these didactic traditions, especially on chemical issues, the present paper is focused on and endeavors to answer the following historiographical questions**:**

1. How was the knowledge transmitted to the Greek speaking regions?
2. What was the interaction of the new scientific ideas with the local scientific culture?
3. What were the continuities or ruptures of the chemical thought in the didactic traditions created by the Greek scholars in the process of shaping a new scientific discourse?
4. What were the scientific (rational), philosophical, social or cultural terms, which dominated this diffusion of new ideas?

5. Was there any rupture or discontinuity with the Aristotelian tradition?
6. Was there rupture or a discontinuity between the scientific traditions as far as they were shaped?

It must be mentioned here that in Greek-speaking regions under the Ottoman dominance there were no Universities, Institutes or Academies, but only primary and secondary schools.

Our conclusions to these questions are as follows:

1. The emergence of a new urban class, which claimed a Greek State, and its peculiar relationship with the Church, specifically the Fanariot elite, the Ottoman Empire, and the Aristotle philosophy, shaped the tendency of Greek scholars into forming a scientific discourse based on empiricism but not in adversity with the Aristotelianism and theology.
2. This is obvious for the didactic tradition of "*chymia*" of Vulgaris and that of Damodos-Anthrakitis–Kavalliotis which stressed the "*chymical*" principles as distinguishable from the Aristotelian elements, however, it accepted the mechanical principles which were influenced by the metaphysics of Aristotelian principles. Thus ruptures are not seen between the new scientific discourse and Aristotelianism but there were some enlightened points of objection to scholastic Aristotelianism adopted by the practice of theology.
3. The main goal of the Greek scholars seems to have been the efforts of shaping, through the mediation of the new scientific ideas, a discourse at a time when no organised research structures were present. Under the dialectics of scientific, social and philosophical terms lead to didactic traditions based on Nature and not on the transcendental and metaphysical frames of theology. To this end, it seems it was the adequate the support of empiricism, which ensured a rational operation of the issues and not a more advanced and theoretical attempt. These objectives were nevertheless objectives of an emerging class.
4. Thus, the Newtonian tradition, that is the chemical affinities dominated and continued as a main stream as has been traced in the work of Psalidas and in the comments in all the translations, such as those of A. Fourcroy and Adet.

At a philosophical level, the Greek scholars in the 18th century were attached to or had adopted the empirical philosophy, of Lock and Kant.[28] In this context they tried to achieve their polititical and scientifical purposes:

1. As it is traced in the works of Koumas and Filippidis they used the Lavoisiers' chemical nomenclature as a paradigmatic language for learning. They adopted the driving principle of the chemical language and rather than the questioning of its epistemological or conceptual requirements. It seems that the

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main goal of the Greek scholars was the creation of ideological mechanisms of education. Thus, the Filippidis' approach to chemistry, was based on his empiricist - philosophical considerations and emphasised the perfect structure of the chemical language, aiming, in general, to the adoption of a new learning language. In other words, he expressed, as it has been reported by Masere and Balibar, the necessity of the upgrading class for a "*cultural revolution"* reducing education to "*the main paper of the ideological superstructure seeking the reproduction of its hegemony*".[29] It was not accidental, that the narrations of Filippidis' mainly meet the educational proposal of Lavoisier. The comment on the use of language as a "*tool of learning*" by Filippidi in the preface of the translation of "Logic" of Condillac,[30] posed first time in Greece the most important of the question, not what dialect should be proposed as common national language, but what language can function as a "*tool of learning*" in an education free from the tyranny of scholasticism.

2. The compatibility of their political purposes with the scientific or educational purposes it is traced in the case of Filippidis,[31] in the context of his Lockean empiricism, where it seems possible the incorporation of Lavoisier's thinking in the speculation of chemical affinities.

Moreover the scholars seem not to be interested in the methodological shifts, another perception as the one that instigated Lavoisier emanating from Condillac, about the knowing subject and prompted him into theoretical constitution of modern chemistry.[32]

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