MINING ENGINEERS, INDUSTRIAL MODERNISATION AND POLITICS IN GREECE, 1870-1940*

Leda Papastefanaki

ABSTRACT: The engineers who studied in Europe in the nineteenth and twentieth centuries and who returned to Greece to work have been seen as bearers of scientific knowledge and the modernising effort. Actually, they were active historical agents contributing with their multiple scientific activities to the process of appropriation of science and technology and industrial modernisation in the specific historical environment. This article aims, through the study of a particular professional group of engineers, the mining engineers, to demonstrate the interaction between scientific and technical professional activities and participation in political and social affairs. For these mining engineers, the technical efficiency and economic growth that industrialisation would bring could not be dissociated from social order and a hierarchical form of social organisation. At the same time, the formation of their professional group, as well as the social organisation that they envisioned, were rooted in gendered and class relations of power.

Introduction

In all countries that have embarked upon the road to industrialisation, engineers have constituted a new professional group that has played an important role in the diffusion of technology, the systematisation of technical education, industrial growth and physical construction, public administration and in the rise of new ways of organising work. Economic history has underscored the importance of systematic technical education at all professional levels as a precondition for economic growth and the increased technological independence of continental Europe (from the second half of the nineteenth century onwards).[1]

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[1] Antoine Picon, *L'invention de l'ingénieur moderne. L'École des Ponts et Chaussées, 1747-1851*, Paris 1992; David Landes, *Ο Προμηθέας χωρίς δεσμά. Τεχνολογική αλλαγή και βιομηχανική ανάπτυξη στη δυτική Ευρώπη από το 1750 μέχρι σήμερα* [originally published as *The Unbound Prometheus: Technological Change and Industrial Development in Western*

The mining sector in modern Greece has a long and varied history. From the nineteenth century and up to 1940, Greek mined ores were exported mainly as raw materials to the international markets, while there were also some important metallurgy plants, such as the one of the Compagnie Française des Mines du Laurium [hereafter CFML]. Most mines were small-scale enterprises in which operations were carried out with low-technology means of mining.[2] Given the importance of mining for the Greek economy from the second half of the nineteenth century and throughout the twentieth, an interest in the formation of the professional group of mining engineers is almost self-evident. The shaping during the interwar years of a critical mass of mining engineers who had studied at European universities seemed to render a discussion of the modernisation of mining enterprises, infrastructures and state services more feasible than ever before.[3] This article focusses on their

Europe from 1750 to the Present, New York 1969], transl. C. Mentzalira, ed. C. Agriantoni, Athens 2009, pp. 175-177, 371-381.

[2] On aspects of the history of the mining sector in the country, see the works by Christina Agriantoni, *Οι απαρχές της εκβιομηχάνισης στην Ελλάδα τον 19ο αιώνα* [The beginning of industrialisation in Greece in the nineteenth century], Athens 1986, and "Βιομηχανία" [Industry], in C. Hadziiossif (ed.), *Ιστορία της Ελλάδας τον 20ου αιώνα. Οι απαρχές, 1900-1922* [History of Greece in the twentieth century: The beginnings, 1900-1922], Vol. I/1, Athens 1999, pp. 173-221. See also Christos Hadziiossif, *Η γηραιά σελήνη. Η βιομηχανία στην ελληνική οικονομία, 1830-1940* [The old moon: Industry in the Greek economy, 1830-1940], Athens 1993; and the works by Leda Papastefanaki, "Από τα ορυκτά για το Γ΄ Ράιχ στα ορυκτά για την 'άμυνα της Δύσεως'. Η εξορυκτική δραστηριότητα στην Ελλάδα, 1941-1966" [From the ores for the Third Reich to the ores for the "defence of the West": Mining activity in Greece, 1941-1966], *Τα Ιστορικά* 57 (2012), pp. 367-408; "'Greece has been Endowed by Nature with this Precious Material…': The Economic History of Bauxite in the European Periphery, 1920s-70s", in R. Gendron, M. Ingulstad and E. Storli (eds), *Aluminum Ore: The Political Economy of the Global Bauxite Industry*, Vancouver 2013, pp. 158-184; "Οικονομικές και κοινωνικές μεταβολές στο Αιγαίο, 19ος-20ος αιώνας. Το παράδειγμα των ορυχείων" [Economic and social changes in the Aegean, nineteenth-twentieth centuries: The case of the mines], in N. Belavilas and L. Papastefanaki (eds), *Ορυχεία στο Αιγαίο. Βιομηχανική αρχαιολογία στην Ελλάδα* [Mines in the Aegean: Industrial archaeology in Greece], Athens 2009, pp. 36-55; *Η φλέβα της γης. Τα μεταλλεία της Ελλάδας, 19ος-20ός αιώνας* [The veins of the earth: The mines of Greece, nineteenth-twentieth century], (forthcoming).

[3] Christina Agriantoni, "Οι μηχανικοί και η βιομηχανία. Μια αποτυχημένη συνάντηση" [Engineers and industry: An unsuccessful encounter], in C. Hadziiossif (ed.), *Ιστορία της Ελλάδας του 20ου αιώνα. Ο μεσοπόλεμος, 1922-1940* [History of Greece in the twentieth century: The interwar period, 1922-1940], Vol. II/1, Athens 2002, pp. 269-293; Yiannis Antoniou, *Οι έλληνες μηχανικοί. Θεσμοί και ιδέες, 1900-1940* [Greek engineers: Institutions and ideas, 1900-1940], Athens 2006.

studies and career development, their role in industry and the operation of mines and in the importing and diffusion of technical culture, as well as in the development of labour relations. The study of the political activity of certain mining engineers highlights the intervention that this professional and social group made in the public arena. The research utilises a wide range of archival material: the register of members [*μητρώο μελών*] of the Technical Chamber of Greece [in the *Τεχνική επετηρίς* (Technical yearbook) of 1934], the Archives of the École Nationale Supérieure des Mines de Paris, the Elias Gounaris Archive in the Hellenic Literary and Historical Archive, the technical and daily press and technical editions of the period.

The article is divided into seven sections. The first section examines the technical education of mining engineers in Europe and Greece. In the second section particular attention is given to the celebrated École des Mines in Paris, where many Greek engineers studied. The third section focusses on the professional careers of mining engineers in Greece. The creation of the professional community of engineers in Greece and the position of mining engineers within it is explored in the fourth section. The modernising vision of the mining engineers as regards the appropriation and popularisation of scientific knowledge is the subject of the fifth section. The last two sections of the article contain a detailed study of the relationship between certain mining engineers and politics, the organisation of the state and the development of labour relations. The figures under study are Phocion Negris and Petros Protopapadakis, both of whom had political careers as members of parliament and ministers, and Themistocles Charitakis, who made intellectual contributions through his writings in the interwar period.

The Technical Education of Mining Engineers in Europe and Greece

The first systematic attempts to establish technical education in Europe date from the mid-eighteenth century. German technical education in mining engineering was the first branch of technical education in Europe to gain an institutional framework, with the foundation of the secondary technical mining schools, the Bergakademien, which later evolved into higher institutes of technical education, and the growth of a network of mining schools providing a basic education (Bergschule).[4] In France, a higher school

[4] Karl Ernst Jeismann and Peter Lundgreen (eds), *Handbuch der deutschen Bildungsgescichte. Von der Neuordnung Deutschlands bis zur Gründung des Deutschen Reiches, 1800-1870*, Vol. III, Munich 1987, pp. 269-310, 310-316. On the relations between the structure of technical education in Germany and industrial development, see Heiner

for the education of mining engineers, the École des Ponts et Chaussés, was founded in 1747, followed by mining schools (Écoles des Mines, 1783) and schools for other branches of engineering (the École Polytechnique in 1794, the École Centrale des Arts et Manufactures in 1829). In the nineteenth century and the early twentieth, these four Parisian engineering *grandes écoles* comprised a system of advanced technical education at a very high level for the economic and social élites, who were later to staff the technical services of the state and, through their education, gained political legitimation and social prestige.[5]

The École des Mines in Paris opened in 1783, when the Corps des Ingénieurs des Mines was also formed. The purpose of the school was to train engineers who could discover and operate mines safely and economically. The Paris school preserved the privilege of training the mining engineers who would staff the state mining services or work in the private sector. In 1829 yet another Paris school, the École Centrale des Arts et Manufactures, was opened: this was a partnership between a group of academics and an entrepreneur to train engineers for industry as well as educating mining engineers.[6] In the nineteenth century, France thus developed a hierarchical

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Stück, "L' émancipation des écoles supérieures techniques et la professionnalisation des ingénieurs en Allemagne au XIXe siècle", in André Grelon (ed.), *Les ingénieurs de la crise. Titre et profession entre les deux guerres*, Paris 1986, pp. 271-289; Wolfgang König, "Technical Education and Industrial Performance in Germany: A Triumph of Heterogeneity", in R. Fox and A. Guagnini (eds), *Education, Technology and Industrial Performance in Europe, 1850-1939*, Cambridge 1993, pp. 65-88 [published in Greek as *Εκπαίδευση, τεχνολογία και βιομηχανικές επιδόσεις στην Ευρώπη, 1850-1939*, transl. N. Sakellariou and K. Tzouanakos, ed. Y. Antoniou, Athens 2007].

[5] Frederick B. Artz, *The Development of Technical Education in France, 1500-1850*, Cambridge, MA, 1966, p. 84; Terry Shinn, *L'École polytechnique. Savoir technique et pouvoir social, 1794-1914*, Paris 1980; Jean Dhombres, "L'École polytechnique et ses historiens", in Ambroise Fourcy, *Histoire de l'École polytechnique*, Paris 1987, pp. 7-69; Picon, *L'invention*; Robert Fox and George Weisz (eds), *The Organization of Science and Technology in France, 1808-1914*, Cambridge 1980; Konstantinos Chatzis, "Theory and Practice in the Education of French Engineers from the Middle of the 18th Century to the Present", *Archives Internationales d'Histoire des Sciences* 60/164 (2010), pp. 43-78.

[6] Artz, *The Development of Technical Education*, pp. 85-86, 163-164, 228-230; Cecile Turion, *L'École des Mines d'Alès de 1841 à nos jours*, Villiers-sur-Marne 2002; Anne-Françoise Garçon, *Entre l'État et l'usine. L'École des Mines de Saint-Étienne au XIXe siècle*, Rennes 2004; André Thépot, *Les ingénieurs des mines du XIXe siècle. Histoire d'un corps technique d'État, 1810-1914*, Vol. I, Paris 1998, pp. 75-77, 211-218; Georges Ribeill, "Des ingénieurs civils en quête d'un titre. Le cas de l'École des Ponts et Chaussées (1851-1934)", in Grelon (ed.), *Les ingénieurs*, pp. 197-209; André Grelon,"The Training and

network of mining schools, with the purpose of rationalising work within a mine, at all levels of production.

In other European countries, there was a delay in the development of technical schools of all degrees for the training of mining engineers. Even Britain was to acquire a higher educational institution for the education of miners, the Royal School of Mines in London, only in 1851; although in 1838 King's College in London had introduced a programme of studies for engineers, which included the education of mining engineers.[7] The Belgian system for the technical education of miners was influenced by that of France. In 1836, the École des Mines of Liège and the École des Mines of Mons were established, to cover the needs of mining engineering. The programme of studies at the Liège school was orientated towards producing miners to staff the Belgian state Corps des Mines, which had been founded in 1831, while that in Mons was private, following the model of the École Centrale des Arts et Manufactures of Paris, and it specialised in training engineers, technicians and foremen for industry. The Catholic Church also contributed to the promotion of higher technical education in Belgium, when the Catholic University of Louvain opened a school for engineers in 1864, the École Spéciale du Genie Civil, d'Industrie et des Mines, with programmes for civil engineers, industrial engineers and mining engineers. The Free University of Brussels opened a polytechnic school in 1873, with programmes for civil engineers, mechanical engineers, chemical engineers, mining engineers and metallurgists. Part of the reason for the dynamic growth of technical education in Belgium was the classification in 1880 of the École des Mines of Mons as a university for mining engineers.[8]

Despite the national peculiarities and differences in the development of traditions of technical education, the interest each country had in the creation of institutions for technical education was linked to aspirations for economic growth, although this was, of course, not an exclusive aim. All European countries in the nineteenth and twentieth centuries witnessed much debate around the theoretical and practical content of technical education, as regards

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Career Structures of Engineers in France, 1880-1939", in Fox and Guagnini (eds), *Education*, pp. 42-64.

[7] Landes, *Ο Προμηθέας χωρίς δεσμά*, pp. 371-381; Anna Guagnini, "Worlds Apart: Academic Instruction and Professional Qualifications in the Training of Mechanical Engineers in England, 1850-1914", in Fox and Guagnini (eds), *Education*, pp. 16-40.

[8] René Brion, "La querelle des ingénieurs en Belgique", in Grelon (ed.), *Les ingénieurs*, pp. 255-270; Jean C. Baudet, "The Training of Engineers in Belgium, 1830-1940", in Fox and Guagnini (eds), *Education*, pp. 93-114.

the granting of qualifications by technical schools and the professional rights that each qualification bestowed. The transformation and upgrading of the status of secondary and higher technical schools to that of higher technical education institutions took place in Germany, Belgium, Spain, Greece and other countries, in response to the social and economic changes resulting from industrialisation.

In Greece, from the foundation of the Greek State until the final decade of the nineteenth century, the Military Academy had been the only educational institution to offer a higher technical education for engineers. Moreover, the Corps of Engineers, under the direction of the Secretariat for the Interior, functioned until 1878 as the government's technical service for carrying out public works.[9] With the 1878 reforms, the programme of studies of the School of Industrial Arts was upgraded with scientific and technical content, and the school could then train civil and mechanical engineers. The process of upgrading the technical studies of the Technical University was completed with the reforms of 1914, when it was renamed the National Metsovion Polytechnic, giving it a new academic identity, and its schools were restructured.[10]

Mining engineering, mineralogy and metallurgy had, since 1888, been taught as separate subjects within the programme of the School of Industrial Arts, and after 1914 chairs in geology and mineralogy, metallurgy and mining projects (later mining and knowledge of metallurgy) were created. There had been proposals to establish a school of mining since 1913, while the law of 1914 (and, later, the decrees of 1917-1919) also foresaw the creation of secondary technical schools attached to the higher schools, so as better to cover all the levels of technical education. Among the secondary technical schools that were foreseen was a technical school for foremen in chemical engineering

[9] Konstantinos Chatzis, "Des ingénieurs militaires au service des civils (1829-1878). Les officiers du Génie en Grèce au XIXe siècle", in K. Chatzis and E. Nicolaidis (eds), *Science, Technology and the 19th-century State: The Role of the Army*, Athens 2003, pp. 69-90; Yiannis Antoniou and Michalis Assimakopoulos, "Notes on the Genesis of the Greek Engineer in the 19th Century: The School of Arts and the Military Academy", in Chatzis and Nicolaidis (eds), *Science, Technology*, pp. 91-138; Antoniou, *Έλληνες μηχανικοί,* pp. 150-157.

[10] Kostas Biris, *Η ιστορία του Εθνικού Μετσοβίου Πολυτεχνείου* [The history of the National Metsovion Polytechnic], Athens 1957; Aggeliki Fenerli, "Σπουδές και σπουδαστές στο Πολυτεχνείο (1860-1870)" [Studies and students in the Polytechnic (1860-1870)], *Τα Ιστορικά* 7 (1987), pp. 103-118; Antoniou, *Έλληνες μηχανικοί*; the National Metsovion Polytechnic [Εθνικό Μετσόβιο Πολυτεχνείο, ΕΜΠ] is now named the National Technical University of Athens [NTUA] in English.

and mining, which was to be part of the school of chemical engineering. This school for foremen was never created.[11]

In 1934, the National Metsovion Polytechnic had five higher schools (civil engineering, electrical engineering, architecture, chemical engineering, and agronomy and rural and surveying engineering), but it did not have a mining school. The departments of mining engineering and metallurgical engineering, with a five-year programme of study, were created after World War II, in 1946, when the school of chemical engineering was divided into three departments. In 1948, the two departments were merged into a unified department of mining and metallurgical engineering, which was part of the school of chemical engineering until 1975, when it became the autonomous school of mining and metallurgical engineering.[12]

Of the 2048 engineers listed in the Register of the Technical Chamber of Greece [hereafter TCG] in 1933-1934, mining engineers comprised only 2% of registered members, with the second smallest membership after shipbuilders (0.8%).[13] Of the 42 mining engineers registered in the TCG in 1934-1935, all had studied mining engineering abroad, while only six had done their initial studies in Greek educational institutions.[14] All the mining engineers had completed their studies in foreign institutions in the period 1876-1932. As can be seen in Table 1, engineers had studied equally in Germany at the Bergakademie in Freiburg and in Belgium at the École Spéciale des Arts et Manufactures et Mines of Liège, while in second place were all those who had studied at the École des Mines of Paris. Those who preferred the École des Mines and the École Centrale des Arts et Manufactures of Paris for their studies were from the older generation, as most had studied there during the last third of the nineteenth century until 1905. Those of a younger generation – those who had studied abroad from 1905 to 1932 – preferred the German institutions and the Liège school, as well as the upgraded mining school of Saint-Étienne in France.

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[11] Antoniou, *Έλληνες μηχανικοί*, pp. 125-126, 136, 198, 202, 204-205, 278-279, 287; *Τεχνική επετηρίς της Ελλάδος* [Technical yearbook of Greece], Vol. I, Athens 1934, pp. 51-66.

[12] *Εθνικό Μετσόβιο Πολυτεχνείο, 1837-1997, εκατόν εξήντα χρόνια* [National Metsovion Polytechnic, 1837-1997, one hundred and sixty years], Athens 1997, pp. 115-116.

[13] *Τεχνική επετηρίς*, Vol. I, p. 30; Agriantoni, "Οι μηχανικοί", pp. 270-272, 284.

[14] *Τεχνική επετηρίς*, Vol. II, Athens 1934, pp. 50, 80, 236, 286-287, 355-356.

Table 1
Greek students of mining engineering in European educational institutions, 1876-1932

European educational institution	Number of Greek students
Sächsische Bergakademie, Freiberg	12
Université, Faculté Technique, École Spéciale des Arts et Manufactures et Mines, Liège	12
École Nationale Supérieure des Mines, Paris	10
École Nationale Supérieure des Mines, Saint-Étienne	4
École Centrale des Arts et Manufactures, Paris	1
Montanische Hochschule, Leoben	1
Preussische Bergakademie, Clausthal	1
Catherine II Highest Imperial Mining School, St Petersburg	1

Source: *Τεχνική επετηρίς της Ελλάδος* [Technical yearbook of Greece], Vol. II, Athens 1934, pp. 3-394.

Studies at the École des Mines in Paris and Greek Students

Studies in mining engineering at the École des Mines of Paris secured graduates a promising career, particularly through their entry into the Corps of Mining Engineers, as well as social prestige and scientific integrity.[15] As the École des Mines of Paris was the choice of many Greek students, who then went on to practise their profession successfully in Greece and abroad, while some became actively involved in politics, a brief outline of the programme of studies and characteristics of the school are given below.

The students who were accepted – after examinations in German, geometry and design – had to be at least 16 years old. After a three-year

[15] Louis Aguillon, *L'École des Mines de Paris. Notice historique*, Paris 1889; *id.*, *Supplément à la notice historique sur l'École Nationale Supérieure des Mines*, Paris 1900; Gabriel Chesneau, *Notre école. Histoire de l'École des Mines*, Paris 1932; Jean-Marc Oury, "Histoire succinte de l'administration des Mines", *Annales des Mines* 1 (1983), bicentenary issue, pp. 31-36; Alain Bucaille, "Le saint-simonisme et le corps des mines", *Annales des Mines* 1 (1983), bicentenary issue, pp. 42-44; Thépot, *Les ingénieurs*.

programme, which combined theoretical training and laboratory work with practical experience in the mines of France, those students who passed their exams became *sous-ingénieurs des mines*. Without the title of *sous-ingénieur des mines*, it would not be possible for the students to be appointed as deputy inspectors or inspectors of the state mines. Students entered the École des Mines after taking classes in mathematics for a period of one to three years in special Parisian lycées, which prepared students for the examinations for entry to the *grandes écoles*.[16] After passing the entrance exams, students would then study regularly at the school. They were taught engineering, mining engineering, mineralogy, geology, palaeontology, mine operation and design. The volume of knowledge that the students had to acquire increased gradually over the nineteenth century, while the addition of new subjects (such as "railways and construction" in 1846 and "agriculture, drainage and irrigation" in 1864) shows how the programme of studies was expanded. In 1848, a class in "industrial economy and legislation" was introduced.

In the 1870s and 1880s, an attempt was made at a broader reorganisation of the programme of studies and, from 1879, the school gradually became more specialised in industrial technology. New subjects were introduced, such as applied geology (1879), industrial chemistry (1887) and applications of electricity (1887), while two distinctive classes were introduced: industrial economy and mining legislation (1885). The chair in industrial economy was held by Émile Cheysson, and that of legislation by Louis Aguillon. Initially, then, the programme of studies was orientated towards a global knowledge of mining engineering. Gradually, however, the character of the education on offer changed, as the aim was for the students to gain more skills in the industrial arts.[17] During the interwar period, the school maintained a double role: to train engineers to staff the state mines service and to award the diploma of mining engineer to all those students who wished to take it. This dual orientation in the professional development of graduates played a role in shaping the curriculum. At the same time, the engineers of the Corps des Ingénieurs des Mines had expanded their professional activities and were now successfully competing against their colleagues in the corps of the Ponts et Chaussées. The education of the future mining engineers at the École des Mines combined different scientific fields, from physics and mathematics to earth sciences. The art of the mining engineer was defined in terms of processes and networks: processes of the extraction and transformation of minerals, as well as networks

[16] Thépot, *Les ingénieurs*, pp. 53-57, 73.

[17] Aguillon, *L'École des Mines* , pp. 216, 228-234; Thépot, *Les ingénieurs*, pp. 78-90.

of businesses and clients related to the production or associated with the use of specific materials. Within the context of the demands of the developing mining industry, the idea of technology must have been more familiar to the mining engineers than the engineers of the Ponts et Chaussées.[18]

Since they benefitted from industrial growth much more than the civil engineers did, the mining engineers who graduated from the Paris school enjoyed a greater success in their personal careers. In the period 1874-1939, the school's graduates worked chiefly in mining, transport and the universities. In the private sector they even had a monopoly over large mining enterprises in France, Algeria and the Ottoman Empire.[19]

The mentality of engineers in France was shaped within particular historical conditions, from the legacy of the Enlightenment and the French Revolution, while Saint-Simonianism had a strong influence on the students of the École Polytechnique and the École des Mines.[20] During the nineteenth century the mining engineers expressed a greater interest than their colleagues in the corps of Ponts et Chaussées in issues such as legislation and the economy and they were receptive to the ideas of Saint-Simonianism.[21] This receptiveness may be explained by participation in the reforming efforts of the Corps des Ingénieurs des Mines, which acted as an intermediary between state policy and business interests. The contribution of engineers to Saint-Simonianism, a movement that is usually understood as anticipating industrial society, although its utopian discourse is overlooked, has been used in later readings to prove that engineers were sensitive to political and social issues.[22]

In the second half of the nineteenth century and first half of the twentieth, the mining engineers of the École des Mines were to pursue brilliant careers in the state services, universities and business and participate in numerous social networks. Some of the old Saint-Simonians among them continued to seek, although now on other terms, the most satisfactory combination of capital and labour, which would provide the key to social peace.[23] Michel Chevalier (1806-1879), a graduate of the École Polytechnique and the

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[18] Aguillon, *L'École des Mines, Supplément*, p. 6; Thépot, *Les ingénieurs*, pp. 185-202; Picon, *L'invention*, pp. 593-598.

[19] Thépot, *Les ingénieurs*, pp. 221-222.

[20] Chesneau, *Notre école*, pp. 146-148.

[21] Bucaille, "Le saint-simonisme".

[22] Picon, *L'invention*, pp. 595-596; *id.*, *Οι σαινσιμονιστές. Ορθός λόγος, φαντασιακό, ουτοπία* [originally published as *Les Saint-Simoniens. Raison, imaginaire et utopie*, Paris 2002], transl. M. Chronopoulou, Athens 2007, pp. 94-102.

[23] Picon, *Οι σαινσιμονιστές*, pp. 149-154.

École des Mines, became a professor of political economy at the Collège de France in 1840 and a consultant on economic policy matters to Napoleon III. Another former Saint-Simonian, Frédéric Le Play (1806-1882), publisher of the *Annales des Mines* and professor of mining engineering at the École des Mines, became known for the Christianity-based social policy that he later developed, in which he argued for preserving social peace. Le Play contributed to the development of empirical sociology, using the method of social observation and writing monographs. He also founded the Société Internationale des Études Pratiques d'Économie Sociale (1856), which was linked to the movement for social Catholicism and introduced the idea of social reform through science. It influenced the liberal school of French political economy. As the problems raised by the 'social question' intensified, some of the advocates of economic liberalism criticised unbridled liberalism and insisted on a moral dimension to industrial relations, thus attempting to correct the excesses of *laissez-faire* policies.[24]

Among those who sought a better balance between the interests of capital and those of labour was Le Play's student, the mining engineer Émile Cheysson (1836-1910), a senior official in the Ministry for Public Works during the period 1874-1885. In 1885, he took up the chair in industrial economy at the École des Mines. Cheysson also taught political economy at the École Libre des Sciences Politiques and was an active member of the Société de Statistique of Paris and of the social reform movement. Cheysson developed the method of the monograph introduced by Le Play and combined it with statistics in order to study the purchasing power of working-class families.[25] He was also particularly involved with the issue of social housing, and, like his teacher, linked his profession as an engineer with finding a resolution to the social issue.[26] In practice, he was interested not only in the problems of the management of companies but, primarily, in the establishment of harmonious social relations.[27]

When the Office du Travail – the precursor of the French Ministry of Labour – was founded in 1891, the engineers of the Corps des Ingénieurs des

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[24] Janet Horne, "Le libéralisme à l'épreuve de l'industrialisation. La réponse du Musée social", in Colette Chambelland (ed.), *Le Musée social en son temps*, Paris 1998, pp. 13-25; Anna Mahera, "Η γαλλική σχολή πολιτικής οικονομίας τον 19ο αιώνα" [The French school of political economy in the nineteenth century], *Τα Ιστορικά* 50 (2009), pp. 17-36.

[25] Antoine Savoye, "Les continuateurs de Le Play au tournant du siècle", *Revue Française de Sociologie* XXII/3 (1981), pp. 315-344.

[26] Émile Cheysson, *Le rôle social de l'ingénieur*, Paris 1897.

[27] *Id.*, *La lutte des classes*, Paris 1893, and *Frédéric Le Play. Sa méthode, sa doctrine, son école*, Paris 1905.

Mines and Corps des Ingénieurs des Ponts et Chaussées were well-represented among its staff.[28] The Office du Travail's turn to engineers continued the tradition started by Le Play of the social role of the engineer. Moreover, the position of mining engineers in the Office du Travail was reinforced by their professional interest in issues of health and safety in the mines, as well as their intermediary role between the state and business.

Despite the serious competition from the technical universities of Germany and the Zurich Polytechnic, which attracted a significant number of students from the late nineteenth century, the four famous engineering *grandes écoles* of Paris remained, until the early twentieth century, a magnet for Greek students who wished to study engineering. A total of 177 Greek students have been identified in all the Parisian engineering schools for the years 1830-1912.[29] The École des Mines of Paris accepted 59 students with Greek names from 1817 to 1940. The number of students at the school per decade can be seen in Table 2: one to three students at most per decade were accepted to study at the school in the period 1820-1869, while their number increased to six per decade in the 1870s and 1880s. These decades saw the beginning of Greek industrialisation, and the opening of the first mines in the Greek State may have led to hopes of a good career as an engineer. In the 1890s, an impressive rise in the number of Greek students can be observed, a fourfold increase from the previous decade. This increase coincides with the exit from the Long Depression and the beginning of a new phase of expansion in mining activity in Greece, the Ottoman Empire and the wider Mediterranean region. In the first decades of the twentieth century, the number of Greek students at the Paris school declined, a fact that must be related to the increasing popularity of the mining schools of Freiburg and Liège. In the 1920s, there was a brief revival of interest among Greeks for the Paris school, but this again fell off in the following decade.

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[28] Isabelle Lespinet-Moret, *L'Office du Travail (1891-1914). La République et la réforme sociale*, Rennes 2007, pp. 130-138.

[29] Efthymios Nicolaidis, "Les élèves grecs de l'École polytechnique (1820-1921)", in G. Grivaud (ed.), *La Diaspora hellénique en France*, Athens 2000, pp. 55-65; Fotini Assimacopoulou and Konstantinos Chatzis, "Éducation et politique au XIX siècle. Les élèves grecs dans les grandes écoles d'ingenieurs en France", in E. Ihsanoglou, K. Chatzis and E. Nicolaidis (eds), *Multicultural Science in the Ottoman Empire*, Turnhout 2003, pp. 123-124; Fotini Assimacopoulou, Konstantinos Chatzis and Anna Mahera, "Élève en France, enseignant en Grèce. Les enseignants de l'École polytechnique d'Athènes (1837-1912) formés dans des écoles d'ingénieurs en France", in A. Cardoso de Matos *et al.* (eds), *The Quest for a Professional Identity: Engineers between Training and Action*, Lisbon 2009, pp. 25-41.

Table 2
Greek students at the École des Mines in Paris, 1817-1940

Decade	Number of Greek students
1820	1
1830	1
1840	2
1850	1
1860	3
1870	6
1880	6
1890	23
1900	3
1910	4
1920	7
1930	2

Sources: Archives of the École Nationale Supérieure des Mines de Paris, Registre des élèves, 1817-1906, 1905-1935; Registre des élèves étrangers, 1817-1901; Association Amicale des Élèves de l'École Nationale Supérieure des Mines, *Liste alphabétique des élèves entres à l'École Nationale Supérieure des Mines depuis l'origine,* Paris 1940; Association Amicale des Élèves de l'École des Mines de Paris, *Compte-rendu annuel (Annuaires)*, 1864-1955.

Among the Greek students who studied engineering in nineteenth-century France, there was a strong presence of scions of the bourgeois class, while professionals and holders of public offices are also represented among the families.[30] We have some data for the social origins of the Greek students at the École des Mines. It appears that some students were from very rich or prosperous families, educated and of good social standing, such as, for example, the Phanariot Negris family, two of whose members, Theodoros Negris and Phocion Negris, graduated from the school. Other graduates with Phanariot origins were Nikolaos Mavrocordatos and Evgenios Rizos Neroulos. The latter was the son of the Greek consul in Bucharest, Dimitrios Rizos Neroulos, and Loukia Soutsou.[31] We also know of certain cases where the father had had a university education and then practised a profession: Panayiotis Charitakis, the

[30] Assimacopoulou and Chatzis, "Éducation et politique", p. 128.

[31] Mihail Dimitri Sturdza, *Dictionnaire historique et généalogique des grandes familles de Grèce, d'Albanie et de Constantinople*, Paris 1983, pp. 324-325, 363, 395.

father of Themistocles, was a lawyer in Mansoura in Egypt, while Aristotelis Papayannopoulos, the father of Theodoros Papayannopoulos, was a doctor, also in Mansoura.[32] Petros Protopapadakis came from a family with a high social status in the local community of Apeiranthos on Naxos: his grandfather had been an archpriest and a representative of the emery workers to King Otto in 1835, producing memoranda on emery. His father, Emmanuel Protopapadakis, was a teacher, while two of his father's brothers had settled in Constantinople around 1873: Georgios was a doctor, while Anastasios was a teacher.[33] We also encounter at least one case of a father and son who were both mining engineers. Anastasios Seferiades, a graduate of the École des Mines (1902), was a mining engineer and consultant in a chromium mine in Turkey in the 1930s, residing in Constantinople. He sent his son, Ioannis Seferiades, to study at the school in Paris, so that he could later work in the Turkish mine.[34]

What professional development and what kind of careers did the Greek graduates of the École des Mines have once they had completed their studies? Some of the engineering graduates of the school, on their return to Greece, taught in the military academies or at the University of Athens and the National Metsovion Polytechnic, while others were part of the state's administrative and technical staff. Several worked as engineers and as directors in the private sector, in industrial enterprises, the railway and mining companies. The railways were a significant opportunity for professional employment for Greek graduates of the École des Mines, as well as for their French colleagues. Most graduates of the school, however, worked in the private sector, mainly in mining companies, or started their own technical firms. The graduates of the École des Mines were not limited to working only within Greek borders, as the French diploma and their solid technical studies meant they could find work as engineers almost everywhere in the Mediterranean and the Balkan countries. Many worked in the Ottoman Empire and later in Turkey.

From Studies to Production and Services

In Greece, the first mining companies to operate systematically in the nineteenth century were initially staffed by European engineers. In the Greek

[32] Papastefanaki, *Η φλέβα της γης*.

[33] Petros Protopapadakis, *Μονογραφία περί Ναξίας σμύριδος και προτάσεις νόμων* [Monograph on Naxian emery and legislative proposals (presented to the Hellenic Parliament)], Athens 1903, pp. 81-85; Alexandros Oikonomou, *Πέτρος Πρωτοπαπαδάκης, 1859-1922. Ένας άνθρωπος και μια εποχή* [Petros Protopapadakis, 1859-1922: A man and an era], Athens 1972, pp. 13, 17.

[34] Papastefanaki, *Η φλέβα της γης*.

Metal Works Company of Lavrion [Εταιρεία Μεταλλουργείων Λαυρίου], the CFML and the other mining companies that began to operate more or less systematically in the nineteenth century, both in Greece and the Ottoman Empire, the technical directors and engineers were usually foreign: primarily French, but also Belgians, Germans and Britons. Their names can be found scattered throughout the sources of the era.[35] The first Greek mining engineers also started to work alongside them. Greek and foreign mining engineers and engineers with high levels of education from European schools, such as the École des Mines and the Bergakademie in Freiberg, interacted with others who had studied in mining schools such as those of Clausthal and Liège. We do not know about the studies, professional careers or social profiles of all of them, but I will attempt to chart the landscape in which the technical employees working in the mining sector operated from the nineteenth century until World War II.

Aside from Phocion Negris, the general director who was based in Athens, and Evgenios Rizos Neroulos, who was based in the workshops, most of the engineers who worked for the Greek Metal Works Company of Lavrion in 1885 were German, their presence perhaps related to the construction of the new German-built washery, which was installed a little later, from 1888 to 1892.[36] The various problems, however, that the Greek Metal Works Company of Lavrion and the CFML had to deal with in Lavrion before the end of the nineteenth century presumably did not make them attractive places for engineers to work. In the 1890s, at least four young French metallurgists, recent graduates of the École des Mines in Paris, were hired by the CFML: Emmanuel Doche, C. Sudre, Johannes Faure and Paul-Louis Regnault. None of them remained in Lavrion (or in any other enterprises controlled by the company in Greece) for more than four or five years. All four, after working in Greece for a few years, left to work as mining engineers in France.[37] The limitations on operations in the enterprises of Lavrion also affected the engineers, who gradually left, either because the salaries on offer were not attractive or because the companies themselves were forced to reduce their technical staff, as well as their workers. L. Guillaume, for example, was a chief mining engineer with the CFML in the decade from 1900, but he left Lavrion in the following decade. In 1920, only R. Mollet, director and also operating engineer, a graduate of the École Centrale

[35] Giorgos Dermatis, *Λαύρειο, το μαύρο φως. Η μεταλλευτική και μεταλλουργική βιομηχανία στο Λαύρειο, 1860-1917. Ελληνική και ευρωπαϊκή διάσταση* [Lavrion, the black light: The mining and metallurgical industry in Lavrion, 1860-1917: The Greek and European dimension], Athens 2003, pp. 272-278, 439-440.

[36] *Ibid.*, pp. 211-212.

[37] Association Amicale des Élèves de l'École des Mines de Paris, *Annuaires*, 1886-1905.

des Arts et Manufactures, who had worked in Lavrion for 27 years, remained. Mollet, dedicated "life and soul" to his work, did not abandon his position even when called upon by the French embassy to do so during the events of November-December 1916.[38] Of course, there are examples of engineers, such as Alexis-Paul Albrand or Jules de Catelin, who, after careers as mining engineers, ended up in managerial positions and as shareholders working for the company's central management.[39] These cases, however, are completely different from the experiences of the majority of operating managers.

The 1934 Register of Members of the TCG is an important source that allows us to map the community of engineers. In the 1930s, among the 2048 registered members of the TCG there were 42 mining engineers, who worked in different mining enterprises, the railways and the public sector or had their own practices. According to the records of the TCG (which contain information on 39 of the 42), 25 mining engineers lived in Athens and Piraeus, 12 in the provinces and 2 abroad. Of these 39 mining engineers, the largest group (17) were private or municipal employees, 11 had their own practices, 10 worked in the public sector and one was a professor at NTUA. Three also held licences as contractors for public works.[40] I have also identified a further 64 engineers with other specialisations in the Register of Members, who at some point in their lives had worked in mining, either conducting land surveys or overseeing the plotting and building of Decauville railways, the installation of facilities and the operation of engineering equipment (cable cars, etc.) or who had even worked as operating engineers or directors in mining companies, perhaps even being contracted to operate the mines.[41] Over half these engineers were civil engineers (37), followed by electricians (6) and electrical engineers (6), mechanical (5) and chemical engineers (5), surveyors (4) and architects (1). The companies that primarily employed engineers of all specialisations, in addition to mining engineers, were the CFML and the Greek Metal Works Company of Lavrion, the Chemical Products and Fertilisers Company SA [ΑΕΕΧΠΛ], the Company of Businesses in Greece [Εταιρεία Επιχειρήσεων εν Ελλάδι] and Locris.[42]

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[38] Papastefanaki, *Η φλέβα της γης*. The events of November-December 1916 were a political dispute, which led to an armed confrontation in Athens between the royalist government of Greece and the forces of the Allies over the issue of Greece's neutrality during World War I.

[39] Association Amicale des Élèves de l'École des Mines de Paris, *Annuaires*, 1877-1925.

[40] *Τεχνική επετηρίς*, Vol. I, p. 30.

[41] As Alexandros C. Vlangalis did in the Seriphos mines in 1901-1903; *Τεχνική επετηρίς*, Vol. II, p. 46.

[42] *Ibid.*, pp. 3-394.

Despite the systematic documentation of the interwar engineers, the TCG Register of Members is not devoid of problems. Some engineers were not registered in the TCG at the moment when the Register was published and, as such, were not documented. Ioannis G. Lambrinides, for example, with a good degree from the École des Mines of Liège, was not on the Register. Other engineers, just embarking on their careers in 1934 when they were included in the TCG Register, were not yet active in the mining sector, and their presence is hence not noted. Such was the case of, for example, Ioannis Lefes from Ikaria, who received his degree in chemical engineering from Braunschweig University of Technology in 1931.[43]

In mapping the mining engineers who worked in Greece during the nineteenth and twentieth centuries, a distinction must first be made between: a) the higher state officials with a career exclusively in the public sector (P. Vouyoukas, etc.); b) those mining engineers who had positions as directors, participated in committees as consultants to the state or companies, taught at the Technical University or the University and who were often shareholders in mining companies (A. Kordellas, P. Negris, E. Gounaris, I. Doanides); and c) those who worked as operating engineers (chief engineers, etc.) in the mining companies.

A characteristic example of a top state official with a high level of scientific training was the army mining engineer Panayiotis G. Vouyoukas.[44] Similar cases of state employees whose careers were spent almost exclusively working for state services were the mining engineers Emmanuel I. Dragoumis (1850-1917), Timotheos Georgakopoulos, Georgios D. Katerinopoulos and Aristotelis Tsakonas. There were, of course, many other mining engineers who worked for the state services for a brief period and then departed to work in the private sector: Emmanuel M. Vordonis, Agis Varvaressos, Viktor Akylas and Alexandros C. Papamarkou. The last two, after having worked in the public sector as inspectors of mines, were not to be satisfied with just being employees in engineering or mining companies, but started their own companies. Some mining engineers worked from 1920 to 1922 in the mineral and coal mines of the Ottoman Empire and Russia, but political developments led them to Greece: Georgios D. Katerinopoulos, Nikolaos E. Papadakis, Nikolaos G. Roussakis, Panayiotis A. Roussopoulos and Miltiades Sapnas. They chiefly staffed the Mines Inspectorate of the Ministry of National

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[43] *Ibid*., p. 187.

[44] *Μέγα ελληνικόν βιογραφικόν λεξικόν* [Great Greek biographical dictionary], Vol. I, Athens 1958, pp. 306-313; "Παναγιώτης Βουγιούκας" [Panayiotis Vouyoukas], *Ήμερολόγιον Σκόκου* 5 (1890), pp. 405-497.

Economy and other state technical services (General Administration of Macedonia, Directorate of Technical Works and the Topography Service of the Ministry of Agriculture, etc.). Gerasimos Tzortzatos, for example, was a graduate of the Bergakademie of Freiberg. After working for many years in the Russian mineral and coal mines of the Vallianos Brothers in Don (1909-1923), he was then employed for eight years in Greek coal and mineral mines, before being appointed as a geologist-engineer with the Directorate of Technical Works of the Ministry of Agriculture.[45]

The transition from state services to the private sector, by occupying management positions and owning company shares, can clearly be seen in the case of the mineralogist Andreas Kordellas (Smyrna, 1836 – Athens, 1909). He was the son of a merchant from Ambelakia who had settled in Smyrna, was a graduate of the industrial school of Zittau in Saxony (1852-1855) and the Bergakademie in Freiberg (1855-1858) and had also taken classes at the school of philosophy of the University of Bonn and the mining school of Liège. When he returned to Greece in 1860, he worked first as a state employee in the Ministry of Finance. He was a member, alongside Panayiotis G. Vouyoukas and Ioannis Soutsos, of the committee which wrote the draft law that eventually became the law "On Mines" in 1861. As a state employee, he visited the inactive mines of Lavrion to assess the possibility of exploiting the ancient slag, as well as many other mines on the islands and the mainland. In 1861 he was appointed foreman of the emery mines on Naxos, a position he held until 1863. He worked as a mineralogist for the Ministry of Finance until 1865, when he became director of works of the first mining company in Lavrion, Hilarion Roux et Cie, and for I. V. Serpieris & Co. (until 1873). From 1887 until 1891, he was the general director of the Greek Metal Works Company of Lavrion. Alongside this, he taught mineralogy and geology at the Military Academy (1882-1894).[46] Kordellas was a member of the Greek Committee for the Exposition Universelle in Paris in 1878 and even wrote, on the occasion of the Exposition, a special study promoting Greece's mineral wealth abroad.[47] He was the first president of the Hellenic Polytechnic Association (1899-1909) and president of the International Fair at the Zappeion in Athens in 1903.[48]

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[45] For biographical notes on these engineers, see Papastefanaki, *Η φλέβα της γης*.

[46] *Βιογραφικόν λεξικόν*, Vol. II, pp. 44-66.

[47] Andreas Kordellas, *Ἡ Ἑλλὰς ἐξεταζομένη γεωλογικῶς καὶ ὀρυκτολογικῶς* [Greece, a geological and mineralogical study], Athens 1878.

[48] Kordellas took part with other engineers in the discussion about the Athens water supply in the late nineteenth century. Spyros Tzokas, "Τεχνικές διαμάχες το κρίσιμο καλοκαίρι

In addition to Andreas Kordellas, other mining engineers, such as Elias Gounaris, Phocion Negris and his nephew, Konstantinos Negris, were directors and shareholders in mining enterprises. Whereas some mining engineers, such as Elias Gounaris, Ioannis Doanides, Stavros Katrakis, and Loukas Mousoulos, balanced management positions and consultancy services to mining companies with an academic career at the National Metsovion Polytechnic, participation in committees and institutions of the state and of their employers with their scholarly publications, Phocion Negris combined his position as a director of mining companies with a political career, while Konstantinos Negris pursued a purely business career.

Elias Gounaris (Argos, 1883-1970), the son of Panayiotis Gounaris, the highest judicial and economic prefect of Argos, as well as a member of the Monopolies' Company, was a professor at the National Metsovion Polytechnic and a technical consultant to businesses in the first decades of the twentieth century and the post-war period. Gounaris had studied civil engineering at the National Metsovion Polytechnic, from which he graduated in 1904, and later studied metallurgical mining at the École Spéciale des Arts et Manufactures et des Mines in Liège, graduating in 1907. He was appointed foreman of the emery mines of Naxos in 1908. He was subsequently promoted as a mineralogist with the Ministry of Finance (1908-1910), appointed Inspector of Mines (1910-1915) and, later, was director of the Mines Service in the Ministry of National Economy (1915-1918). As a state employee, he prepared reports, laws, the *Κανονισμός μεταλλευτικών εργασιών* [Regulations for mining operations] and managerial publications (such as *Παραχωρήσεις μεταλλείων* [Mining concessions] in 1916 and *Μεταλλευτική νομοθεσία* [Mining law] in 1917).[49] From 1918 until 1930, he was an adjunct professor and, from 1930 to 1954, a professor in metallurgy and mining at the National Metsovion Polytechnic. He additionally served as the general secretary and vice president of the Greek Industrialists' League [ΣΕΒ] (1931-1940) and of the Union of Mining and Metallurgical Enterprises (1924-1940), was the employer representative for the Social Security Foundation [IKA] (1936-

του 1899. Η δημόσια εικόνα του επιστήμονα-μηχανικού" [Technical controversies in the crucial summer of 1899: The public image of the scientist-engineer], *170 χρόνια Πολυτεχνείο. Οι μηχανικοί και η τεχνολογία στην Ελλάδα* [170 years of the Polytechnic: Engineers and technology in Greece (conference proceedings)], Vol. II, Athens 2012, pp. 172-173.

[49] Hellenic Literary and Historical Archive, Athens, Archive of Elias Gounaris, *Υπόμνημα περί των μέχρι σήμερον εργασιών του Ηλία Π. Γούναρη, υποψηφίου δια την έδραν των Μεταλλευτικών Έργων* [Memorandum on the works to date of Elias P. Gounaris, candidate for the chair in mining works], 8-2-1918.

1941) and a delegate to the International Labour Conference (1930-1940, 1945, 1947).[50] In addition to administrative and legal texts, Gounaris co-wrote studies and articles on metallurgy, metalwork and mining, as well as numerous technical reports for the companies of which he was a consultant. Similar cases to that of Elias Gounaris were those of his fellow mining engineers and National Metsovion Polytechnic professors Ioannis Doanides and – after World War II – Stavros Katrakis and Loukas Mousoulos.

Of the mining engineers who acted not only as technical personnel in the mining companies but pursued purely business activities, it is worth singling out Konstantinos Negris (1876-1948). The son of Theodoros Negris and Aglaia Stratigopoulou and nephew of the mining engineer Phocion Negris, he studied civil engineering at the National Metsovion Polytechnic (1897). He continued his studies in mining engineering at the École Spéciale des Arts et Manufactures et Mines in Liège (1901), after which he worked for the Greek Metal Works Company of Lavrion (1897-1899), as an engineer (1902-1908) and as a chief operating engineer (1908-1918) for the CFML, before pursuing a very active business career. He became managing director of the Greek Chemical Products and Fertilisers Company SA in 1919 and a member of its board of directors in 1920. From this period onwards, he became integrated into the core of the Greek Chemical Products and Fertilisers Company SA's industrial and business group: in the 1920s and 1930s he was a shareowner and member of the board of directors of numerous companies, most of which were involved in the fertiliser industry of Piraeus.[51] Konstantinos Negris was

[50] After World War II, Gounaris was a member of the German Reparations mission (1948-1950), technical consultant to the Ministry for Coordination (1950-1951) and technical consultant to the Public Power Corporation (from 1951). He was also involved in the administration and management of many mining and industrial enterprises. He was a technical consultant to the Mining Union SA (1918-1929), Greek Coal Mines SA (1922-1924), Piraeus-Athens-Peloponnese Railway and many lignite mines (1918-1924), the Company of Businesses in Greece SA (1919, 1924) and the National Bank of Greece (1937-1949), director of the company Elias Gounaris & Co. (1920-1922), general director of Psychiko Quarries SA, consultant to the New Corinth Canal Company SA (1932), the Greek Powder and Cartridge Company (1932-1940) and the Sheet Steel and Tinplate Company (1947-1949). Hellenic Literary and Historical Archive, Archive of Elias Gounaris; *Τεχνική επετηρίς*, Vol. II, p. 73.

[51] He was a shareholder and board member of the mining companies Businesses in Greece, Kassandra Mining Operations, Hephaestus, Melos Sulphur Mines and the International Mining Company, of the industrial companies BIO, Hermes paper manufacturers, the Athena automobile company, the Titan cement company and the ETMA artificial silk company. *Τεχνική επετηρίς*, Vol. II, pp. 236-237; Sturdza, *Dictionnaire*, p. 363; *Βιογραφικόν λεξικόν*, Vol. II, p. 161; Papastefanaki, *Η φλέβα της γης*.

not simply another mining company shareholder, but an industrialist with an active presence in the country's economic life and employer organisations in the interwar period. He was president of the Greek Industrialists' League (in 1924-1927 and 1931-1933) and the Union of Mining and Metallurgical Enterprises of Greece. He also served on the boards of the Commercial and Industrial Chamber of Athens and the Association of Sociétés Anonymes, while in 1932 he was a member of the Supreme Economic Council.

Several engineers pursued business activities, either establishing or participating in mining companies and, chiefly, serving as contractors in the operation of mines in the nineteenth century and the first half of the twentieth: Emile Grohmann and his son Georg;[52] the brothers Leonidas and Aristides P. Skender; and Loudovikos Depian, Spyridon Despozitos[53] and his sons Evgenios and Arturo Despozitos, as well as Ioannis Lambrinides. These engineers with business interests (and/or contractors) should, in any case, be distinguished from those mining engineers who were employees in mining companies, overseeing the extraction of the ore and directing production. Some engineers dedicated their whole professional lives to working as technical personnel (operating engineers, head engineers, technical directors, etc.) in mining companies. These include the mining engineers Orestes Argyropoulos (CFML), Charalambos Kanakis (the Oropos lignite mines), Sotirios Bournakis (the Kymi lignite mines) and the civil engineer Spyridon Demolitsas. Other engineers, after having worked for some shorter or longer

[52] The German mining engineer Emile Grohmann was, from 1880 to 1906, a contractor for the French Seriphos-Spiliazeza company in the mines of Seriphos. He also controlled and operated other mines (1903-1905). His son Georg, who had studied at the mining school of Clausthal, succeeded him as contractor for the operation of the Seriphos-Spiliazeza mines (1906-1940). Georg also operated the public mine of Chalara (1911-1940), as well as other mines on the islands, in Crete and in the Peloponnese (1930s), and was a shareholder in several mining companies. During the Occupation, Georg Grohmann continued to operate the Seriphos mines as an officer of the German army. Andreas Kordellas, *Ο μεταλλευτικός πλούτος και αι αλυκαί της Ελλάδος* [The mineral wealth and the saltpans of Greece], Athens 1902, p. 84; E. Gounaris, *Η εκμετάλλευσις των μεταλλείων της Ελλάδος κατά το έτος 1910* [The exploitation of Greek mines in the year 1910], Athens 1911, pp. 45, 69; Papastefanaki, *Η φλέβα της γης*.

[53] In the early twentieth century, the engineers Loudovikos Depian and Spyridon Despozitos operated mines either alone or as part of a cooperative (Lavreotiki, Grammatiko, Mykonos, Skyros, Ermioni) and were shareholders in mining companies connected to CFML and the Greek Chemical Products and Fertilisers Company SA. In the nineteenth century Spyridon Despozitos was the British consul at Lavrion. Gounaris, *Η εκμετάλλευσις*, pp. 49, 72-74; Papastefanaki, *Η φλέβα της γης*.

time as technical personnel for such enterprises, chose to start their own businesses as contractors, although some occasionally returned to the public sector at particular moments in their careers, given the absence of other opportunities. The careers of mining engineers such as Nikolaos Roussakis, Miltiades Sapnas, Agis Varvaressos, Nikolaos Patsis, Ioannis Manousos, Ioannis Solomos and his fellow student in Liège, Ioannis G. Lambrinides, fit this picture of frequent professional changes.

Only a small piece of the mining engineers puzzle belongs to those who worked exclusively for state services. The largest piece of this picture is that of the engineers who combined different professional arenas, moving from place to place, company to company, from the private to the public sector and vice versa. In most cases, mining engineers shifted between private enterprises and state bureaucracy, between being a freelancer and being an employee, between earning a wage and being a contractor. This situation of constant flux from one sector of economy activity to another appears to have been a general feature of the engineering profession in the interwar period, while the "[…] close productive and institutional relationship between [the sectors] largely reflects the core of the professional identity of the engineers".[54] The intense mobility of the engineers between different professional sectors and between varied enterprises describes from one other perspective the mining landscape in Greece in the nineteenth and twentieth centuries, as the distribution of capital appears to have been reflected in the organisation of production within the enterprises. The professional mobility of the mining engineers depended, that is, on the limited turnover of the mining companies in Greece and, hence, with their continuous search for better professional prospects, in accordance with the level of their studies and their qualifications.

The Formation of the Professional Community

From the 1880s until the interwar period, the community of Greek engineers gradually came to be formed, with the creation of associations (Greek Technical Association, 1899) and professional organisations (the Technical Chamber was founded in 1923), as well as the publications of the specialist technical press. The main forum for dialogue on technical issues and the technical works that accompanied urbanisation and industrialisation, the technical press, also contributed to creating social networks of engineers and to establishing their scientific integrity.[55] It also hosted discussions on the professional development

[54] Antoniou, *Έλληνες μηχανικοί*, p. 311.

[55] *Ibid*., pp. 181-193; Spyros Tzokas, "Περιοδικά και κοινότητες μηχανικών στην Ελλάδα.

of engineers. The path towards the professionalisation of engineers was accompanied by pressure to consolidate their academic qualifications and create an institutional framework for the terms under which the profession was to be practised, an issue that to a large extent was linked to the pressures that Greek engineers faced in the labour market.[56] More specifically, the few mining engineers faced, aside from the limited turnover of the mining companies, the competition of experts and all those who had been at "unspecified schools" or institutions that were not equivalent to the higher schools of the National Metsovion Polytechnic. In the 1930s, they were to attempt through their professional organisation, the Technical Chamber, to secure legal protection for the qualification and profession of the graduate mining engineer. They also competed to take part in projects that were the responsibility of civil engineers (and/or engineers with other specialities), invoking the broader technical education they had acquired in schools of higher education abroad and their "technical consciousness".[57] The latter would not permit them, the mining engineers of the TCG claimed, to undertake projects that they would not be able to complete. They continued, however, to argue fervently that, in effect, and "in practice mining engineers are considered able to perform any kind of scientific project".[58] The competition within the engineering profession in the interwar period is reminiscent of the similar professional disputes between mining engineers and civil engineers for the areas in which each specialisation would operate in nineteenth-century France, as revealed in the studies of Antoine Picon and André Thépot, highlighting the way in which the professional identity of this branch was formed. This identity was based upon scientific technical knowledge, a technical consciousness and the idea that engineers are transmitters of technical culture and rational discourse. The features that comprised the identity of the engineer were not neutral from the perspective of social class nor from that of gender: they differentiated engineers from workers, emphasising the hierarchical social structure, and also distinguished between the public space (of science, industry, services), in which engineers were active, and the private space of the home, in which the mothers, wives and daughters of engineers were active. They differentiated, ultimately, between the space of science and the

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Η περίοδος πριν την ίδρυση του Τεχνικού Επιμελητηρίου της Ελλάδας" [Engineering journals and communities in Greece: The period before the institution of the Technical Chamber of Greece], *Νεύσις* 18 (2010), pp. 49-68.

[56] Antoniou, *Έλληνες μηχανικοί*, pp. 330-352.

[57] *Τεχνικά Χρονικά* 70-71 (1934), pp. 1040-1042, 1052, 1061-1063, 1076-1079.

[58] *Ibid.*, p. 1063.

technical, which was considered to belong to the male sphere, and the space of nature, which was considered to belong to the female sphere.

The world of mining engineering was a strictly male one, as has been apparent thus far. Both in Europe and in Greece, mining engineers, as well as the engineers from all the other specialisations who worked for mining companies in the nineteenth and twentieth centuries, were men. The mines – places that were inhospitable, tough and dangerous – were not considered places suitable for women. The few female engineers who graduated from the National Metsovion Polytechnic from the 1920s onwards preferred schools with a greater emphasis on the fine arts (architecture) or schools whose graduates could find employment in clean and sterilised laboratories (chemical engineering), schools, that is, that appear to have been orientated to women, according to the existing social stereotypes. Moreover, most female engineers in Greece pursued a career in the public sector, leaving the factories, construction and public works to the men.[59] In the mines and in the mining companies and related public services in general, the only women one might find were the wives and mothers of the engineers. The cultural signing of technology and the profession of the engineer as male are based on the primary dichotomy of Western thought between reason and nature, a dichotomy in which reason is usually identified with masculinity, while nature is identified with femininity.[60] However, the use of dichotomies to classify human behaviours and systems of knowledge conceals inequalities, which express real (and/or symbolic) relationships of power. Technology and science are powerful elements of a ruling male identity of white, middle-class men.[61] The very studies and professional formation of engineers contain a gendered dimension. The male dominance of the profession of engineer creates a new version of masculinity for the men of the middle class, a

[59] Konstantinos Chatzis and Efthymios Nicolaidis, "A Pyrrhic Victory: Greek Women's Conquest of a Profession in Crisis (1923-1996)", in A. Canel, R. Oldenziel and K. Zachmann (eds), *Crossing Boundaries, Building Bridges: Comparing the History of Women Engineers, 1870s-1990s*, London 2000, pp. 253-278; Antoniou, *Οι έλληνες μηχανικοί*, pp. 309-310.

[60] Delphine Gardey and Ilana Löwy, *L'invention du naturel. Les sciences et la fabrication du féminin et du masculin*, Paris 2000.

[61] Ruth Oldenziel, *Making Technology Masculine: Men, Women and Modern Machines in America, 1870-1945*, Amsterdam 1999; Lisa Frehill, "The Gendered Construction of the Engineering Profession in the United States, 1893-1920", *Men and Masculinities* 6/4 (2004), pp. 383-403; Darina Martykánová, "La profession, la masculinité et le travail. La représentation sociale des ingénieurs en Espagne pendant la deuxième moitié du XIXe siècle", in A. Derouet, S. Paye and C. Frapier (eds), *La production de l'ingénieur. Contributions à l'histoire sociale d'une catégorie professionnelle*, Paris (forthcoming).

masculinity that is identified with technical knowledge. This particular version is manifested in the workplaces, offices and mines, in the scientific associations and professional unions and in the pressure for recognition of the profession, even in the public debate on technical matters. The ways, practices and strategies through which the profession of engineer was formed and practised, in particular that of mining engineer, in Greece were interwoven with the language of social class and gender: on the one hand, they reinforced the social division of labour between intellectual and manual labour, while, on the other, they strengthened the gendered division of intellectual labour. Moreover, they presented rationalisation and the acquisition of technical knowledge as elements in the construction of male bourgeois identity and the expression of male pride for the men of the middle class.

The Appropriation and Popularisation of Scientific Knowledge: The Modernising Vision of the Engineers

Certain historiographical approaches have adopted the theory of "transfer" and "adaptation" of scientific knowledge from the centre to the periphery, whereas others adopt the concept of "appropriation" as a tool for the understanding of the constitution of science and technology in the countries of the European periphery. The concept of "appropriation" possesses a dynamic, as it brings to light the definitive role of historical subjects and local communities in the transformation of scientific knowledge, ideas and practices – derived from the centre – and in their subsequent incorporation within the framework of differing social and cultural traditions.[62] Within the context of this debate, I believe that the multiple scientific activities of engineers in the Ottoman Empire and Greece (with translations, teaching, etc.) and the dissemination of scientific knowledge through popularisation are aspects of the process of appropriation of science and technology in the specific historical environment.

The engineers who had studied in Europe in the nineteenth century and the early twentieth and who had returned to Greece and the Ottoman Empire in order to work have been seen by historians as bearers of scientific knowledge and the modernising effort. It has been argued, in other words, that those engineers who returned after their studies in European educational institutions contributed through their work to the modernisation and reform of public

[62] On the discussion, see Kostas Gavroglu *et al*., "Science and Technology in the European Periphery: Some Historiographical Reflections", *History of Science* 46 (2008), pp. 153-175; Faidra Papanelopoulou, Agustí Nieto-Galan and Enrique Perdiguero (eds), *Popularizing Science and Technology in the European Periphery, 1800-2000*, Aldershot 2009.

administration and education and to the introduction of technology into industry and infrastructure. At the same time, the engineers undoubtedly played a seminal role in the establishment and diffusion of technical knowledge, as well as the popularisation of science. They published scholarly studies and manuals, produced translations and introduced, adopted and spread scientific technical terminology.[63] With this approach, they implicitly adopted a theoretical model that contrasted the antiquity of the infrastructure and state mechanisms of South-East Europe with the modernisation of Western European countries. This, in turn, indirectly reproduced a discourse of shortages and "backwardness", which had already been adopted by engineers in the nineteenth and early twentieth centuries, in contrast with an ideal archetype of Westernisation and modernisation. This discourse did not take into account the internal dynamics of societies. Moreover, the very concepts of technical progress and "modernisation" or "rationalisation" contained meanings that were not neutral, either from the perspective of class or that of gender. A characteristic example of this approach of the engineers, who, as bearers of technical and scientific knowledge, "civilise" the uneducated "people", is the argument of the metallurgist Andreas Kordellas, in the introduction to a manual of scientific terms which he translated from German, four years after the first edition had been published in Zurich in 1879:

> To make equal the civilisation of Greece and all the works of its social strata with the civilisation of the West, it is necessary to spread scientific knowledge among the people, it is necessary instead of wasteful novels to introduce popular scientific readings, for the people not only to have virtues and be moral but to expel outdated prejudices and to perfect their professions as scientifically as possible.[64]

The scientific task of translating terminology is here linked, directly, to a process of civilisation, which scientists, in particular engineers, are called upon to perform. The popularised scientific publications produced by

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[63] Meropi Anastassiadou-Dumont, "Science et engagement. La modernité ottomane à l'âge des nationalismes", in M. Anastassiadou-Dumont (ed.), *Médecins et ingénieurs ottomans à l'âge des nationalismes*, Paris and Istanbul 2003, pp. 5-28; Assimacopoulou and Chatzis, "Education", pp. 123-124; Fotini Assimacopoulou and Konstantinos Chatzis, "Σπουδαστές στη Γαλλία, μηχανικοί στην Ελλάδα. Ο κόσμος των ελλήνων μηχανικών, 19ος – αρχές 20ού αιώνα" [Students in France, engineers in Greece: The world of Greek engineers, nineteenth – early twentieth century], *Νεοελληνικά Ιστορικά* 1 (2008), pp. 121-128.

[64] Andreas Kordellas, *Ὀνομαστικὸν ἐπιστημονικῶν ὅρων πρὸς χρῆσιν τῆς Στρατιωτικῆς Σχολῆς τῶν Εὐελπίδων ἐκ μεταφράσεως, διασκευῆς καὶ ἐπαυξήσεως τοῦ ὑπὸ D. Kaltbruner ἐγχειριδίου τοῦ ὁδοιπόρου* [Dictionary of scientific terms for use by the Evelpidon Military Academy, translated, adapted and expanded from D. Kaltbrunner's traveller's guide], Athens 1883, p. vi.

scientists for the benefit of the "people" were to contribute to the spread of scientific knowledge and were to improve the practice of manual labour. These publications were also contrasted with "wasteful" literature, and their moralising dimension is emphasised. Long before the publishing programme of the Society for the Distribution of Useful Books [Σύλλογος προς Διάδοσιν Ωφελίμων Βιβλίων], envisioned by Dimitrios Vikelas, Kordellas had proclaimed, already in the 1880s, a civilising and moralising programme for the working class, using the vehicle of scientific knowledge.

A section of the work of the mining engineers consisted, in addition to preparing technical studies for companies and supervising mining work on the spot, of the creation of a new scientific and technical terminology, the writing and publication of scientific studies and manuals for teaching purposes and the translation of scholarly works into Greek.[65] In 1889, Petros Protopapadakis, then working as an engineer with the Peloponnese Railway Company (1888-1889), wrote a study on the financial management of the railway line, in which the problems caused by the absence of a full technical terminology were apparent.[66] A year later, he published in book form the lessons on theoretical and applied engineering that he taught at the Military Academy, the Naval Academy and the School of Industrial Arts, because, as he wrote in the prologue, there was a "complete lack" of a book in the Greek language on the basics of engineering.[67] In the following years, he worked to spread scientific knowledge, publishing two popular works on astronomy and the natural sciences in the series of the Society for the Distribution of Useful Books.[68] These examples can be multiplied: the engineers of the nineteenth century and the early twentieth published manuals, translated and wrote (original or otherwise) studies; they contributed, that is, to the

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[65] See the publications of Panayiotis Vouyoukas, *Σύντομος περιγραφὴ τῶν ὀρυκτῶν τῆς Ἑλλάδος* [Short description of the ores of Greece], Athens 1856; Kordellas, *Ἡ Ἑλλὰς ἐξεταζομένη γεωλογικῶς καὶ ὀρυκτολογικῶς*; and *id.*, *Στοιχεῖα ὀρυκτολογίας* [Elements of mineralogy], Athens 1888.

[66] Petros Protopapadakis, *Οἰκονομικὴ διαχείρισις τῶν ὑπηρεσιῶν τῆς γραμμῆς καὶ τῆς χρήσεως τοῦ σιδηροδρόμου Πειραιῶς-Ἀθηνῶν-Πελοποννήσου. Μελέτη γενομένη ἐντολὴ τῆς διευθύνσεως αὐτοῦ κατὰ Ἰούνιον καὶ Αὔγουστον 1888* [Economic management of the services of the line and use of the Piraeus-Athens-Peloponnese railway: Study done on the order of the management in June and August 1888], Athens 1889.

[67] *Id.*, *Μαθήματα μηχανικῆς θεωρητικῆς καὶ ἐφηρμοσμένης*, A: *Κινητικὴ καὶ δυναμικὴ τοῦ σημείου* [Lessons in applied and theoretical engineering, I: Point kinetics and dynamics], Athens 1890.

[68] *Id.*, *Ἥλιος, ζωή και κίνησις* [Sun, life and movement], Athens 1901, and *Η Γη* [The Earth], Athens 1906.

propagation of scientific knowledge, the introduction and consolidation of a technical terminology, the introduction and establishment of new subjects at the Technical University and to the dissemination of new methods in the technical sciences.[69] Even during the interwar period, when a Greek technical terminology for the mining industry had been established, relevant manuals continued to appear. New subjects, such as the management and scientific organisation of work, occupied the intellectual activities of the engineers. Themistocles Charitakis, who worked systematically on the translation and publication of works on scientific management, struggled with the translation of terminology, just as the previous generation of engineers had done.[70]

The popularisation of scientific knowledge was of particular interest for engineers. Aside from the scholarly and professional associations and the publications in the specialist technical press, some mining engineers were active in the Parnassos Literary Society, the Association for the Promotion of Education and Learning and the Society for the Distribution of Useful Books. Characteristically, Petros Protopapadakis, Emmanuel Dragoumis and Ioannis Doanides were, among their other positions, members of the Board of Directors of the Society for the Distribution of Useful Books. Doanides, moreover, was actively involved until the end of his life in the administration of the Association and of the Sevastopouleios Industrial School.[71]

Although the systematic analysis of the popularisation enterprise of engineers is not the aim of this study, we can, nonetheless, draw attention to the findings of recent research in connection with the popularisation of the natural sciences in the same period in Greece. The public discourse on science in the second half of the nineteenth century had a direct correlation with utilitarianism as a system of ethics and as an ideology and with the idea of progress. The undertaking of popularisation for the spreading of useful knowledge had, therefore, distinct social, political and ideological implications, as it aimed to raise the educational level and the moral training of the "populace", attainments which were expected to contribute to "social progress".[72] The spreading of useful knowledge, a part of which was the

[69] Assimacopoulou and Chatzis, "Σπουδαστές", pp. 121-123.

[70] Themistocles Charitakis, "Το διάγραμμα Gantt μέσον διοικήσεως και οργανώσεως υπό Wallace Clark" [The Gantt chart, a tool for management and organisation by Wallace Clark], intro. and transl. in the Greek edition, *Αρχείον Οικονομικών και Κοινωνικών Επιστημών* 17 (1937), pp. 230-231.

[71] "Ι. Δοανίδης" [I. Doanides], *Βιογραφικόν λεξικόν*, Vol. III, pp. 534-537.

[72] Eirini Mergoupi-Savaidou, *Δημόσιος λόγος περί επιστήμης στην Ελλάδα, 1870-1900. Εκλαϊκευτικά εγχειρήματα στο Πανεπιστήμιο Αθηνών, στους πολιτιστικούς συλλόγους και*

undertaking of making widely known the natural and mechanical sciences and their importance, was employed as a means of intellectual and political manipulation of the middle and lower social strata in reproducing the existing power relations.

Engineers as Politicians: Phocion Negris and Petros Protopapadakis

Some of the Greek mining engineer graduates of the École des Mines in Paris took an active part in the political life of Greece, were elected as members of parliament and held ministries or other official positions. While Professor Ioannis Argyropoulos had served temporarily in 1916 as minister of transport in the caretaker government of Spyridon Lambros,[73] two other mining engineer ministers, Phocion Negris (fig. 1) and Petros Protopapadakis (fig. 2), were systematically involved in the politics of the early twentieth century.

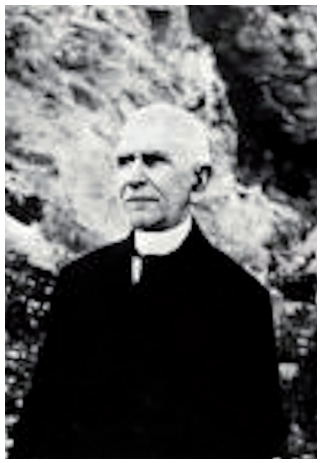

Fig. 1. Phocion Negris.

Fig. 2. Petros Protopapadakis.

Source: Modern Greek Visual Prosopography, Institute for Neohellenic Research / National Hellenic Research Foundation, Athens.

στα περιοδικά [The public discourse on science in Greece, 1870-1900: Popularisation efforts in the University of Athens, cultural associations and the journals], unpublished PhD thesis, University of Athens, Athens 2010.

[73] Douglas Dakin, *Η ενοποίηση της Ελλάδας, 1770-1923* [originally published as *The Unification of Greece, 1770-1923*, London 1972], transl. A. Xanthopoulos, Athens 1982, p. 434.

Phocion Negris descended from the distinguished Phanariot Negris family. His father, Konstantinos, a student of Neophytos Vamvas and protégé of Alexandros Mavrocordatos during his time in Paris, had studied at the École Polytechnique and was a professor of mathematics at the University of Athens (1837-1843, 1843-1845), resigning from this position for political reasons. In 1848, Konstantinos Negris took an active part in the debate on the forced circulation of the drachma and also played a role in the organisation of a charitable response to begging in Athens. In 1864, along with other members of the bourgeoisie, he established the Merciful Company of Athens [Ελεήμονα Εταιρεία Αθηνών], of which he was vice president. He was opposed to the demand for universal suffrage and took part in the elections of 1869 on a platform of independent candidates, as president of an electoral association that supported the implementation of constitutional order, moderate modernisation and the functioning of a parliamentary system.[74] The two sons of Konstantinos Negris, Theodoros (Athens, 1836-1888) and Phocion (Athens, 1846-1928), resided in Paris for many years, studying at the École Polytechnique and the École des Mines, from which the former graduated in 1863 and the latter in 1872. On his return to Greece, Theodoros taught mathematics at the Military Academy, while Phocion pursued a brilliant career as a technical director for mining companies, before becoming involved in politics. Phocion Negris married Eleni Rizou Neroulou, scion of another distinguished Phanariot family, with whom he had a daughter, Loukia (who later married Asimakis Zaimis).

On his return to Greece in the early 1870s, Phocion Negris served as general ephor of Lavrion (1871-1875), overseeing "the extrusions, slags and mines of Lavrion". He stood down as ephor to take up the position of general director of the Greek Metal Works Company of Lavrion (1875-1886, 1894-1898). In 1887, he became managing director and later general director of the Public and Municipal Works' Company [Εταιρεία Δημοσίων και Δημοτικών Έργων, ΕΔΔΕ], a position he held until the end of the 1890s. He was first elected

[74] Michael Stefanidis, *Ιστορία της Φυσικομαθηματικής Σχολής* [The history of the School of Physics and Mathematics], Athens 1952, p. 5; Giorgos Stassinopoulos, *Νομισματική θεωρία και πολιτική στην Ελλάδα τον 19ο αιώνα* [Monetary theory and politics in Greece, nineteenth century], Athens 2000, pp. 102-106; Maria Korasidou, *Οι άθλιοι των Αθηνών και οι θεραπευτές τους. Φτώχεια και φιλανθρωπία στην ελληνική πρωτεύουσα τον 19ο αιώνα* [The wretched of Athens and their carers: Poverty and charity in the Greek capital in the nineteenth century], Athens 1995, pp. 90-97; Gunnar Hering, *Τα πολιτικά κόμματα στην Ελλάδα, 1821-1936* [originally published as *Die politischen Parteien in Griechenland, 1821-1936*, Munich 1992], transl. T. Paraskevopoulos, Vol. I, Athens 2004, pp. 470, 653-655.

member of parliament for Attica and Boeotia in 1887, from which time he was almost continually elected. He was also elected mayor of Lavreotiki (1895-1898). Negris served as minister of finance in 1898-1899 and 1901-1902 in the short-lived governments of Alexandros Zaimis and as minister of the interior in 1916-1917 and Transport in 1916, also in the Zaimis' governments.[75]

As general director of the Greek Metal Works Company of Lavrion, Negris played a decisive role in the technological modernisation of the company in the period 1875-1886, chiefly with the installation of the washery for enriching the extrusions and in replacing the deficient Spanish furnaces with Pilz furnaces. At Mantoudi, where the magnesite mines of the Public and Municipal Works' Company were located, he installed firebricks, an industrial innovation unique in Greece in the late nineteenth century. In addition to managing mines and mining companies, Negris published studies on the ancient washeries of the mines of Lavrion, as well as geological studies, presenting the findings of his research to the Académie des Sciences and the Société Géologique de France. In 1918, he was awarded an honorary doctorate in the natural sciences by the University of Athens for his scientific studies, while in 1926 he was made the first president of the Academy of Athens.[76]

At the ministry of finance, Negris' work was associated with: a) reforming the operations of the International Financial Control; b) drawing up the loan with which the Piraeus-borderlands railway was built; and c) aiming for a balanced budget.[77] As a member of parliament, as well as a shareholder, he opposed the introduction of income tax as proposed by Athanasios Eftaxias in 1909, suggesting instead a tax on rent, which, in his view, "correlated with taxpayers' assets".[78] He also reacted to the new taxation on mining companies, arguing that the rates should be lower so as to boost their growth and even proposed that the land tax be replaced by a tax on annuities, which was fairer.[79]

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[75] Andreas Andreades, "Φωκίων Νέγρης" [Phocion Negris], *Νέα Εστία* 3 (1928), pp. 442-446; I. P. Doanidis, "Φωκίων Νέγρης" [Phocion Negris], *Ημερολόγιον της Μεγάλης Ελλάδος* 8 (1929), pp. 67-84; Sturdza, *Dictionnaire*, p. 363.

[76] Phocion Négris, *Laveries anciennes du Laurium*, Paris 1881; Doanides, "Φωκίων Νέγρης", pp. 71, 73, 78-81; Dermatis, *Λαύρειο, το μαύρο φως*, pp. 204, 273-275; Papastefanaki, *Προσεγγίσεις*.

[77] Andreades, "Φωκίων Νέγρης", p. 445.

[78] Adamantios Syrmaloglou, *Φορολογία ή χρεοκοπία. Η φορολογική πολιτική στη Βουλή των Ελλήνων, 1862-1910* [Taxation or bankruptcy: The fiscal policy in the Hellenic Parliament, 1862-1910], Athens 2007, pp. 252-255.

[79] *Σκριπ* (20 October 1909), p. 2, and (23 October 1909), p. 2.

Negris' parliamentary contribution can be found, in particular, in the introduction of the ΒΩΜΑ law (1901) on mines and in his continual efforts to introduce social insurance to Greece, from as early as the first decade of the twentieth century. The ΒΩΜΑ law reorganised the Miners' Fund, which had been founded in 1882. The Fund compensated workers only for workplace accidents during work underground, even though Negris had proposed that the insurance be expanded to retirement pensions. In 1902, Negris, as minister of finance, submitted a draft law for extending the legislation to compensating those workers suffering from workplace accidents in all industries and he also expanded the insurance coverage to hospital treatment and to retirement pensions for all workers. The funds came from obligatory contributions made by employers and workers. The draft law was not discussed, however, because of a change in government. Negris again presented the draft law of 1902, now broadened, in June and December 1906, as a proposed law "on hospital treatment and pensions for the staff of various industrial enterprises and on pensions for public servants to emery miners". On both occasions, the proposal was rejected. Dismayed that he would not secure the passage of the law for workers in all industries, because of the reaction of the industrialists themselves, he made his proposal once again for just miners and quarry workers in March 1907 and November 1909. "But, in vain!", as he himself confessed.[80] During World War I and the general social unrest, Negris observed that if the law that he had repeatedly proposed in the previous decade had been passed: "relations between employers and workers would not have the harsh character they have today, with continuous uprisings, damaging the interested parties directly and the government indirectly".[81]

The committee that had been formed in 1912 by the minister Andreas Michalakopoulos, in order to draft a bill for insurance for private employees, included Negris, Spyros Koronis, Spyros Theodoropoulos, Spyros Papafrangos and Thrasyvoulos Petmezas. The bill, however, had not been presented to parliament by 1916. In that year, Negris hoped that the work of the committee

[80] Phocion Negris, "Περί ταμείου ασφαλείας κατά των ατυχημάτων των εργατών" [On an insurance fund for worker accidents] *Αρχιμήδης* 12/7-8 (1906); *id.*, *Περί συντάξεων εν Ελλάδι και ειδικώτερον περί του ανωτάτου βάρους εις το μέλλον των δημοσίων συντάξεων επί του δημοσίου θησαυρού* [On pensions in Greece, especially the great future burden of state pensions on the state treasury], Athens 1916, p. 14. See also Antonis Liakos, *Εργασία και πολιτική στην Ελλάδα του Μεσοπολέμου. Το Διεθνές Γραφείο Εργασίας και η ανάδυση των κοινωνικών θεσμών* [Labour and politics in interwar Greece: The International Labour Organization and the emergence of social institutions], Athens 1993, pp. 379, 382.

[81] Negris, *Περί συντάξεων*, p. 14.

would not be forgotten in the drawers of the ministry, but he wished, even more ardently, that a bill would be presented once more to parliament on the issue of insurance for old age pensions and health care for the working class, whose members "are still unprotected or inadequately protected by the various associations" and that the issue be comprehensively settled "on a secure and just basis".[82]

After World War I, Negris based his hopes for the restoration of political and social peace on the idea of the League of Nations. In fact, he served as the first president of the Greek League of Nations Society (1920-1927), vice president of the International Federation of League of Nations Societies (1925-1927) and honorary president of the Greek Association in the final years before his death (1926-1928).[83] Through the Society's newsletter, he promoted issues related not only to the rehabilitation of the Asia Minor refugees, but also current legislation in other European countries and in America, in order to tackle unemployment.[84] He had, that is, a continuous and permanent interest in securing social peace and for preventative, not repressive, measures.

Negris was presented in the press of his day and by his biographers as a modest and honourable politician, above "petty party" conflicts. His bourgeois origins and scientific status lent him the indisputable characteristics of a politician who acted selflessly in the public interest. It was even argued that he was one of the few politicians who was especially loved by both "the advanced class and the people".[85] As the member of parliament for Attica and Boeotia, he drew his voters chiefly from Lavrion and from regions such as Mesogeia, Marathon and the province of Megaris,[86] from where a section of the workers of Lavrion came. In his systematic interest in the improvement of the living conditions of the Lavrion workers and in insurance coverage for miners, and workers in general, we can distinguish the influence of ideas that were circulating at that time in French circles, in relation to the role of the

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[82] *Ibid.*, pp. 15-16.

[83] *Id.*, "Οργάνωσις και δράσις των Συλλόγων της Κοινωνίας των Εθνών" [Organisation and action of the Associations in the League of Nations], *Δελτίον Ελληνικού Συλλόγου της Κοινωνίας των Εθνών* 1/1 (1921), pp. 42-47.

[84] *Id.*, "Περί της ασφαλείας εναντίον της ανεργίας (chômage)" [On the security against unemployment (chômage)], *Δελτίον Ελληνικού Συλλόγου της Κοινωνίας των Εθνών* 2/6 (1922), pp. 3-15; *id.*, "Η καταπολέμησις της ανεργίας (chômage) εις περίπτωσιν οξείας κρίσεως της εργασίας" [The fight against unemployment (chômage) as an example of the extreme crisis of labour], *Δελτίον Ελληνικού Συλλόγου της Κοινωνίας των Εθνών* 2/7 (1923), pp. 3-7.

[85] *Σκριπ* (16 February 1905), p. 1.

[86] *Σκριπ* (27 April 1910), p. 4, and (26 February 1905), pp. 3-4.

engineer and the preservation of social peace. Negris, a graduate of the École des Mines, where Saint-Simonian ideas were popular, adopted practices and developed strategies throughout his professional and political careers which aspired to give an ethical dimension to industrial capitalism. As a member of mining companies, he had an intermediary role between employers and workers, a role that he performed literally, putting out the fires during the 1897 strike by CFML workers.[87]

As a bourgeois politician, Negris eloquently expressed, in the late nineteenth and early twentieth centuries, the increasing bourgeois interest in reforming labour relations with the intervention of the state and the implementation of a social policy in the workplace. The realisation of the long-term social inequality and the gradual decline of employer paternalism inspired in the first decade of the twentieth century the voices of the bourgeoisie to call for a new political approach to labour relations. Negris was a proponent of this view when, in 1906, he started the preamble for a draft law he submitted to parliament with Wilhelm I's declaration to the Reichstag:

> […] if we can be sure that we will leave behind us a new and stable guarantee for internal peace, and having given the welfare needed to those who suffer, as much as they are entitled to […] Finding the best means to ensure this level of welfare is truly difficult, but also unavoidable for any community built upon the moral foundations of Christian social relations.[88]

Negris' experience in the mines of Lavrion, where he came to understand from up close "the needs and just claims" of the workers was the basis for his belief in the need for social insurance for workplace accidents, for health care and old age pensions, so that: "Workers and employers coming together and acting together can be united inseparably with feelings of love and concord, which are necessary for the advancement of every enterprise and every society."[89]

Petros Protopapadakis (Naxos, 1858 – Athens, 1922), a graduate of the École Polytechnique (1883) and the École des Mines (1887), who had also

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[87] According to the description given by both of his biographers, the negotiations between the miners and Serpieri had reached an impasse, and the workers had barricaded their employer in his house and were firing on him. Serpieri's wife asked Negris to help. Given his modesty and the reputation he had among the workers, he was able to calm the excited spirits and convince the workers to put out the fire that they had lit in the house. Andreades, "Φωκίων Νέγρης", p. 444; Doanides, "Φωκίων Νέγρης", pp. 74-75.

[88] "Preamble" to the draft law "on pensions for the staff of various industrial enterprises", *Government Gazette*, Appendix, period XVIII (1906), p. 325.

[89] *Ibid.*, p. 325.

successfully passed the course on railways at the École Nationale des Ponts et Chaussées, worked for the year 1887-1888 for the Compagnie des Chemins de Fer du Midi. On his return to Greece in 1888, he was appointed professor in engineering at the Military Academy and the Naval Academy and worked as an engineer for the Peloponnese Railway Company (1888-1889). He taught port and water supply works at the School of Industrial Arts (1889-1891) and worked as a technical director on the building of the Corinth Canal (1890-1895). He was also a contractor for the construction of the railway networks of Greece and the Ottoman Empire and worked as a building contractor. In addition, he was director of technical services for the Municipality of Athens (1899-1900, 1915).[90]

Protopapadakis became involved in politics in the first decade of the twentieth century, after having worked for 12 years in Greece, in the meantime marrying Smaragda Oikonomou, the daughter of Aristeides Oikonomou, with whom he had four children. Protopapadakis, although he was not the scion of a distinguished family as Phocion Negris was, was still relatively prosperous, since he appears to have had significant property and shares around 1900 and was a figure in society circles. He was a member of parliament for the Cyclades in 1902-1904 and in 1906-1910. He participated in Stefanos Dragoumis' parliamentary group (1905) and in 1907-1909 he was part of the parliamentary group led by Dragoumis and Dimitrios Gounaris.[91] Protopapadakis served as minister of finance in the government of Gounaris in 1915, although not a member of parliament. He returned to the political scene in 1920-1922, serving as minister of finance in 1921-1922 in the governments of Nikolaos Kalogeropoulos and Gounaris, as minister for food and self-sufficiency also in 1921-1922 and, for a brief period, as prime minister and minister of military affairs in 1922.[92] He was tried during the Trial of the Six, sentenced to death and executed by firing squad.

During the years of his study in Paris, Protopapadakis had come to know Gustave d'Eichthal, who offered him financial and social support. His relationship with the elderly Saint-Simonian – who, during his sojourn

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[90] *Τεχνική επετηρίς*, Vol. I, p. 158; Oikonomou, *Πέτρος Πρωτοπαπαδάκης*, pp. 56-57, 61-64, 75-86, 201-202; Antoniou, *Οι έλληνες μηχανικοί*, pp. 128, 185.

[91] Protopapadakis found himself outside Parliament from 1910 to 1920, not having stood in the 1910 elections and failing to be elected in those of 1912 and 1915.

[92] Oikonomou, *Πέτρος Πρωτοπαπαδάκης*, pp. 94-95; Syrmaloglou, *Φορολογία ή χρεοκοπία*, pp. 161-165, 172; Dakin, *Η ενοποίηση της Ελλάδας*, pp. 429-435; Thanassis Bohotis, "Εσωτερική πολιτική" [Internal politics], in Hadziiossif (ed.), *Ιστορία της Ελλάδας*, Vol. I/2, pp. 41, 55, 84, 100.

in Greece in 1833-1835, had contributed to the creation of the Office of Public Economy in the ministry of the interior and who died in 1886 when Protopapadakis was still studying in Paris – must have left an impression on the young engineer. Nonetheless, this is not the place to investigate another supporter of the ideas of Saint-Simon and, in any case, the various Saint-Simonian influences in Greece have already been investigated.[93]

Throughout his political career, Protopapadakis articulated a coherent economic argument in parliament, with analytical thought and practical economic consideration. His parliamentary presence was distinguished for its practicality as regards economic issues, while references to economic theory are absent from his parliamentary speeches and published writings. He did, however, use statistical and quantitative methods. His positions on the country's economic policies primarily concerned fiscal consolidation and the institutional modernisation of the public administration. Especially during the first phase of his parliamentary career (1902-1910), his views chimed with the economic ideas of the International Financial Control imposed upon the country in 1898, as regards fiscal discipline and the modernisation of the public administration.[94] Protopapadakis opposed protectionism and supported an increase in direct taxation and a decrease in indirect taxation, arguing that duties and indirect taxes burdened the middle and working classes.

Protopapadakis' parliamentary career began in May 1903, when he proposed two draft bills for the modernisation of the main source of economic activity in his electoral constituency, Naxian emery. The proposals concerned: a) the sale and operation of emery; and b) the creation of an emery workers' fund, as they had not been included in the regulations of the ΒΩΜΑ law in 1901. The bills were accompanied by a preamble of several pages, which comprehensively examined the production and consumption of emery on a global scale, presenting the historical development of the ownership of the emery mines of Naxos and the commercial exploitation of the ore by Greek governments and proposing different management systems. These proposals were not voted in, but were published together with the preamble in a bound volume, at parliamentary expense.[95]

The most representative text by the Naxian politician during this period is the report of several pages that he submitted to parliament in 1907 as the

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[93] Christina Agriantoni, "Επίμετρο. Οι σαινσιμονικές ιδέες στην Ελλάδα" [Afterwards: Saint-Simonian ideas in Greece], in Picon, *Οι σαινσιμονιστές*, pp. 329-341.

[94] Syrmaloglou, *Φορολογία ή χρεοκοπία*, pp. 119, 164-174, 262.

[95] Protopapadakis, *Μονογραφία περί Ναξίας σμύριδος*.

rapporteur for the minority on the committee for the public budget of the Georgios Theotokis government.[96] In this report he analysed the state income for the years 1880-1905, observing that the proportion of the income from direct taxes was continually being reduced, while, in contrast, the proportion of the income from indirect taxes was gradually rising, concluding that: "[…] the meaning of tax is completely overlooked in Greece, where it is imposed upon the income of the tax-paying citizen and not upon his consumption. Tax has ended up, that is, being forced on those with the greatest needs in life, and not on the annuity."[97]

Protopapadakis' observations on the burdens of the lower economic classes conform to a great degree with the more recent observations of researchers on the unequal distribution of the tax burden in the Greek State.[98] He believed that the tax burden of the lower classes along with the bad administration, lack of justice and public security made the country unliveable for the weaker classes and saw transatlantic migration as a "peaceful revolution" of the poor against the difficulties of life in Greece.[99] He therefore supported the reorganisation of public administration, a more just distribution of tax burdens and an increase in public expenditure on health and education, which was the lowest among all the Balkan countries, as well as the reorganisation of the statistics service.[100]

For Protopapadakis, public health was the chief engine of economic growth, and he thus fully adopted the views of doctors who at that time were working on related issues, arguing that the improvement of public health through the prevention of infectious diseases must be the focus of the government's interest.[101] Protopapadakis' emphasis on the economic value of health (as securing the necessary labour and reducing the number of days and funds spent on treatment) found a place within the broader discussion on public health in the Greece of the early twentieth century. This debate, the participants of which included distinguished members of the community of doctors and engineers, concerned the improvement of infrastructure and

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[96] Petros Protopapadakis, *Έκθεσις της μειονοψηφίας της επί του προϋπολογισμού του κράτους επιτροπής* [Report of the minority on the state budget committee (presented to the Hellenic Parliament)], Athens 1907.

[97] *Ibid*., p. 10.

[98] George Dertilis, *Ατελέσφοροι ή τελεσφόροι; Φόροι και εξουσία στο νεοελληνικό κράτος* [Ineffective or effective? Taxation and political power in modern Greece], Athens 1993.

[99] Protopapadakis, *Έκθεσις*, p. 24.

[100] *Ibid*., pp. 40, 194-195.

[101] *Ibid*., pp. 165-171.

the reduction of the morbidity and mortality rates within the population. However, it also raised more general issues of how to clean up Greek society, both literally and metaphorically.[102] Protopapadakis came to see the country's productive forces themselves as ill, since "they are sleeping a sleep that is not natural, but that of a sick person in a stupor, against which we must react with all our powers".[103] The means for awakening the population were to be found in the improvement of public health and the expansion of technical education on all levels. He made it clear, however, that by professional training he did not mean "the creation of schools designed to train dependents of the public budget […], but the propagation among the people of that positive knowledge that made the nineteenth century glorious and which must be used as a guide in every action, down to the last farmer". The technical educational institutions were obliged, "intelligently and effectively", to work to make known to the public "those healthy economic principles", so as to make even the last farmer "a figure that is beneficial to the engine of the whole national economy".[104] The success of modern civilisation was due to technical knowledge being inoculated with classical knowledge, he argued, citing Gerolamo Boccardo, the advocate of economic liberalism and professor of political economy at the University of Genoa. In examining the technical services of the state, he observed that they impeded both oversight of public works and the way in which public money was used. He then sharply criticised the School of Industrial Arts, which had proved ineffective as a school for foremen, as "nowhere responded to the needs of technical education", since it could not produce engineers that were "suitably formed and practising adequately", so as to be useful for the state services. He located the reasons for the low standards of the School, which did not fulfil the preconditions even of a "lower technical college" in Europe, to inadequate organisation, the curriculum, the lack of laboratories and practical exercise and to a teaching staff consisting mostly of "mediocrities", despite the presence of certain teachers of a much higher standard.[105]

In the second phase of his political activity (1920-1922), Protopapadakis' economic policy focussed on reducing the public deficit. In 1922, he opted for

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[102] Leda Papastefanaki, "Politics, Modernisation and Public Health in Greece (1900-1940): The Case of Occupational Health", in C. Promitzer, S. Trubeta and M. Turda (eds), *Health, Hygiene and Eugenics in South-eastern Europe to 1945*, Budapest and New York 2011, pp. 167-174.

[103] Protopapadakis, *Έκθεσις*, p. 194.

[104] *Ibid*., pp. 194-195.

[105] *Ibid.,* pp. 227-228.

the solution of a forced loan and the cutting in half of the currency, in order to cover the needs of the state. The imposition of the emergency measure of the forced loan of course gave a temporary economic breather to diplomatically isolated Greece and has been seen as a successful and globally innovative act, but also as a significant violation of the right to private property.[106]

By way of conclusion, both Phocion Negris and Petros Protopapadakis were moderates in politics, as they showed a constant interest in the introduction and establishment of social security schemes, the bettering of the living standards of the lower orders, improvement in public health and education and the development of technical and vocational training. Through their interventions, which were based on their specialist scientific knowledge and experience, which they derived from the environment in which they worked, their interest was orientated not only towards the technological and organisational modernisation of the enterprises in which they were employed, but towards the modernisation of the state and of Greek society. Even if they were not purist supporters of the Saint-Simon ideology with which they came into contact during their studies at the École des Mines in the nineteenth century, nevertheless, the ensuring of social cohesion was an on-going concern for these two engineers and politicians. They were convinced that science and technology would contribute to the country's economic and industrial development, and that these in turn should ensure an improvement in the population's standard of living and the maintenance of peace in society and between the classes.

The Engineer as Social Reformer: Themistocles Charitakis

The American methods of production and management that had already reached Europe before World War I spread significantly throughout the continent during the interwar period. The ideas of Frederick Winslow Taylor and Henry Ford on mass production and consumption, the chain of production and marketing science encountered the deep desire of the European bourgeoisie to use technology in order to increase production and alleviate social conflicts. The bourgeois strategies of defence in many

[106] Syrmaloglou, *Φορολογία ή χρεοκοπία*, pp. 120, 172-174; Michalis Psalidopoulos, *Η κρίση του 1929 και οι έλληνες οικονομολόγοι* [The crisis of 1929 and the Greek economists], Athens 1989, pp. 61-62; Christos Hadziiossif, "Το προσφυγικό σοκ, οι σταθερές και οι μεταβολές της ελληνικής οικονομίας" [The refugees' shock, the constants and the changes of the Greek economy], in Hadziiossif (ed.), *Ιστορία της Ελλάδας*, Vol. II/1, p. 17.

European countries shared similarities in respect to their broad receptiveness to Fordism and Taylorism. The "scientific management of work", with the use of rationalisation (the strict division of labour, the time and motion study, the production chain, the assembly line, the expansion of the piece-rate system, production bonuses, etc.), advocated by Taylor was widely discussed in European bourgeois settings. In most cases where "Taylorism" was adopted, the "scientific management of work" was understood almost exclusively as a tool for managing staff, while the adaptation of Taylorist methods to the practices of European employers always met with reaction from the workers.[107]

In the interwar period, at a time when the Greek technical press was focussed on promoting the ideas of scientific management, the work of the mining engineer Themistocles Charitakis seemed eloquently to condense the interest of the technical world and the bourgeoisie for rational organisation, an increase in productivity and the management of labour relations. Themistocles Charitakis was born in Athens in 1888 and studied at the École des Mines in Paris (1907-1910), where one of his professors was Henry Le Châtelier, one of the leading proponents of Taylorism in France. On his return to Greece, Charitakis worked as an engineering consultant with his own technical studies firm. From 1929, he was a lecturer in "applied political economy" at the Supreme School of Economics and Business and a technical consultant to the Technical Chamber in 1931-1932. He played a leading role in the publication of the technical journal *Έργα* [Works], was secretary of the Greek Association for the Scientific Management of Labour (1936) and made a systematic attempt to introduce the methods of the scientific management of labour to Greece through publications and his involvement in international debates. Despite his active participation in the debate around rationalisation in the interwar period and his association with the Greek version of "reactionary modernism" in the second half of the 1930s, Charitakis did not succeed in 1939 in being elected to the chair of Technical Operation of Works at the National Metsovion Polytechnic.[108]

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[107] Charles Maier, "Between Taylorism and Technocracy: European Ideologies and the Vision of Industrial Productivity in the 1920s", *Journal of Contemporary History* 5 (1970), pp. 27-51; François Caron, *Les deux révolutions industrielles du XXe siècle*, Paris 1997, pp. 95-101, 310-318; Aimée Moutet, *Les logiques de l'entreprise. La rationalisation dans l'industrie française de l'entre-deux-guerres*, Paris 1997.

[108] On reactionary modernism in Germany in the interwar period, see Jeffrey Herf, *Αντιδραστικός μοντερνισμός. Τεχνολογία, κουλτούρα και πολιτική στη Βαϊμάρη και το Γ΄ Ράιχ* [originally published as *Reactionary Modernism: Technology, Culture and Politics in Weimar and the Third Reich*, Cambridge 1984], transl. P. Matalas, ed. C. Hadziiossif, Heraklion 1996.

In 1924, Charitakis published an extensive summary of the 1917 book by the mining engineer Henry Fayol, who had attempted to advance "scientific management" by setting the foundations of the scientific method.[109] Fayol, who had worked in the Decazeville mines in the 1890s, had set as his goal the creation, through the management of work, of a normative universe of industrial order that would bear no relation to the previous personal and paternalistic management of workers.[110] During the transition from empiricism to the scientific method, the advantage of Henry Fayol's work over that of Frederick Winslow Taylor lay, according to Charitakis, in the fact that the French engineer had taken into consideration the findings of political economy and the social sciences. As for Fayol's method of studying management issues, Charitakis argued that it was "the same as the experimental method of Claude Bernard in his introduction to experimental medicine, the so-called positivist method of Auguste Comte in the social sciences or, more simply, the scientific method of Cartesianism".[111] Charitakis attempted to explain just what scientific management was: "The management is faced with problems similar to that of medicine as applied to the whole of the social organism."[112] The following year, Charitakis presented the system of Henry Ford, which he described as a successful implementation of Taylor's theory, without, however, Taylor's scientific dimensions and theoretical basis.[113] In 1926, given that the convergence of Taylorism and Fayolism had been achieved, Charitakis published two articles in which he presented the principles of the scientific application of rationalisation and the problems that this field could solve (maximisation of the performance of machines and men, reduction of workers' fatigue, scientific management of work).[114] In a 1929

On Charitakis, see Antoniou, *Έλληνες μηχανικοί*, pp. 325-330; Yiannis Antoniou, Michalis Assimakopoulos and Konstantinos Chatzis, "The National Identity of Interwar Greek Engineers: Elitism, Rationalization, Technocracy, and Reactionary Modernism", *History and Technology* 23/3 (2007), pp. 241-261.

[109] Themistocles Charitakis, "Η εν τη βιομηχανία διοίκησις και γενικώτεραι αυτής εφαρμογαί κατά τον H. Fayol" [The industrial administration and its general applications, according to H. Fayol], *Αρχείον Οικονομικών και Κοινωνικών Επιστημών* 4 (1924), pp. 7-61.

[110] Yves Cohen, "Fayol, un instituteur de l'ordre industriel", *Entreprises et Histoire* 3/34 (2003), pp. 29-67.

[111] Charitakis, "Η εν τη βιομηχανία", pp. 7-8.

[112] *Ibid.*, p. 8.

[113] *Id.,* "Φορδισμός. Αι ιδέαι του Henry Ford περί διοργανώσεως της βιομηχανίας" [Fordism, Henry Ford's ideas on industrial organisation], *Αρχείον Οικονομικών και Κοινωνικών Επιστημών* 5 (1925), pp. 378-379.

[114] *Id.*, "Η επιστήμη της οργανώσεως της εργασίας" [The science of work organisation],

article describing scientific vocational orientation, he argued that through psychometric methods it is possible: a) to use individuals' "professional abilities" in an excellent way; and b) that a satisfactory "choice" of individuals be made in relation to their profession. Psychometrics can achieve:

> […] the determination of the professional ability of workers, compiling a full catalogue of professions, through which the individual being examined can find the or those professions for which he is suitable and those that, because of physical or psychological form or for educational or economic reasons, it appears he should avoid […] Thus, by knowing, at least for the simpler professions, if he is in a position to fulfil the job which he wants to do or whether he should find another for which he is more suitable.[115]

Psychometric methods were already being applied in special laboratories in England, Germany, France, the USA and elsewhere, where, with the help of tests and a variety of examinations, human reactions to external stimulation were graded. Those who took the psychometric tests could then be directed to suitable jobs and be excluded from jobs that were unsuitable for them. The examinations measured memory, attention and intelligence, and even the endurance and health of the workers.[116] Charitakis ended his article by presenting a table of professional credentials with the required "normal", "psychological" and educational credentials for a series of professions (builder, painter, stonemason, carpenter, bookbinder, barber, etc.), which had been produced by the career development office in Lyon.[117] Under the guise of an objective scientific observation, which would theoretically benefit the workers, as it would direct them into jobs that were suitable for them, the psychometric method, part of the Taylorian-inspired "scientific management of labour", Charitakis noted, classified and created models of workers, excluded them from jobs or guided them to specific jobs according to the needs of production. By reading Charitakis' article on scientific vocational orientation, I could presume that the management of production, on the basis of normative models and the taxonomic measures of engineers and the other sciences that promoted the scientific management of work, made a drastic intervention into the social division of labour, creating new and more

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Έργα 29 (1926), pp. 97-101; *id*., "Διδασκαλία της διοικήσεως των εργασιών" [Instruction of scientific management], *Έργα* 30 (1926), pp. 121-127.

[115] *Id*., "Ο επιστημονικός επαγγελματικός προσανατολισμός" [The scientific vocational orientation], *Έργα* 91 (1929), p. 539.

[116] *Ibid*., pp. 540-543.

[117] *Ibid*., pp. 543-544.

profound divisions and exclusions. In my view, these taxonomies, presented as neutral and objective, were in reality taxonomies on the lines of gender, class, ethnicity and religion, as can be seen from a more careful analysis of the professional criteria required for the different jobs. These taxonomies exacerbated the divisions in the labour market and reinforced society's hierarchical structure. Although it is not certain that such psychometric tests were used by Greek companies in the interwar or post-war periods, it is worth mentioning that these models of taxonomy concealed an element of authoritarianism.

In his 1930 report in the Greek technical press on the 4th International Congress on the Scientific Management of Labour held in Paris, Charitakis made particular reference to the contribution made by Henry Le Châtelier on the relationship between the scientific management of work and the social issue:

> It behoves all and the smaller engineers to have the ambition to be good guides of men and through Knowledge, based on the celebrated Cartesian method, and Free Will, supported by the desire to spread their educated opinions in a spirit of justice and right thinking, to contribute to the resolution of this [social problem].[118]

He argued that the importance of the scientific management of work was even greater for countries with limited industrialisation, such as Greece, because it was a "means for rapid and safe progress […] to the foundations of being methodical, the fight against imprudence, disorder, the spirit of the purposeless change in methods and means".[119]

Some years later, in 1937, Charitakis translated the work of the engineer Henry Laurence Gantt into Greek, on monitoring production and productivity in the workplace through the use of charts. Gantt, who had worked with Taylor, had devised one of the best-known bonus systems for inspiring greater productivity from workers ("task and bonus"). The management of work using a Gantt chart was based on time and not on quantity, and this relationship was seen as his greatest contribution to management and the scientific management of work. A further advantage of the Gantt chart was that it introduced a management system that could be understood not only

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[118] *Id.*, "Το εν Παρισίοις Δ΄ Διεθνές Συνέδριον της Επιστημονικής Οργανώσεως της Εργασίας" [The 4th International Congress on the Scientific Management of Labour in Paris], *Έργα* 111 (1930), p. 389.

[119] *Ibid.*, pp. 387- 391.

"by someone from the supervisory staff but equally well by the workers".[120] As Charitakis argued in the introduction to the translation, there are reservations about the new working methods when they appear as the importing of innovations into businesses by outside people, but it is recognised nonetheless that they are a natural continuation of:

> […] the centuries-old attempts by humanity on the basis of knowledge of the natural, psychological, economic and ethical factors, for the production of more, cheaper and better products, for distribution to the consumers, with at the same time the best remuneration for the productive employers and workers. The new methods secure the most logical, best and appropriate use of the elements of production.[121]

Conclusions

Mining engineers cannot be seen as "neutral" bearers of modernisation and scientific knowledge, but as active historical agents who, through the vehicle of scientific and technical knowledge, contributed in many ways to the enterprise of industrial modernisation in Greece from 1870 to 1940 and attempted to implement a broad civilising and moralising programme for Greek society.

Mining engineers in Greece, as employees of the state mechanism, formed and oversaw the running of the institutional framework of the mines. As engineers in secondary production, they played a crucial role in the organisation and management of production and the appropriation of technology, while they also contributed to the consolidation of new social relations between the rural populations and the mining regions. In the case of the engineers, scientific thought served the modernising vision, which was translated using the terms of industry and the development of a technical culture. The intermediary role of the engineers between the workers and the employers often made them intermediaries between capital and labour: from this derived, moreover, the increasing interest of engineers such as Phocion Negris and Petros Protopapadakis to reform labour relations and social policy and to establish social insurance policies.

Mining engineers intervened in the management of production, but also demanded an active role in political life: Phocion Negris and Petros Protopapadakis intervened in public affairs and were politically active in

[120] *Id.*, "Το διάγραμμα Gantt", p. 233.
[121] *Ibid.*, pp. 231-232.

the effort to maintain social hierarchies and peace in society. On the other hand, such mining engineers as Konstantinos Negris and Elias Gounaris, who were entrepreneurs and shareholders in mining and industrial enterprises, participated systematically in employer organisations.

The formation of mining engineers' professional groups, as well as the social organisation that they envisioned, were rooted in gendered and class relations of power. The interest in technology and the management of industrial production went along with their demand for the management of society itself. Whether Saint-Simonians or not, the engineers who worked in Greece in the late nineteenth century and the first half of the twentieth moved between technical efficacy and economic growth, between the innovation of technical civilisation and the easing of the social tensions that resulted from the new social relations of industrial capitalism. Economic growth for them could not be disconnected from social order and a hierarchical social organisation. In a brilliant, albeit extreme way the demand for social order was expressed by the mining engineer Themistocles Charitakis in the interwar period, just at the time when political authoritarianism was spreading in Greece and Europe.

University of Ioannina