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INTRODUCING SCIENCES IN THE NEW STATES: THE ESTABLISHMENT OF THE PHYSICS AND CHEMISTRY LABORATORIES AT THE UNIVERSITY OF ATHENS.

The treasure was there.
It was hidden.
Keith Jarret, *Treasure Island.*

Introduction

Greece became an independent state in 1832, after a long period under the rule of the Ottoman Empire, which lasted over four centuries. Therefore it is interesting from the point of view of the history of science to trace the first steps of the introduction and development of sciences in a new state, in a country just liberated, as was Greece at that time, and to compare this procedure with the relevant situation in the other countries of South-Eastern Europe.

The present study gives the reader an idea about the status of scientific activities in an area which belonged to the European periphery but also served as a regional center for South-Eastern Europe during the second half of the 19th century. During that period, scientific activities also related to the institutionalization of science and the gradual vanishing of the "isolated scholar" scientist of the previous period[1]. Scholars of that type were responsible for the introduction of Physics and Chemistry in the wider Greek intellectual area, which covered most of the Balkans during the 18th and the first quarter of the 19th centuries. Due to a long-term research project carried out by the Institute for Neohellenic Research/National Hellenic Research Foundation, the dissemination and development of sciences such as Physics, Chemistry, Mathematics, Geography, Medicine etc. has already been studied

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[1] The dissemination of physics and chemistry in 18th century Greece is analyzed in: George N. Vlahakis, A note for the penetration of Newtonian scientific thought in Greece, *Nuncius*, 2/1993, pp. 645-656 ; George N. Vlahakis, "The appearance of a new science in 18th century Greece. The case of Chemistry", *Nuncius*,1/1995, pp. 33-50.

extensively for the period 1700-1821, a period known as "Neohellenic Enlightenment" or "Neohellenic Revival"[2].

The basic target of Greek scholars' efforts during the Neohellenic Revival was to defeat ignorance and superstition by disseminating the basic principles of science among as many people as possible, following a Baconian approach to the role that science should play as a component of society[3]. Greek Scholars were more interested in grasping the nature of science, in understanding its methods, and using already existing scientific products for "social purposes" than in producing new knowledge. For that reason, the production of original scientific theories was not one of the priorities of the Greek scientific community during the aforementioned period. It is this early attitude towards science that, even later and during more normal political periods of Greek history, governed the scientific activities in this part of Europe. As a result, during the 19th century pure scientific research never became one of the priorities of the governmental bodies in Greece, which financed relevant efforts in a rather hesitating way. In conclusion, it becomes obvious that during the Neohellenic Enlightenment (1700-1821) the lack of original scientific production was not due to the weakness of Greek scholars but, in some degree, was a conscious choice. Original knowledge was expected to be produced in a future stage, when a "scientific market" would be formed and the society would be mature enough to support the expenses of primary scientific research. A stage related directly, in a theoretical level at least, to the establishment of a University in the independent Greek State. It is unquestionable that, compared with the situation during the Ottoman occupation, the priorities and the needs for scientific development in the new state should not be only different but more urgent as well. Therefore, in an independent country a critical mass of well-trained scientists is unavoidable, if social, cultural and economical progress are seriously taken under consideration by the relevant authorities. But for those who know the Greek reality well enough, things almost never happen as they are supposed to do.

It would then be rather extraordinary if the scientific activity in Greece was an exception to this rule. The significant activity relating to Physics and Chemistry during the last decades before the War of Independence, which started in 1821, actually fell rapidly to nil after the foundation of the Greek state[4]. No

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[2] The period has been characterized as "Neohellenic Enlightenment", by one of the best 20th century historians of modern Greece K.Th. Dimaras. "Neohellenic Revival" is an expression coined by 19th century Greek scholars.

[3] This "Baconian" approach of the role of the sciences in the University has been prevailed throughout the period of the Neohellenic Revival. Prof. I. Karas has discussed the general climate of the scientific development in Greece in several studies, as: Iannis Karas, *Οι θετικές επιστήμες στον ελληνικό χώρο (15ος-19ος αι.)*, (The natural sciences in the Greek area (15th-19th century), Athens, Zaharopoulos, 1991, pp. 232-262.

[4] More than 170 scientific books had been published before 1821. This number falls logarithmically

attempt to promote the introduction of sciences in the Greek speaking regions of Southeastern Europe was undertaken any longer, not even the mere translations of European textbooks, as one can see from the bibliography regarding Greek 19th century books of Physics published after 1850.

I. The Institutions : the University of Athens

The University of Athens was established in 1837 by King Othon. Physics and mathematics from the very beginning were incorporated in the Faculty of Philosophy. Chemistry was only part of the Physics department. This organization of the academic fields, reflecting the hegemony of the philosophy over the other disciplines, lasted during the course of the 19th century. This may give us a clear idea about the delay of the academic reformations in Greece, given that such patterns had been abolished in European universities since mid or late 18th century[5]. The majority of the Greek University professors continued to believe that: "Philosophy [is the] first born daughter of the Hellenic intelligence, the science of the sciences, the main academic science", an expression coming from K.A. Venizelos (?-1862), professor of Chemistry at the University of Athens for a short period. Consequently, given that even professors of physical sciences viewed the disciplines they were engaged in to be subfields of philosophy, it was very difficult to claim for their organizational autonomy form the Faculty of Philosophy. As far as Chemistry is concerned, its incorporation into the Physics Department can probably be explained by the following reasons. The first one has to do with the fact that Chemistry was "younger" in the Greek area than Physics, which was considered an ancient Greek achievement because of the long lasted Aristotelian tradition, and therefore a "period of maturation" under the umbrella of Physics was necessary before chemistry would be an independent academic discipline. The second reason has to do with equilibrium among the professorships within the University. Stroumbos, the professor of Physics, was older and more powerful than the young Venizelos, professor of Chemistry.

Although this was the general climate, rather early the need to buy some scientific instruments became evident, if the University truly wanted to be considered an institution where experimental physics and chemistry could be taught in an significant degree.

The Head of the University for the year 1841-42, M.N. Kostis (1805-1861), professor of Medicine, will note in an address delivered before the Senate just

to zero when the War of Independence started. A detailed index of these books will be appeared soon in CNR/NHRF site in the Web.

5 George N. Vlahakis, "The Introduction of Classical Physics in Greece: The Role of the Italian Universities and Publications", *History of Universities*, 1998, pp. 157-180.

four years after the foundation of the University:

> "We provided also for the development of the other collections of the University, four hundred drachmas for the Chemical Laboratory. The same amount of money was provided for the Cabinet of Physics. Gentlemen, this cabinet is in good situation. The brilliant and luxurious instruments closed in the boxes, the electric machine and the air pump, both donations of a wealthy Greek, have been assembled and are ready for the experiments of Physics"[6].

Two things become obvious from the reference above. The first one is that the first instruments for the University were not bought by the State but they were donated by a wealthy Greek, and the second one that they were restricted only to an electric machine and to an air-pump. Let us note that donations were very common at that time. Once again, this gives the impression that during the 19th century science in Greece remained in the situation that characterized the status of scientific practices during the 18th century. Experiments were considered to be part of the teaching process, having only a demonstrational character. The students did not perform themselves any experiment.

Trying to find the reasons for that delay in the development of sciences, the professors of the University realized that one of the possible explanations was the incorporation of physics and chemistry in the Faculty of Philosophy.
During the year 1881-82 Panagiotis Kyriakos (1835-1900), Head for that year, commented :

> "The existing lack of several branches of physical sciences in our University syllabus obliges us to define more faculties for the satisfaction of many scientific and social needs in the future. The foundation of such faculties should not be considered a luxury for any reason because (...) we must develop also new opportunities for studies for the young people, in order to avoid unbecoming situations due to young people's preference to study only a few disciplines"[7].

The above words make clear that the autonomy of the faculty of Physics and Chemistry, which finally took place in 1904, was not only considered a factor for the development of these sciences but also a key action to prevent the majority of the students from following Law and Medicine Schools, while the Greek society of that time was not able to absorb all the graduates from these schools. That is a phenomenon which proves that the Greek governments did not define the number of the students in every school by taking into consideration the real needs of the society but that this decision was too often based on political criteria.

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[6] M.N. Κωστής, *Λόγος εκφωνηθείς τη 4η Οκτωβρίου 1842, Υπό του πρώην Πρυτάνεως Μ.Ν. Κωστή, παραδίδοντος εις τον διάδοχόν του την διεύθυνσιν του Οθωνείου Πανεπιστημείου*, (Address delivered on October 4, 1842, by the former Head M.N. Kostis handing over the direction of the University to his successor), Athens, 1842.

[7] Panagiotis Kyriakos, *Λόγος εκφωνηθείς υπό του πρώην Πρυτάνεως Π. Κυριακού, παραδίδοντος εις τον διάδοχόν του την διεύθυνσιν του Εθνικού Πανεπιστημίου* (Address delivered by Pan.

II. The individuals

During the period under examination, that is the 19th century, the first professor of physics was Dimitrios Stroumbos (1806-1890). He studied physical sciences at the University of Geneva and at the Ecole Polytechnique in France. He was appointed full professor in 1855[8].

Stroumbos was succeeded by Timoleon A. Argyropoulos (1847-1912). Argyropoulos had graduated from the University of Athens and studied physics for five years at the University of the Sorbonne (France). He became lecturer in 1884, assistant professor in 1855, and full professor in 1890[9].

As for Chemistry, the sole scientist who was responsible for the real introduction of that science in Greece, was Anastasios K. Christomanos (1841-1906). He was born in Vienna. He studied at Vienna Technical University (1858), at the Gessey University, at the University of Berlin, at the Technical University of Karlsruhe and at the University of Heidelberg. He became assistant of Bunsen during the research program of the latter on spectral analysis. He worked as a chemist in the paints factory "Milidinger". In 1862 he took the position of teacher of Physics in the Academy for teachers in Athens. He was appointed at the University of Athens as lecturer of general chemistry in 1863, assistant professor in 1866 and full professor in 1869. According to the historian of sciences Michael Stephanides[10], the Stockholm Academy proposed to Christomanos to submit candidacy for the Nobel Prize in Chemistry[11].

These three professors and their activity marked the standards for the physical sciences in the underdeveloped Greece of the 19th century.

We would like to deal with these central figures of the Greek University because in Greece, even in the few cases when there were institutions for the promotion of science, these institutions were qualified on the basis of the personal contribution of the individuals who were involved in their functioning. And it is not a matter of chance, if after the retirement of these individuals, the link breaks between the scientific institution and the scientific activity, and no long term scientific tradition can possibly be formed. The particular characteristic of the professors at the University of Athens, with the partial exception of Christomanos, was that though they had given promising signs for contributing seriously to the development of sciences they were involved in

Kyriakos handing over the direction of the University to his successor), Athens, 1883, p. 13.

8 Michail Stephanides, *Εθνικόν και Καποδιστριακόν Πανεπιστήμιον Αθηνών. Ιστορία της Φυσικομαθηματικής Σχολής, (National and Kapodistrian University of Athens. History of the Physics and Mathematics School)*, Athens, 1952, pp. 8-9.

9 *Ibid.*, pp. 19-20.

10 *Minutes of the Faculty of Philosophy*, 17th February 1906, p. 85. For the role of Michael Stephanides see: Panagiotis Michailaris, Towards the formation of the scientific personality of Michael Stephanidis, *Sciences in the Greek Area*, Athens, 1997 (in Greek).

11 *Ibid.* (see note 8), pp. 12-14.

during their postgraduate studies, after their return to Greece they contented themselves to the role of popularizers of science.

As was mentioned before, physical sciences at the University of Athens had been incorporated in the Faculty of Philosophy. A Faculty where, as I. Karas has stressed out, "the place of free thinking has been occupied by the devotion to the ancients". In this rather conservative climate arose a new effort to establish a new "enlightenment" movement during the 19th century, a movement having more or less the same principles of what was called "Neohellenic Revival" (1700-1821).

From the middle of 1860s onwards, new attempts for the development of knowledge provided by the University took place. The ideological framework for these efforts is described in an excellent Address delivered in 1897 by Anastasios Christomanos under the title "Physical Sciences and Progress". Its content, according to our opinion, is the manifest for a new intellectual crusade to liberate Greece from the status of a country belonging to the European Periphery. He wrote characteristically:

> "Our nation [is] under a process of revival. We revive (...) by devotedly keeping our traditions, through which we are connected with our beloved ancestors, on the one hand, and by competing with the leading nations of contemporary civilization and hoping to surpass them, on the other hand"[12].

This paragraph might be easily attributed to any of the Greek scholars of the Neohellenic Revival, such as Koumas, Theotokis, Korais etc. But, in our opinion, Christomanos was actually influenced by similar opinions expressed during the last three decades of the 19th century in Germany, where sciences and especially physics and chemistry were considered to be a decisive tool for the development of the German nation. Describing the development of Chemistry in Germany he wrote: " During the last two years in particular six huge chemical laboratories have been built in Germany, in the cities of Berlin, Bonn, Aachen, Leipzig, Munchen and lately in Vienna"[13]. Christomanos did not content himself with the theoretical approach of the scientific knowledge. He claimed that this knowledge should lead to the improvement of people's everyday life through the production of relevant industrial goods or its application in other fields like medicine.

Christomanos has often referred to the advantages of the recent inventions of his time, such as telephone and telegraph. He has even foreseen that "the improvement of light-telephone is a mater of time, when with great velocity and

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12 Christomanos, *Φυσικαί Επιστήμαι και Πρόοδος. Λόγος απαγγελθείς εν τω Εθνικώ Πανεπιστημίω τη 17η Δεκεμβρίου 1896 υπό Α.Κ. Χρηστομάνου, αναλαμβάνοντος την Πρυτανείαν του έτους 1896-97,* (Physical Sciences and Progress. Address delivered at the University of Athens on October 17, 1896 by A.K. Christomanos undertaking its direction), p. 4.

13 *Λόγος εκφωνηθείς τη 25η Οκτωβρίου 1870 ημέρα της επισήμου εγκαθιδρύσεως των νέων αρχών του Εθνικού Πανεπιστημίου υπό του πρώην Πρυτάνεως κ. Παύλου Καλλιγά,* (Address delivered on October 25, 1870 by the former Head Pavlos Kalligas), Athens, 1870, p. 171.

without distinction of time and space everybody may communicate with each other from any distance"[14]. He has also considered cinema and photography to be technologies useful for the sciences: " [things] that have never been seen by the best human eye, even through perfect glasses and telescopes, may be discovered by the photography (...)"[15]. This opinion was quite interesting. It was more than a simple reference to recent inventions for the amusement of the public as it informs us that (some) scientists understood very quickly the benefits they might gain from the use of such inventions in experimental sciences. It is also proved that Christomanos after his return to Greece continued to get adequate information on the improvements in chemistry as he described the recently discovered elements Helion and Argon and the recent progress within Aluminium metallurgy (which reduced the price of this valuable metal significantly) as well as Pasteur's discoveries[16]. Christomanos believed that all the above novelties and especially the practical use of electricity were the result of the proper exploitation of the principle of conservation of energy, a principle expressed in the mid-1840s[17]. In parallel, Christomanos gave the reader of his address a slight idea for the materialistic foundation of the physical reality: "The matter has existed, exists and will exist. Chemistry is the history of the matter's phases"[18].

The materialistic approach of the nature seems to be unconsciously incorporated into the Greek savants' interpretation schemes of the cosmos's laws, though most of them insisted on supporting that the universe was created and governed by God's will.

Christomanos chose to finish his text repeating with emphasis an other classic thesis of the Greek enlighteners of the period before the War for Independence.

> "Let us permit the best pupils to enter the Physics Department (...) in order to perfect themselves and to be used later as teachers of natural sciences. And when their work will produce results, when their mission for the reformation of the society will penetrate in every class, then, but only then, will we able to speak about national awakening and power"[19].

In that case too, we may argue that Christomanos had been influenced by the spirit of late 19th century German nationalism and its educational and scientific policies, as he had lived and studied in countries of German culture for many years. These thoughts did not remain just "words without meaning" for Christomanos. As soon as he undertook duties in the University, he started

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[14] *Ibid.* (see note 12), p. 11.
[15] *Ibid.*, p. 12.
[16] *Ibid.*, p. 14.
[17] For the influence that principle had in the further development of applied physics see: Peter M. Harman, *Energy, Force and Matter: The Conceptual Development of Nineteenth-Century Physics*, Cambridge University Press, 1982.
[18] *Ibid.* (see note 12), p. 27.
[19] *Ibid.*, p. 32.

working for the establishment of a fully equipped and well-organized chemical laboratory. Christomanos vision for a chemical laboratory is described with his own words as follows:

> "I judge needless to speak for a long time in favor of the moral usefulness of our chemical laboratory because it is obvious to everybody. Besides the fact that the chemical laboratory in our country, which is full of minerals, could be a nursery of the industrial applications, incalculable will be the usefulness from the practical training of medicine and pharmacy students".

Let us note that Xaverios Landerer (1809-1885)[20], the former professor of Chemistry from Athens University had in his possession a cabinet-like collection of a few instruments. When he retired, he requested a rather large amount of money from the authorities of the University to leave these instruments in the possession of the University. This behavior, unsuitable for a professor, provoked the anger of the Head of that time.

Christomanos' efforts may be put in parallel with the transfer in Greece of the European model for teaching and research in laboratories, equipped properly with precision instruments of new technology and run, apart from the full professor, by experts assistants who were responsible for the maintenance of the laboratory and the instruction of the students.

It is evident, that during this transfer process, which undoubtedly faced many difficulties, sometimes foreseen, sometimes unexpected, Christomanos influenced, with the positive meaning of the term, the professors of Physics at the University of Athens. He did so to a lesser degree to Dimitrios Stroumbos and much more to his successor Timoleon Argyropoulos. To reconstruct the various stages of this process, we based our opinion mainly on the information included in the minutes of the Senate's meetings, that is the only available sources for information about what was happening at the University during that period. These texts, though written in an elegant style and filtered from any actually thorny expressions because of their public character, give us many details, qualitative as well as quantitative.

During 1864-65 when the Head of the University was Prof. of Mineralogy, Heraklis Mitsopoulos (1816-1892), the Senate decided to give financial support of 4 500 and 2 500 drachmas (dr.) respectively for increasing the collections of chemical and physical apparati. These 7 000 dr. represented about 2/3 of the money which had been granted to the Faculty of Philosophy for buying items for the library and the scientific collections of the University. According to the prices of the time, this was a relatively significant amount of money if one thinks that the salary of a full professor with many years of service was about 400-450 dr. per month. Thanks to that money, An. Christomanos, who had been appointed meanwhile as professor of experimental chemistry, succeeding Alexandros Venizelos who died unexpectedly at a very young age, bought from the well-

20 *Ibid.* (see note 8), pp. 7-8.

known instrument maker G. Zenoir in Vienna about 3000 dr. worth of instruments and chemical materials. At the same time he restored the room of the chemical laboratory, and bought shelves and tables for the experiments which cost no less than 730 dr.

As for Physics, D. Stroumbos ordered instruments of 2 250 dr. value from Paris, while the other half of the original amount was devoted to the supply of instruments from Vienna "where [instruments] are constructed in lower price though not worse in quality than those made in Paris". These first efforts seemed to bring results, even though moderate. During the academic year 1867-68 twenty two students of Medicine and twelve from the School of Pharmacy were trained in the chemical laboratory. The Head of the University during that year Theodore Orphanides (1817-1886), Professor of Botany and poet himself, concluded the following:

> "(...) we have a chemical laboratory ; if it is enriched every year, it will soon be perfect and probably will not be constrained to remain in the area which it occupied in the main University building, and a nearby separate building will be necessary to be built"[21].

This proposal may give us a hint, that Christomanos had already, though unofficially, pressed the authorities of the University for a new building for the laboratory of chemistry. We must not forget again that during the 1860's and the 1870's in Germany a great effort had been undertaken for the improvement of the facilities of the experimental sciences, especially Physics and Chemistry, and many buildings had been constructed for that purpose[22].

About the transfer of the chemical laboratory to a new building, we find more information in the Address of Pavlos Kalligas (1814-1896) when he served as Head of the University during the year 1869-70. At the beginning of his address, Kalligas gave the reasons that led the authorities of the University to accept the proposal for a new special building for the chemical laboratory:

> "As is today our chemical laboratory, located in a small room, it is responsible for damages both for itself and for the others. For itself, because there are kept all the chemical instruments, some of them really precious, which are endangered from the gases and need frequent maintenance or replacement. For the others, because these gases, transferred to the above floor, where the Natural History Museum and the Library are placed, threaten there also to cause very severe damages".

The same year, the Senate decided to buy a site of about 7 500 sq.'s and value of about 52 000 dr. in Solonos Street, near the University, to be used for the construction of a building, which would be used for the chemical laboratory, the

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[21] Λόγος εκφωνηθείς τη 24η Νοεμβρίου 1868 ημέρα της επισήμου εγκαθιδρύσεως των νέων αρχών του εθνικού Πανεπιστημίου υπό του Πρυτάνεως Θεοδώρου Γ. Ορφανίδου, (Address delivered on October 24, 1868 by the Head Theodoros G. Orphanides), Athens, 1868, p. 54.

[22] A very interesting article on that subject has been written by David Cahan, The institutional revolution in German physics, 1865-1914, *Historical studies in the physical sciences*, 15(2)/1985, pp. 1-65.

anatomical laboratory and the pharmaceutical school. The building's plans were drawn up by two famous architects, who have built very significant public buildings in Athens, Tsiller and Kaftanzoglou[23]. The cost of the building was estimated to be about 250 000 dr.

The interior of the Chemical Laboratory has been designed by Christomanos, who was influenced by German prototypes. He had submitted his plans to the architect of the Berlin Chemical Laboratory Zastrau and to the famous chemist Hofmann and received very favorable comments. He also collaborated with professor Kolbe of the University of Leipzig, who, according to Christomanos's opinion, had constructed the best chemical laboratory in Germany from a scientific point of view.

The high cost of the building seemed to frighten the Senate, which worried for the property of the University and postponed the decision of allocating a budget of about 50 000 dr. which had been proposed to start the construction process. Facing that unfortunate situation Christomanos in his annual report tried to prove "that mostly disastrous and especially from a financial point of view is the further delay for the starting of the building, whereas the construction of the chemical laboratory is a profitable enterprise".

His arguments seemed to convince Kalligas who finally adopted Christomanos' proposal, despite the decision of the members of the Senate:

> "Our Chemical Laboratory if it is established in such a building, will be the one and only in the East and will raise Greece as a pioneer country in that field of the sciences, which is so significant because of its applications in the industry. Therefore, do not hesitate, for any reason, to give Greek society all the means which can be used to learn the secrets of the natural world"[24].

In Kalligas's words is reflected the general spirit of the role he dreamed the University of Athens to be playing in Southeastern Europe as a junction point of knowledge's transfer from West to East. Actually it was the role of a regional center, the cradle of the new sciences for the Balkan people. Kalligas wanted to reproduce the situation prevailed during the period of the Neohellenic Revival, when Romanians and Bulgarians were studying at Greek schools. For example the most prominent Bulgarian introducer of the classical physics in Bulgaria Ivan Seliminski (1799-1867), born in Sliven, took lessons in the school of Kydoniai under the Greek teacher of natural sciences and philosophy Theophilos Kairis, between 1817 and 1821. He established a school in Sliven in 1825, and another one in Bucharest in 1831, where he used the Greek language exclusively. Greek was the language he used also for his written works which were translated in Bulgarian much later. Similar was the case of Emmanouil Vaskidovich (1795?-1875) who had as professors the enlightened Greek scholars Neophytos Vamvas and Konstantinos Vardalahos. Vaskidovich also taught Physics in Greek for

23 *Ibid.* (see note 13), p. 14.
24 *Ibid.*, p. 17.

about 20 years (1824-1846). At the time when the Greek University tried to do its first steps, in Bulgaria appeared the first Bulgarian book of Physics. It was Nayden Guerov's *Survey of Physics*, 1849. In 1869 in Plovdiv was published the second Bulgarian textbook of Physics by J. Grouev ; it was a translation of A. Ganot's "Experimental Physics". Two other books of lower level appeared in 1872 and 1874. Therefore we might conclude that there were available opportunities for the Greek scientists to intervene in the development of physical sciences in Bulgaria and Romania. This was actually one of their aims. But finally they failed to have even the slightest influence on the development of scientific thought in the Balkans. That happened primarily because nationalism in both these neighboring countries had developed, so that Bulgarians and Romanians did not considered it right that Greeks, a nation, in similar financial and political situation to theirs, could rule over them scientifically. Another reason why Bulgarians and Romanians turned their back to Greek scientists was that the needs of their societies could not be satisfied with the expertise that Greeks were able to provide, a knowledge which was not original and remained "poor" in comparison with that supplied by the European centers.

On the other hand, if we take a glance at the situation of the scientific education in the Ottoman Empire we would see that there the situation was rather worse, although systematic and permanent efforts had already started, which gave fruitful results in the beginning of the 20th century. In an article entitled "L' Enseignement en Turquie" published in the *Revue des Deux Mondes* on October 15, 1876, Ernest de Salve described the ignorance of the Turkish people in many sciences and crafts. The first steps towards the improvement of this situation were based on efforts of the French governments. One of the results of this effort was the foundation of a high school in Istanbul (Mekteb-i-sultanisi) where a physics room, a chemical laboratory and a natural history classroom were established for the lectures of these sciences.

Furthermore, Christomanos took great care to supply high schools with instruments of chemistry having in mind to create the necessary conditions for teaching chemistry within secondary education. In Physics the same evolution, although not so fast, can be observed. Stroumbos bought new instruments from Paris whose value was about 4 000 dr., made by the well known firms Dubosq and Ruhmcorff[25]. In parallel, the University gave credit of 250 francs for the monthly salary of a French engineer expert who would undertake the maintenance and construction of physics instruments.

But all the efforts to find the appropriate person failed and the result was rather disastrous as "without such responsible assistant it was not possible to permit the assistant professors to use the instruments as the Senate has decided in many occasions". The University insisted on this practice from the beginning

25 *Ibid.*, p. 18

of the functioning of the Physics department. In his address as Head of the University, M.N. Kostis (1842) noted that:

> "the instruments are used only by the full professor of Physics. For reasons [the professor of Physics] has already explained to the Senate and have been approved, it is not permitted that the assistant professors and lecturers use these instrument, as the Professor is responsible for them"[26].

The positive attitude cultivated by P. Kalligas seemed to be reversed at the time the Head of the University was K. Vousakis (1819-1898):

> "While we are trying to find some space, such as four or six rooms for the practical works outside of the University, we are transferred suddenly, according to Christomanos plans, to real palaces of sciences, as if practical, anatomical or chemical exercises needed brilliant and luxurious buildings" [27].

Vousakis claimed that the cost of the new building for the chemical laboratory was too high, but this argument was proved rather a bad excuse, as another building was bought for 200 000 dr. Therefore, others must be the real reasons for the postponement of the new chemical laboratory building.

In 1873-74 the Head of the University G. Makkas (1818-1905) claimed that despite the efforts for modernizing the instruments, the instruments' collections remained very poor. Makkas considered the government responsible for that situation and argued that one of the results of its policy was that no well-trained scientists could be found in Greece, so scientists from foreign countries had to be invited. That year Stroumbos continued to enrich the "Cabinet of Physics" by buying from France new instruments, mainly for optics, galvanism acoustics and heat. These instruments were of his own choice and he traveled to Paris for that reason. Their value was of about 4 000 dr. These instruments were coming from the firms Dubosq, Ruhmcorff, Koenig, Alvergnat, Decretet, Rousseu etc., that is some of the most famous instruments makers in 19th century Europe[28]. Meanwhile the engineer who was supposed to be responsible for the instruments of Physics and Chemistry at the University and the Pireaus High School finally had been found. The expenses for the functioning of the chemical laboratory were up to about 6 600 dr. Now in this laboratory, besides the students of Medicine and Pharmacy, some students of the Physics Department were doing practical exercise. The students of the first category were 29 and those of the second were 8.

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[26] *Ibid.* (see note 6), p. 7.

[27] *Λόγος, εκφωνηθείς τη 29 Νοεμβρίου 1871 ημέρα της επισήμου εγκαθιδρύσεως των νέων αρχών του Εθνικού Πανεπιστημίου υπό του πρώην Πρυτάνεως Κωνσταντίνου Βουσάκη*, (Address delivered on November 29, 1871 by the former Head Konstantinos Vousakis), Athens, 1872.

[28] *Λόγος Γεωργίου Α. Μακκά παραδίδοντος την Πρυτανείαν εις τον Διάδοχον αυτού κον Παναγιώτην Ρομποτήν τη 17 οεμβρίου 1874*, (Address delivered by Georgios A. Makkas handing over the direction of the University to his successor Panagiotis Rombotis on November 17, 1874), Athens, 1875, pp. 70-71.

But Christomanos never stopped stressing the necessity of the construction of a new Chemical Laboratory which, in his opinion, would also be useful "for the introduction and establishment of the chemical industry in Greece, without which nobody can imagine today the development of trade and civilization to the point reached by the nations cultivating chemistry "[29].

Meanwhile, he did not leave the old chemical laboratory to its fate. Furnishing, supplies of instruments and materials, took so much of his time that, as he complained, he had no free time for original scientific research. Actually, Christomanos published some scientific papers, more than his other colleagues at the University of Athens, but, following the tradition in the 19th century Universities, he gave more importance to teaching than to research. During the following year, 6 students from the physics department and 25 others from the pharmaceutical school were trained in the chemical laboratory. Now Christomanos's disappointment about the case of the new chemical laboratory building is obvious:

> "I did not buy anything for the enrichment of the collections, which, though regularly maintained, are exposed to fatal destruction in the completely unfit room of the chemical laboratory"[30].

During academic year 1880-81, the Head of the University was V. Lacon (1838-1900). As Professor of Mathematics, he was friendly to the natural sciences. Seizing that opportunity, Christomanos submitted once more the plans for the new chemical laboratory building[31].

He spent about 2 500 dr. for buying instruments from Berlin (Schuchart) and Gerlitz (Wormbrunn). Among them was an equipment to prove the laws of Marriot and Gay-Lussac as well as an electrolytic device of his own construction whose production and representation in Europe had been undertaken by Wormbrunn.

Other smaller amounts of money were spent for repairing and maintaining the laboratory instruments, such as that of the Ruhmkorff device, which needed be sent abroad for repair.

Three physics and fourteen pharmaceutical school's students were trained that year (1880-81) in the chemical laboratory.

Prof. Stroumbos continued to enrich the collections of physical instruments, spending 2 000 dr. "to reach gradually the full perfection of the Cabinet of Physics". Stroumbos considered probably that one had to start by acquiring a full series of instruments before the students could be offered the opportunity to use them. During that period, in 1882-83, the building of a modern and according to

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29 Christomanos *in ibid.*, p. 72.

30 *Ibid.* (see note 7), p. 83.

31 *Λόγος εκφωνηθείς, εν τω Εθνικώ Πανεπιστημίω τη ενδεκάτη Ιανουαρίου του έτους 1881 υπό Βασιλείου Λάκωνος*, (Address delivered at the University of Athens on January 11, 1881 by Vasilios Lakon), Athens, 1882.

the European standards chemical laboratory was attempted once again.

For that year, the University budget was 200 000 dr. but the Ministry of Education, based on bureaucratic excuses, did not permit their consumption. The University insisted. In the following year, the Head submitted a modified budget but the government refused once again the proper amount of money. This attitude disappointed Christomanos, who realized that his vision for a University education in Greece comparable to that of the European countries was running the risk of remaining in the sphere of Utopia. In his 1882-83 report about his activities Christomanos wrote:

> "This failure (regarding the building of the new chemical laboratory) disappointed [all people interested in the development of chemistry] and since then any hope to see better days for Chemistry in our country had vanished. So that we did nothing for the enrichment of the Chemical Laboratory".

And in the 1883-84 report he concluded:

> "On You [the Head] and on your paternal care for the Chemistry in Greece depends that these works be not the last ones"[32].

But Christomanos was one of the very few people who had the charisma to transform their utopias into reality. His continuing efforts finally had a happy end. In 1887 the new chemical laboratory was established. A building which was a real jewel for Greece during the last quarter of the 19th century, where the consciences of many generations of students have been formed.

Stroumbos died in 1890, the year when the new chemical laboratory building was given to Christomanos who started working there from the 18th January onwards and paying 40 000 dr. for the furnishing. In this building was also transferred the collection of instruments of Physics and with low expenses a genuine physical laboratory was established for the first time. As Prof. Argyropoulos mentioned himself, thanks to this transfer he was able to invent a new experiment, making visible "the several vibrations of sound generators chords". This experiment was presented at the Academy of Sciences in Paris by the French Academician Prof. Cornu. Argyropoulos seized the chance he had to use the modern facilities of the new Chemical Laboratory and it seems that he was active both in research and teaching. He constructed a dark room, both for his own scientific research and the experimental work done by his students in optics. Twenty-five students made such experiments that year (1890).

In 1890-91 Argyropoulos taught experimental physics for six hours per week and continued doing research. At that time he announced the construction of a device showing that denser bodies do not always have a greater refraction coefficient. Five years later Argyropoulos was in the zenith of his career. He was the first Greek scholar to use X-rays in research and medicine very soon after their invention by Roentgen. He worked also with mobile equipment donated by

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32 Address delivered by Venizelos in 1883-84, pp. 118-119.

the "Times", the well known English newspaper, outside of the laboratory, and did many radiographs for injured soldiers or patients in the hospitals.
The first inventory of the instruments of Physics is published that year, containing 560 instruments of mechanics, optics, heat, electricity and magnetism.

Conclusion

From what has been described in the previous pages it becomes obvious that the introduction of the teaching of the physical sciences at the University level in Greece during the 19th century faced a series of difficulties, related mainly to the political and ideological framework prevailing during that period.

The fundamental ideology which characterized the Greek society during the 19th century was one that preached the creation of a state which could be considered the heir and the extension (continuation) of the ancient Greek civilization, after centuries of alteration from the influence of the Christian spirit of the Byzantine Empire. This ideology actually left the development of the physical sciences outside the scope of the central governmental policy, while the " theoretical" sciences (humanities), such as philosophy, archaeology, theology, developed within a favorable setting.

In this general climate, the development of Physics, Chemistry and Mathematics was based on personal efforts and isolated attempts, which nevertheless gradually achieved some positive results. Results which were far from being sufficient to support the native development of scientific research but which are also of some importance, and therefore must not be totally neglected.

Among the personalities whose action permitted the Physical sciences to gradually gain an autonomous presence in the cultural field in 19th Greece are the chemist An. Christomanos and the physicist Timoleon Argyropoulos.

The first one, working hard to develop chemistry as an applied experimental science, was strongly influenced by the relevant University pattern which he had experienced during his stay in Germany. His Mediterranean enthusiasm, in combination with his "German" sense of methodical work, permitted Christomanos to see his personal "scientific dream" fulfilled : a new chemical laboratory for the University of Athens. Thanks to this Laboratory, which was one of the best buildings of that kind in Europe, several generations of Greek students have been trained in chemistry.

Timoleon Argyropoulos, though a man of lower profile compared to An. Christomanos, also succeeded, though partially, in restoring Physics as a very important science in the conscience of Greek society. He understood that basic scientific research was considered by many people to be a luxury and that it was very difficult to find people willing to provide enough financial support for its promotion. Therefore, he tried to present physics' achievements as valuable and

beneficial for society. For that reason he was one of the first physicists who used X-rays for diagnostic purposes in Medicine.

Argyropoulos has been mostly influenced by the French scientific tradition. Besides this fact, his collaboration with Christomanos was very good.

Both, Argyropoulos and Christomanos served their sciences with devotion and they are justifiably recognized as the levers for the development of scientific thought in modern Greece.

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