THE MILITARY MARCH OF PHYSICS – I: PHYSICS AND MECHANICAL SCIENCES IN THE CURRICULA OF THE 19TH CENTURY OTTOMAN MILITARY SCHOOLS

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Physics in the Ottoman Empire originated from two sources, both inherited from the medieval Islamic scientific tradition. Mathematical sciences constituted one of these sources, where optics and mechanics were considered as sub-disciplines of these sciences in earlier classifications. Optics was best represented by the works of Takiyüddin (d. 1585) who was a follower of Ibn el-Heysem's and Kemaladdin Fârisî's school of optics. With his *Navru Hadikat al-Absâr va Nuru Hakîkat al-Anzâr* (1574), Takiyüddin not only embraced the Heysem-Fârisî approach, but also made minor original contributions to issues such as the production of colors by refraction and the linear propagation of light.[1] Mechanics, however, was a more established scientific field compared to optics. A number of manuscripts were written on mechanical clocks, automatons, lifting weights, water pumps, and the density of materials. The first Ottoman work written in the early mechanics tradition was composed by Alâuddîn el-Kirmânî, a scholar who migrated from Persia to Anatolia in the time of Sultan Mehmed II (r. 1444-46 and 1451-81). The aforementioned Takiyüddin is the last representative of this tradition and his work on mechanical clocks, *Al-Kavakib al-Durriya fi Vaz'al-Bangamat al-Davriyya* (1559), is the earliest Middle Eastern text on European mechanical clocks.[2] Scientific traditions of Islamic optics and mechanics, however, seem to have vanished in the Ottoman Empire after the sixteenth-century. During the nineteenth-century, optics came under the purview of physics. Mechanics, on the other hand, split into several distinct branches: some of which were included in the study of physics, while others remained within the realm of mechanics. Mechanics itself dramatically changed in the nineteenth-century.

Natural philosophy was the second source from which the Ottomans drew on physics before the nineteenth-century. The long-standing madrasa tradition

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1 H. G. Topdemir, 'Osmanlılarda fizik çalışmaları' in *Osmanlı*, Vol. VIII, Yeni Türkiye Yayınları, Ankara, 1999, pp. 445-460; H.G. Topdemir, *Takiyüddin'in Optik Kitabı: Işığın Niteliği ve Görmenin Oluşumu*, Ankara 1999.

2 *Osmanlı Tabii ve Tatbiki Bilimler Literatürü*, Vol.I, E. İhsanoğlu, R. Şeşen et al. (eds), IRCICA, Istanbul, 2006, pp. 14-16, 41-43; Topdemir, 'Osmanlılarda fizik çalışmaları', pp. 446-447; F. Günergun, 'Science in the Ottoman World' in *Imperialism and Science: Social Impact and Interaction*, G. N. Vlahakis et al. (eds), ABC-CLIO, California, 2006.

of Islamic culture handed down a specific understanding of philosophy to the Ottomans. The philosophy (*hikmet*) courses at the madrasas offered a tripartite curriculum to students: natural philosophy, logic, and metaphysics. The most admired philosophical texts were the *Hidâyetü'l-hikme* by Esîrüddîn el-Ebherî (d. 1265) and the *Hikmetü'l-ayn* by Necmüddîn el-Kâtibî (d. 1277). These thirteenth-century texts as well as their commentaries and their annototations were still influential in the teaching of philosophy in the eighteenth-century. The parts of these texts dealing with natural philosophy can be classified within the framework of Avicenna's reception of Aristotelian physics.[3]

This very brief summary of the history of physics before the nineteenth-century sketches a portrait of an extended medieval period in the Ottoman Empire. The research carried out so far does not provide sufficient clue that Ottomans have adopted the physics of Galileo, Descartes, or Newton prior to nineteenth-century.[4] How then can we account for the remarkable changes in physics and mechanics that took place in the nineteenth-century Ottoman Empire? During this century, the Ottoman Empire underwent a series of reforms that replaced the building blocks of "the long-preserved and honored institutions of the classical Ottoman state by new ones, inspired by an increasing knowledge of European thought, society, and government and modified to satisfy Ottoman needs and conditions." [5] This period of modernization was quite significant for the appropriation of European sciences and techniques as well. The Ottoman state played a key role in opening a new era for the reception of modern sciences, establishing new institutions for military and public education, and improving the existing ones. The nineteenth-century is also significant in the history of physics in the western world: Physics in the nineteenth century, as Buchwald and Hong have noted, "was transformed into a professional, unified,

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3 C. İzgi, *Osmanlı Medreselerinde İlim*, Vol. II, İz yayıncılık, Istanbul, 1997, pp. 107-128.

4 The work of İbrahim Müteferrika (d. 1747), who was the founder of the first Ottoman printing house and an Ottoman intellectual, however, constitutes an exception. Müteferrika, while preparing Katip Çelebi's (1609-1657) work on geography -the *Cihannüma*- for publishing in 1730-32, annotated some outdated issues on geography, geometry, astronomy, cosmography etc., and updated them with more contemporary knowledge. İnan Kalaycıoğlulları examined İbrahim Müteferrika's annotations and concluded that Müteferrika, who supported Copernicus' heliocentric model, referred to Galilei and Descartes's arguments as physical evidences confirming the heliocentric model. For the time being, Müteferrika's annotations are the only evidences pointing to Ottomans' encounters with modern physics prior to nineteenth-century. See İ. Kalaycıoğulları, *Katip Çelebi'nin Cihannümâ Adlı Eserine İbrâhim Müteferrika'nın Yaptığı Ekler Doğrultusunda Çağdaş Bilimlerin Türkiye'ye Girişi*, Unpublished master thesis, Ankara University, Ankara, 2003, p. 47; A. A. Adıvar, *Osmanlı Türklerinde İlim*, 6. bs. Remzi Kitabevi, İstanbul, 2000, p. 171. For the publishing of Cihannüma by Müteferrika see Orlin Sabev, *İbrahim Müteferrika ya da İlk Osmanlı Matbaa Serüveni (1726-1746)*, Istanbul: Yeditepe Yayınevi, 2006, pp. 209-222.

5 S. J. Shaw, E. K. Shaw, *History of the Ottoman Empire and the Modern Turkey*, Vol.II (Reform, Revolution and Republic: The Rise of Modern Turkey 1808-1975), Cambridge University Press, Cambridge, 1977, p. vii.

quantitative, and exact discipline with methods that markedly distinguished it from astronomy, chemistry and mathematics".[6]

Within this context, the present research will examine the teaching of physics and mechanical sciences in the Ottoman military schools of the nineteenth-century. It aims to contribute to an overall understanding of the history of physics in Turkey. For several reasons, it can be considered as an introductory study. Firstly, this research does not deal with civil(ian) institutions of higher education. Despite the existence of promising studies in the history of Ottoman education, there is still much to be done in order to provide historical analysis of the curricula and the teaching of sciences. Secondly, I unavoidably had to leave out of scope the laboratories and the role of experiment in physics education. Although it is an intriguing subject, my preliminary research has revealed only a limited number of sources. On the other hand, the slow and accumulative progress of physics in the Ottoman Empire could not be written without the history of military educational institutions because modern physics was established in these schools: The *Mühendishane-i Berri-i Hümayun* (the Military Engineering School), the *Mekteb-i Bahriye-i Şahane* (the Naval Academy), the *Mekteb-i Tıbbiye-i Şahane* (the Military School of Medicine), and the *Mekteb-i Harbiye-i Şahane* (the Military Academy).

This study is divided into three parts, each containing a different category which I consider as an essential element in the establishment of physics education: The curriculum, the teacher, and the textbook. This article focuses on the place of physics and mechanical sciences in the curricula of Ottoman military schools. It examines the historical evolution of physics courses parallel to the major educational reforms enacted by the Ottoman government and tries to unveil how these courses were affected by the changes in educational policies or by redefinitions of the intended profile of the graduates of these schools. The role of professionals, i.e., the physics teachers, and the textbooks on physics and mechanics written by the teachers of these schools will be investigated in a second article: *The Military March of Physics-II*.

Physics at the Military Engineering School (the Mühendishane-i Berri-i Hümayun)

In the eighteenth-century, the Ottoman administrators made significant attempts to organize military education in order to modernize the army. Thus, with the assistance of European experts, the corps of salaried bombardiers (*ulûfeli humbaracılar ocağı*) was created in 1735 and the school of artillery (*topçu mektebi*) was opened in 1772. However, the major enterprise was the

[6] J. Z. Buchwald, S. Hong, 'Physics' in *From Natural Philosophy to the Sciences: Writing the History of Nineteenth-century Science*, D. Cahan (ed.), Chicago University Press, USA, 2003, p. 165.

opening of the *Hendesehane*, an establishment where the teaching of sciences and techniques became central. This institution constituted the very core of military engineering schools. It was founded in the imperial shipyard of Istanbul in 1775 through the initiatives of Grand Admiral Gazi Hasan Pasha. Foreign officers, among them the Baron de Tott, largely contributed for its early institutionalization by teaching mathematics.[7] The original plan behind the *Hendesehane* project was to train naval officers knowledgeable in geometry and geography.[8] In the following years, fortification courses for land army officers were included in the program and the *Hendesehane* became a school where naval and land army officers were trained together. From 1781 on, the school came to be referred to as "Mühendishane" (lit. room for engineers). The courses for land army officers were transferred to a newly constructed building in Hasköy in 1797, but the courses for naval officers continued to be offered in the shipyard; thus, the two institutions were physically separated from one another. Students selected from the imperial corps of architects, the corps of salaried bombardiers, and the corps of sappers were incorporated into the engineering school in Hasköy, by then called the *Mühendishane-i Berri-i Hümayun*.[9]

A new regulation was prepared for the *Mühendishane-i Berri-i Hümayun* (henceforth referred to as *Mühendishane*) in 1806, during the reign of the Sultan Selim III. However, some of the arrangements foreseen with this regulation could not be put into practice because of the political instability which followed the dethronement of Selim III in 1807. During the reign of Sultan Mustafa IV, another regulation was enacted (1808).[10] Comparative study of both regulations shows that education was divided into four grades: It began with the 4th grade

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7 For the history of engineering education and engineering schools in the Ottoman Empire, see Mehmed Esad, *Mirat-ı Mühendishane-i Berri-i Hümayun*, S. Erdem (ed.), İTÜ Bilim ve Teknoloji Tarihi Araştırma Merkezi Yay. No.3, Istanbul, 1986; K. Beydilli, *Türk Bilim ve Matbaacılık Tarihinde Mühendishâne: Mühendishâne Matbaası ve Kütüphânesi (1776-1826)*, Eren Yayınları, Istanbul, 1995; M. Kaçar, *Osmanlı Devleti'nde Bilim ve Eğitim Anlayışındaki Değişmeler ve Mühendishanelerin Kuruluşu*, unpublished PhD thesis, Istanbul University, 1996; M. Kaçar, 'Osmanlı İmparatorluğunda Askeri Sahada Yenileşme Döneminin Başlangıcı', *Osmanlı Bilimi Araştırmaları*, Vol. I, 1995, pp. 209-225; M. Kaçar, 'Osmanlı İmparatorluğunda Askeri Teknik Eğitimde Modernleşme Çalışmaları ve Mühendishanelerin Kuruluşu (1808'e kadar)', *Osmanlı Bilimi Araştırmaları*, Vol. II, 1998, pp. 69-137; M. Kaçar, 'The Development in the Attitude of the Ottoman State Towards Science and Education and the Establishment of the Engineering Schools (Mühendishanes)'in *Science, Technology and Industry in the Ottoman World: Proceedings of the XXth International Congress of History of Science (1997)*, E. İhsanoğlu, A. Djebbar et al. (eds.), Belgium, 2000, pp. 81-90. For the history of engineering as a profession in the Ottoman Empire, see D. Martykánová, *Los ingenieros en España y en el Imperio Otomano. Una historia comparada*, unpublished Ph.D. Thesis, Universidad Autónoma de Madrid, 2010; D. Martykánová, *Reconstructing Ottoman Engineers: Archaeology of a Profession (1789-1914)*, Edizioni Plus, Pisa, 2010.

8 Kaçar, *Osmanlı Devleti'nde Bilim ve Eğitim Anlayışındaki Değişmeler ve Mühendishanelerin Kuruluşu*, p. 116, 196 onwards.

9 *ibid,* pp. 96-100, 142- 143, 169-172.

10 Beydilli, p. 79.

and ended with the 1st grade. The duration of training was designed as one year for the 4th grade, and two years for each of the 3rd and the 2nd grades. The duration of the 1st grade, meanwhile, was not officially defined. Teaching staff included 1 chief instructor, 3 instructors, and 4 assistant teachers (*halife*), each allocated to grades in such a way that, one instructor and one assistant teacher were in charge to teach all courses of a grade. The instructor of the first grade was called "chief instructor".[11] In his in-depth study on the early history of engineering education in the Ottoman Empire, M. Kaçar argues that this grade system was first articulated in the 1806 regulation. Pointing to differences between engineering education, on the one hand, and traditional training received in madrasas, on the other, as well as the innovations that the former introduced, he argued that the grade system might have been inspired by French institutions.[12] D. Martykánová, on the other hand, pictures the late eighteenth and early nineteenth-century institutionalization of the *Mühendishane* as a case of hybridization whose ingredients were the Ottoman administrative-military traditions, madrasa system, and the experience transfused by foreign experts.[13]

With respect to the place of physics and mechanical sciences during the early years of the *Mühendishane*, the role of the 1806 and 1808 regulations becomes highly important. Among all the Ottoman modern military institutions, the *Mühendishane* was the first school which included physical and mechanical sciences in its curriculum. Both the 1806 and 1808 regulation[14] included a mechanics course in the final grade program.

After 1808, documents do not allow us to track the presence of physical and mechanical sciences in the official programs/curricula for about 40 years, since the next regulation was prepared in 1848. The teaching of mechanics seems to have continued during this period: The existence of two manuscripts on non-mechanical subjects of physics written by Yahya Naci Efendi, as well as the memoirs of Ahmed Sırrı, a student at the school between 1837 and 1844, led us to argue that physics courses might have been given in the *Mühendishane* in the first half of the nineteenth-century.[15]

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11 Beydilli, p. 85.

12 Kaçar, *Osmanlı Devleti'nde Bilim ve Eğitim Anlayışındaki Değişmeler ve Mühendishanelerin Kuruluşu*, pp. 128-129.

13 Martykánová, *Reconstructing Ottoman Engineers: Archaeology of a Profession (1789-1914)*, p.63.

14 Beydilli, p. 85.

15 Yahya Naci's manuscripts are *Risale-i Hikmet-i Tabiiye* (1809) and *Risale-i Seyyale-i Berkiye* (1812). For the memoirs of Ahmed Sırrı, see Ahmed Sırrı, *Mühendishane-i Berri-i Hümayun Nazırı İstihkam Feriki Saadetlü Ahmed Sırrı Paşa Hazretlerinin Sergüzeşti*, pp. 25-31(undated manuscript held in the private collection of Emre Dölen).

In the mid-nineteenth-century, the *Mühendishane* underwent a notable transformation under the directorship of Bekir Pasha, a former graduate of the *Mühendishane*. His five-year training in England and his six-year administrative experience in the Ottoman Empire culminated in his appointment as director to the *Mühendishane* in 1846/47.[16] His initiatives aiming to reform the education led to the organization of the school into four grades, each providing a year of training into two divisions of specialization, namely artillery and architecture.[17] Thereby, the former organization of the school was eliminated and the duration of education was limited to four years. According to Bekir Pasha's model, the 1848 curriculum was as follows[18]:

First year (preparatory class): Arabic, Persian, History, Geography, Arithmetic, Geometry, Algebra.

Second year: Mechanics, Physics, Descriptive geometry, Perspective, French, Drawing.

Third year (artillery class): Field fortification, Topography, Chemistry, Permanent Fortification, Military practice for artillery soldiers, Reading on artillery from French books.

Third year (architecture class): Art of architecture, Topography, Chemistry, Application of mechanics to architecture, Architectural drawing, and Readings on architecture from French books.

Fourth year (artillery class): Artillery manoeuvre, Riding practice, Permanent fortification, Artillery practice.

Fourth year (architecture class): Mineralogy, Steam Production, Drawing of buildings, roads, bridges, Construction of reservoirs and channels, Architectural subjects.

This program witnesses the significance of physics instruction in the *Mühendishane*. Physics course was put in the second year of the program nevertheless, as Bekir Pasha stated, the sufficient conditions for the teaching of physics and chemistry were not available at that time. The school did not have the necessary scientific instruments for physics teaching, and neither were physics and chemistry teachers readily available. As a solution, the students were to be provisionally sent to the *Mekteb-i Harbiye* until the scientific instruments were provided and a teacher was assigned.[19]

The school building had to be renovated in 1872, and the students of the *Mühendishane* were moved to the *Mekteb-i Harbiye*. These accommodations between 1872 and 1878, led the students of the two schools to have joint and

16 Mehmed Esad, *Mirat-ı Mühendishane-i Berri-i Hümayun*, pp. 49-52.

17 *ibid*, p. 75.

18 *ibid*, pp. 79-84.

19 *ibid*, p. 79.

separate courses.[20] Although the *Mühendishane* was not totally dissolved, the legal and administrative changes of the *Mekteb-i Harbiye*, especially its 1877 regulation affected the *Mühendishane*.[21] Specifically, the new program had both negative and positive impacts upon the teaching of physics and mechanical sciences. The negative aspect consisted in the elimination of physics courses from the three-year training in the artillery and the fortification, in spite of the fact that either physics or mechanics had been an integral part of the curriculum for a long time. The positive aspect of the new program, was the initiation of a four-year staff officer (*Erkân-ı Harbiye*) training program following the artillery and fortification classes. According to the new regulation, the staff officers would be trained in a more elaborate science program, like their peers in the *Mekteb-i Harbiye*. The physics courses for the artillery and fortification staff officers' class were designed as follows: Simple machines (1st grade, 46 lectures); Application of physics (1st grade, 16 lectures); Mechanics (3rd grade, 96 lectures); Application of mechanics (4th grade, 64 lectures).[22]

In the final decades of the nineteenth-century, the program of the *Mühendishane* was improved once more and this would have a notable impact on the teaching of physics. At the request of the office of the commander in chief, new reform plans for military schools were prepared in 1888 by the Prussian members of a commission set by the Sultan Abdülhamid II. According to the new program of the *Mühendishane,*[23] a physics course was included into the first-year curriculum. The content was defined as "general physics," but physics topics related to artillery and engineering would be emphasized. More advanced courses on physics and mechanics were added to the program of a newly established class, *the class of the distinguished ones*. This class would include selected students who have completed artillery or fortification training. Physics courses of this two-year program included electricity, heat, and the mechanical properties of matter.[24]

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20 T.C. Başbakanlık Osmanlı Arşivi (BOA, The Ottoman Archive of the Prime Ministry of the Republic of Turkey, Istanbul), İ.DH, 644/44792, Şevval 1288 (January 1872).

21 For the whole program see Mehmed Esad, *Mirat-ı Mekteb-i Harbiye*, Şirket-i Mürettibiye Matbaası, Istanbul, hijri 1310, pp. 101-130.

22 Mehmed Esad, *Mirat-ı Mekteb-i Harbiye,* pp. 122-125.

23 Two different draft plans were prepared for the *Mühendishane*: one by the inspector of the military schools, the German officer von der Goltz, and the other by a member of the artillery and fortification commission, Ristow Pasha. The two plans were combined and accepted by the military authority with a few alterations. See 'Topçu ve İstihkam Komisyonunun 27 Şevval 1305 (7 Temmuz 1888) tarihli arz mazbatası', BOA, Y.PRK.ASK. 48/37.

24 Mehmed Esad, *Mirat-ı Mühendishane-i Berri-i Hümayun,* pp. 110, 118.

Physics at the Naval Academy (the Mekteb-i Bahriye-i Şahane)

The Mekteb-i Bahriye, the Naval Academy of the Ottoman Empire, had its origins in the *Hendesehane*, as did the *Mühendishane*.[25] Until 1797, the *Mekteb-i Bahriye* only trained naval officers and navy captains. The education was not sophisticated; the main goal was to teach geography and map-making to navy officers. The 1797 reform proposal of Grand Admiral Küçük Hüseyin Pasha, however, anticipated the training of a second group of students: the shipbuilders.[26] This act can be considered as a step towards transcending the traditional master-apprentice method of learning in shipbuilding. Additionally, a scientific and a more systematized training would also put an end to the constant need for foreign engineers hired for construction of galleons. This was a strong motivation and it might have greatly influenced the establishment of a shipbuilding class. Engineer Jacques Balthasar le Brun, consulted by Küçük Hüseyin Pasha during the preparation of the reform proposal, was appointed to teach shipbuilding based on the laws of geometry, to this second group of students.[27]

Another significant breakthrough in the course of the history of education at the *Mekteb-i Bahriye* took place during the 1848 reform by the Patrona Mustafa Pasha (d. 1871).[28] His introduction of a new kind of organization into the school, which had already been adapted or about to be accepted in other military schools of the Empire, drew a line between the old and the new in the training of naval officers. It consisted in removing the flexible class system and in redesigning the educational levels into four-year grades. This system would not only reduce the duration of training - from 8-9 years to 4- but also increase the number of graduates. In his reform proposal, Patrona Mustafa Pasha also outlined the creation of a third class or a new division in the *Mekteb-i Bahriye* (apart from the classes for navigation officers and shipbuilders) for the

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25 Since its establishment, the school was called by various names: in the eighteenth-century the *Tersane Hendesehanesi*, the *Hendesehane-i Bahrî* and the *Mühendishane-i Bahrî-i Hümayûn*, in the nineteenth-century the *Mekteb-i Bahriye-i Şahane*, the *Mekteb-i Bahriye-i Hazret-i Şahane*, the *Mekteb-i Fünûn-i Bahriye* or the *Mekteb-i Fünûn-i Bahriye-i Şahane*. Along with this article I preferred to call the *Mekteb-i Bahriye* for short.

26 For the complete version of Küçük Hüseyin Pasha's reform proposal, see Kaçar, *Osmanlı Devleti'nde Bilim ve Eğitim Anlayışındaki Değişmeler ve Mühendishanelerin Kuruluşu*, p. 116, p. 196 onwards.

27 *ibid*, pp.118-120. For the establishment history of the *Mekteb-i Bahriye* in general, see also M. Kaçar, 'Tersâne Hendesehânesi'nden Bahriye Mektebi'ne Mühendishâne-i Bahrî-i Hümâyûn', *Osmanlı Bilimi Araştırmaları*, Vol. IX, (1-2), 2007 / 2008, pp. 51-77.

28 The complete version of the proposal has been published in F. Kurtoğlu, *Deniz Mektepleri Tarihçesi: 1928/1939 İkinci kitap*, Deniz Matbaası, Istanbul, 1941, pp. 30-35 and A. İ. Gencer, *Bahriye'de Yapılan Islahat Hareketleri ve Bahriye Nezareti'nin Kuruluşu (1789/1867)*, Türk Tarih Kurumu Yayınları, Ankara, 2001, pp. 277-281.

machinery technicians, whose purpose would be to work in the imperial shipyard factories after graduation.

Another division, *steam class* was opened during the reign of Sultan Abdülaziz (1861-1876),[29] probably in 1863. The list showing the results of the 1864 exams at the *Mekteb-i Bahriye* witnesses that this class had a five-year curriculum.[30] The aim was to train technicians to operate machines available on ships. *Steam class*, might actually have developed from the *machinery technicians' class*. The first steamships in the Ottoman Empire were purchased during Sultan Abdülmecid's reign (1839-1861). At first, almost all machinery technicians who worked in these ships were foreigners, hired particularly from Britain. The graduates of *steam class* of the *Mekteb-i Bahriye*, started to replace those foreign experts in the course of time.[31] The name of the *steam class* was later changed to the *division of drawing of machinery* and, after 1874, was called *mechanical engineering*.[32]

Among the science courses, mechanics has the longest history in the curriculum of the *Mekteb-i Bahriye*. The first document hinting at the teaching of mechanics, dates back to the 1840s, and mentions the presence of a mechanics teacher among the school's staff.[33] There is, however, no concrete evidence of registered physics or mechanics courses in the programs before 1848. I assume that the first official attempt was made by Patrona Mustafa Pasha in 1848, who added a mechanics course to the *machinery technicians*' program. On the other hand, mechanics neither existed in nor was suggested for the *shipbuilding* program instituted by Mustafa Pasha's regulation, although the importance of mechanics knowledge in modern shipbuilding techniques had become evident since the beginning of the nineteenth-century. This fact was emphasized by Henry Eckford[34] in 1830 during his service in the Ottoman Empire. In order to attain the rank of the states well known for their superiority in warship production, Eckford strongly recommended that Ottoman authorities should train skilled naval architects knowledgeable in mechanics. According to

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29 F. Çoker, *Deniz Harp Okulumuz (1773),* 6th ed., Vol. I, 2000, p. 19; Gencer, *Bahriye'de Yapılan Islahat Hareketleri ve Bahriye Nezareti'nin Kuruluşu (1789/1867)*, p. 270;

30 Kurtoğlu, *Deniz Mektepleri Tarihçesi*, pp. 41-44.

31 Çoker, p. 19.

32 *Deniz Harp Okulu Tarihçesi*, Kenan Sayacı (ed), İstanbul Deniz Müzesi Müdürlüğü yayınları, p. 234 vd.

33 See 1848 Patrona Mustafa Pasha's reform proposal in Gencer, *Bahriye'de Yapılan Islahat Hareketleri ve Bahriye Nezareti'nin Kuruluşu (1789/1867)*.

34 Henry Eckford (1775-1832), an American shipbuilding engineer, was one of the experts sent to Istanbul in accordance with the Treaty of Commerce and Navigation (1830) between the United States and the Ottoman Empire. Eckford's mission was to construct warships according to American models, but he also wrote a report about his observations and recommendations to reform the imperial shipyard and shipbuilding techniques. See A. İ. Gencer, *Türk Denizcilik Tarihi Araştırmaları*, Türkiye Denizciler Sendikası Eğitim Dizisi: 2, Istanbul, 1986. pp. 37-40, 43-46.

him, knowledge of architecture alone enables the drawing of beautiful sketches on paper. Without the assistance of knowledge in mechanics, he argued, these nice looking ships would surely cause expense, but would not bring real benefit to the Ottoman State.[35] In spite of this advice, mechanics could not be a part of shipbuilding program for the next 20 years. We are not well informed about the programs of the 1850s due to a lack of documents, but mechanics courses were listed in the 1864 syllabus of both the *shipbuilding* and *steam classes*' programs. Moreover, the syllabus of the *steam class* included a course titled 'Fluids' which might have dwelt on fluid mechanics.[36]

Number and variety of mechanics courses increased after 1868, specifically in the divisions of *shipbuilding* and *machinery*. That year, Said Pasha (1830-1895),[37] a member of the Imperial Shipyard Council, was appointed director to the *Mekteb-i Bahriye*. Shortly after his assignment, he prepared a new regulation for the school which was accepted by the authorities and put into action on 3 November 1868.[38] Said Pasha occupied this post until 1873 and the curricula of the *Mekteb-i Bahriye* dramatically changed during his directorship. A considerable number of courses on physics and mechanical sciences (both theoretical and applied) became included in the 1869 program. The curriculum of the divisions is as follows:[39]

The division of navigation (4-year education):
Physics-chemistry-geology (a combined science course, 1st grade)
Science of steam (3rd grade)

The division of machinery design (4-year education):
Physics-chemistry-geology (a combined science course, 1st grade)
Calculations for machinery (1st, 2nd, 3rd and 4th grades)
Drawing of machinery (1st, 2nd, 3rd and 4th grades)
The resistance of materials (3rd and 4th grades)
Mechanics of solids (equilibrium and motion of solid bodies) (2nd and 3rd grades)
Mechanics of liquids (equilibrium and motion of liquids) (4th grade)

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35 Gencer, *Türk Denizcilik Tarihi Araştırmaları*, pp. 37-40, 43-46.

36 Kurtoğlu, *Deniz Mektepleri Tarihçesi,* pp. 41-44.

37 He graduated from the *Mühendishane-i Berri* and was sent to Edinburgh University. He stayed in Britain between 1854 and 1859, making observations and gaining experience in the Royal Arsenal in Woolwich, the rifle factory in Enfield, the gunpowder factory in Waltham, and the Royal Observatory in Greenwich. See A. Kılıç, 'Said Paşa (Eğinli, İngiliz, Büyük)'in *Yaşamları ve Yapıtlarıyla Osmanlılar Ansiklopedisi*, Vol.II, Yapı Kredi Yayınları, Istanbul, 1999, p.490; Gencer, *Bahriye'de Yapılan Islahat Hareketleri ve Bahriye Nezareti'nin Kuruluşu (1789/1867)*, pp.271-272.

38 BOA, İ. DUİT, 185/84, 185/85.

39 The programs of the *Mekteb-i Bahriye* from 1869 to 1898 (with a few years missing) were derived from the schedules which include the students' names and the scores they received on the general exams *(Mekteb-i Fünun-i Harbiye-i Hazret-i Şahane şakirdanının imtihan-ı umumi cetvelleri*) by Kenan Sayacı. He published this meticulous work in *Deniz Harp Okulu Tarihçesi* (pp. 234-255). We have mostly used this study to trace the evolution of physical and mechanical science courses in the *Mekteb-i Bahriye*.

The division of shipbuilding (4-year education):
Physics-chemistry-geology (a combined science course, 1st grade)
The resistance of materials (3rd and 4th grades)
Mechanics of solids (equilibrium and motion of solid bodies) (2nd and 3rd grades)
Mechanics of liquids (equilibrium and motion of liquids) (4th grade)

The number of lectures per year allocated to each course in 1875 shows the rapid improvement in the teaching of mechanical sciences during Said Pasha's reform.[40]

The division of navigation:
Mechanics [of solids]: 60 lectures

The division of drawing of machinery:
Mechanics of solids: 75 lectures
Mechanics of liquids: 75 lectures
Mechanics of gases: 30 lectures
The resistance of materials: 30 lectures

The division of shipbuilding:
Mechanics of solids: 70 lectures
Mechanics of liquids: 70 lectures
Mechanics of gases: 30 lectures
The resistance of materials: 30 lectures

Compared to mechanics, then, physics entered the program of the *Mekteb-i Bahriye* quite late. Physics as a general science course entered the program in 1869, due to Said Pasha's reform.[41] In this 1869 program, a combined science course, including physics, chemistry and geology, was put in the syllabus of the first years of divisions of *navigation*, *machinery*, and *shipbuilding*. The following year, however, physics was detached from the other two and became a separate course. Physics preserved its place in the program until 1875 when, it was moved to the preparatory classes' curriculum during the central reorganization of preparatory education in all military schools of the Empire.

In the last decades of the nineteenth-century, another physics course entered the program of the *Mekteb-i Bahriye*. It was devoted to electricity and its applications in navigation. The Maritime Council, helding in high regard the naval forces of foreign countries due to their technological superiority, and emphasized the importance of using electricity to equip warships as well as the installation of electric lighthouses. The introduction of electricity and its naval applications to the Council's agenda, as well as the discussions about promoting

40 BOA, İDH, 733/60062.

41 *Deniz Harp Okulu Tarihçesi*, pp. 234-235.

navy officers qualified enough to use the electrical devices of modern ships had an impact on the program of the *Mekteb-i Bahriye*.[42] The electricity courses started in 1885 and were first taught by Émile Lacoine[43] and Raif Efendi, and then by Salih Zeki.[44] All three instructors were civilians and were considered to be among the most knowledgeable people on the electricity in the Empire.

Physics at the Military School of Medicine (the Mekteb-i Tıbbiye-i Şahane)

The *Mekteb-i Tıbbiye-i Şahane* (the Military School of Medicine) was another nineteenth-century Ottoman institution where physics courses were taught. The school goes back to the *Tıphane-i Amire* founded in Istanbul in 1827 during the reign of Sultan Mahmud II in order to train Muslim physicians and surgeons for the new Ottoman army, *Asakir-i Mansure-i Muhammediye* (the Victorious Soldiers of Mohammed). They were expected to be capable of mastering both old and modern medical knowledge. The chief physician of the Court, Mustafa Behçet Efendi (1774-1834), played a crucial role in the establishment the school.[45] The curriculum of the school was designed as four grade levels but the duration of education was not specified. The duration of a grade was undetermined and depended on teacher's satisfaction and decision: If the student was knowledgeable enough, the teacher would allow him to pass to the next grade. The first grade opened in 1826, but the students of this class reached the final grade in 1833.

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42 BOA, Y.A.RES, 28/49.; Y.A.RES, 29/36.

43 Electrical engineer Émile Henri Lacoine (1835-1899) got a job offer from the Ottoman Ministry of Telegraph while he was heading to his job in the Suez Canal and decided to stay in Istanbul. Besides working as technical inspector, he taught telegraphy courses to the officers of this institution. He worked for the installation of telegraph lines (Rome-Paris, Jeddah-Suakin, Marseilles-Djibouti) and in locating the lighthouses in Dardanelles. For more information about his life and works, see F. Günergun, 'Salih Zeki ve astronomi: Rasathane-i Amire müdürlüğünden 1914 tam güneş tutulmasına', *Osmanlı Bilimi Araştırmaları: Salih Zeki Özel Sayısı,* Vol. VII (1), 2005, pp.117-118.

44 The mathematician and historian of science Salih Zeki (1864-1921) was one of the most eminent figures of the Turkish history of science. For more information about his life and works, see C. Saraç, *Salih Zeki Bey Hayatı ve Eserleri,* Y. I. Ülman (ed.), Kızıl elma yayınları, Istanbul, 2001; *Osmanlı Bilimi Araştırmaları*: *Salih Zeki Özel Sayısı*, Vol. VII (1), 2005.

45 When he submitted a series of reports to Sultan Mahmud II in 1826, Mustafa Behçet Efendi rationalized the necessity of a medical school as follows: "During war time and peace time, it is necessary to cure the ill and injured soldiers and dress their wounds; however the most of the Muslim physicians in Istanbul know only the ancient medical methods. To deserve to be called a physician however, one should definitely know both the ancient and new medicine. If the State establishes a medical school in Istanbul, and the medical knowledge is taught by the competent teachers there, it will be possible to cure the soldiers of *Asakir-i Mansure-i Muhammediye* by Muslim physicians in a couple of years." For the rest of the report dated 23 December 1826 (22 Cemaziyülevvel 1242), see F.N. Uzluk, *Hekimbaşı Mustafa Behçet – Zâti, Eserleri Üstüne Bir Araştırma*, Ankara Üniversitesi Tıp Tarihi Enstitüsü Yayınları No.3, Ankara, 1954, pp.52-53; A. Ataç, '14 Mart 1827'de Açılan Tıp Okulunun açılışı ile ilgili dört belge', *Yeni Tıp Tarihi Araştırmaları*, (2-3), 1996/97, pp. 249-250, 255-256.

Physics courses were introduced into medical education in 1833 with the opening of the the final grade.[46] Together with physics, chemistry and botany courses were included in the syllabus of the final grade. This means that the first generation of students had first taken courses on medical sciences and learned physics, chemistry, and botany only later. This understanding of medical education differed from that practiced in the rest of the century when teaching used to start with courses in physical and natural sciences and continued with the theory and practice of medicine and surgery. Why were physics, chemistry, and botany put on top of the medical sciences pyramid? Was it because they were perceived as more superior or harder to master? In my opinion, this was not related to the classification of sciences or to pedagogical concerns. It seems that it was a temporary solution to two problems simultaneously: Supplying the army with physicians in a short time and achieving the goals of education set in the reports of the chief physician. Students who completed the third grade were assigned to the hospitals or troops as assistant physicians. While they were gaining practice, the chief physician started preparations to open the final grade where physics and other courses were to be taught.[47] Apparently, these sciences were considered important elements of the new medicine and the chief physician did not sacrifice them despite the urgent requirements of the army.[48] In one form or another, students completed these courses. On the other hand, this also means that natural sciences did not play a key role in the introduction of new medical knowledge. As we have seen, Ottoman authorities might have believed that students could learn new medicine without natural sciences. The *Tıphane-i Amire* represented a transition period and this way of understanding would change in a decade.

No historical records are available from the *Tıphane-i Amire* period which may elucidate the content of the physics courses. The little information we have is on the lecturers of physics. The teaching staff of the school was distributed in such a way that one teacher would be in charge of one grade and teach all of its courses. The courses of the final grade, including physics, were taught by Civani Efendi between 1833 and 1835, and by İstefan Efendi from 1835 to 1837. Both of them were non-Muslims Ottoman citizens. Civani Efendi was a physician educated in philosophical and medical sciences in France and Italy.[49]

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46 A. Altıntaş, 'Osmanlılarda modern anlamda tıp eğitiminin başlaması- Tıbhane-i Amire' in *Osmanlı,* Vol.VIII, Yeni Türkiye Yayınları, Ankara, 1999, p.536.

47 *ibid*, p.536.

48 Mustafa Behçet Efendi's interests went beyond medical sciences; he also made an abridged Turkish translation of Buffon's *Histoire Naturelle* titled *Tercüme-i Tarih-i Tabîiye.*

49 Altıntaş, pp.536, 538.

The *Tıphane-i Amire* was a milestone in the history of Ottoman medical education. The essential reforms, however, started in 1839, when the school moved to Galata-Serai and its name changed to the *Mekteb-i Tıbbiye-i Adliye-i Şahane* (the Imperial School of Medicine). In accordance with the will of Sultan Mahmud II, the reorganization of medical education was entrusted to Austrian physicians: Dr. Karl A. Bernard (1808-1844) was appointed director of the school in 1838. Bernard reorganized the medical education and restructured the clinics according to the model of the Josephinum, the Military Academy of Medicine in Vienna. A botanical garden, collections of physics, anatomy, and natural history as well as a rich library were created.[50] The duration of education was increased to 6 years (2 years for preparatory and 4 years for medical education), and French was assigned as the official language of education.[51]

Following the 1839 reform, physics continued to be a part of medical education.[52] Throughout the nineteenth-century, it was generally taught in the first year. Occasionally, physics teaching extended over two years, as in the case of the 1845-50 curriculum. Physics courses were mostly accompanied by other

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50 In addition to his administrative duties, Bernard taught surgery, internal medicine, and botany at the school. He published his *Eléments de Botanique* (1842), *Les Bains de Brousse* (1842), *Précis de Percussion et d'Auscultation* (1843) ve *Pharmacopoea Castrensis Ottomana* (1844) in Istanbul. For more information about his life and works, see T. Baytop, 'Bernard, Karl Ambros' in *Dünden Bugüne İstanbul Ansiklopedisi*, Vol.II, Kültür Bakanlığı Yayınları; Tarih Vakfı, Istanbul, 1994, pp. 158-159; *V. Türk-Avusturya Tıbbi İlişkileri Simpozyumu Bildirileri (5 Ekim 1994)*, A. Terzioğlu & E.Lucius (eds.), Istanbul, 1995 ; F. Günergun, A. Baytop, 'Türkiye'de modern botanik eğitiminin başlangıcı ve Dr. C. A. Bernard'ın katkıları' in A. Baytop's *Türkiye'de Botanik Tarihi Araştırmaları*, TÜBİTAK Yayınları, Ankara, 2004, pp. 194-211.

51 A. Terzioğlu, 'Galatasaray'da Mekteb-i Tıbbiye-i Şahane'nin tesisi ve bizde modern tıp eğitiminin gelişmesinde önemi' in *Mekteb-i Tıbbiye-i Adliye-i Şahane ve Bizde Modern Tıp Eğitiminin Gelişmesine Katkıları. Kuruluşunun 150. Yıldönümü Anısına 18 Eylül 1989'da Yapılan Simpozyuma Sunulan Bildiriler,* A.Terzioğlu & E.Lucius (eds.), Arkeoloji ve Sanat Yayınları, Istanbul, 1993, pp.11-23.

52 I reached this conclusion based on various studies which brought to light the programs of the *Mekteb-i Tıbbiye*. For the programs belonging to the establishment years: Rıza Tahsin, *Tıp Fakültesi Tarihçesi (Mir'ât-ı Mekteb-i Tıbbiye)*, A. Kazancıgil (ed), Vol. I, Özel Yayınları, Istanbul, 1991, pp. 16, 17. For 1842-43 program: S. Eyice, 'Dr. Karl Ambros Bernard (Charles Ambroise Bernard) ve Mekteb-i Tıbbiye-i Adliye-yi Şahane'ye dair birkaç not' in *Türk Tıbbının Batılılaşması – Gülhane'nin 90. Kuruluş Yıldönümü Anısına 11-15 Mart 1988'de Ankara ve İstanbul'da Yapılan Simpozyuma Sunulan Bildiriler*, A. Terzioğlu & E.Lucius (eds.), Istanbul, 1993, p.113. For 1843-44, 1845-46, 1847-48 programs: Y. I. Ülman, *Journal de Constantinople'a Göre Mekteb-i Tıbbiye-i Adliye-i Şahane'nin Galatasaray Dönemi*, unpublished MA thesis, Istanbul University, Istanbul, 1994, p.47, 62. For 1846-47 program: Y. I. Ülman, 'Mekteb-i Tıbbiye-i Adliye-i Şahane'nin 1846-1847 öğretim yılı faaliyet raporu', *Yeni Tıp Tarihi Araştırmaları*, Vol. IV, 1998, p. 145. For 1849-50 program: Y. I. Ülman, *Gazette Médicale de Constantinople ve Tıp Tarihimizdeki Önemi*, unpublished PhD thesis, Istanbul University, Istanbul, 1999, p. 167. For 1850-51 program: Y. I. Ülman, 'Mekteb-i Tıbbiye'nin 1850-51 öğretim yılı faaliyet raporu ve mezuniyet töreni', *Osmanlı Bilimi Araştırmaları*, Vol. IV (1), 2002, p. 59. For 1877, 1878 and 1879 programs: Y. Ö. Şirin, 'Osmanlı Sâlnâmelerinde 1908 tarihine kadar tıp eğitimi', *Yeni Tıp Tarihi Araştırmaları*, Vol. V, 1999, pp. 285-286, 260-61. For the last years of the nineteenth-century: Tevfik Sağlam, *Nasıl Okudum*, 3rd ed, H. Hatemi, A. Kazancıgil, (eds), Nehir Yayınları, Istanbul, 1991, pp. 71, 83.

science courses such as chemistry and botany. Sometimes, medical courses such as microscopic anatomy and descriptive anatomy were added to the program of the first grade as well. We can identify its content as a general physics course, since it was listed as medical physics only once, in the 1842 program.

Physics at the Military Academy (the Mekteb-i Harbiye-i Şahane)

The abolishment of the Janissary Corps and the establishment of *Asakir-i Mansure-i Muhammediye* in 1826 constitutes a landmark in the Ottoman military history. Acquiring well trained military staff and commanding officers was an important issue for the new army. From its very inception, the new army suffered from a lack of qualified staff, even for handling the correspondence and the bookkeeping of the troops.[53] To meet this requirement, the *talimhane* (the house of military training) was opened in 1826, where youngsters under 15 were instructed in reading-writing, given basic religious training and military practices. The Ottoman-Russian War of 1828-29 interrupted this enterprise and the *talimhane* had to be closed just two years after its foundation.[54] In order to train qualified officers, Helmuth von Moltke[55] advised Sultan Mahmud II to send students to Europe. This step, however, would not meet the needs of the entire army. Therefore, the Sultan decided to open a military school in Istanbul. The State budget, depleted by the war, did not permit such an expensive enterprise.[56] Until more propitious conditions were set, the Ottomans had to resort once more to the method of in-service-training.

The *sıbyan bölükleri* (the school of the guards),[57] an improved version of the *talimhane*, was constituted in the Selimiye barracks in Istanbul in 1831.[58] Selected from among the most talented soldiers, these youngsters were trained in reading-writing, arithmetic, geometry, geography, algebra, and the principles of military maneuvers and duties, and were appointed to the troops endowed with military ranks of corporal, sergeant, and lieutenant.[59] This educational

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53 *Harp Okulu Tarihçesi: 1834-1945*, p. 5; N. Berkes, *Türkiye'de Çağdaşlaşma*, A. Kuyaş (ed.), YKY, Istanbul, 2002, p. 191.

54 *Harp Okulu Tarihçesi: 1834-1945*, p. 5.

55 Prussian military officer [lieutenant] Helmuth von Moltke (1800-1891) came to Istanbul in 1835 upon the invitation of Sultan Mahmud II. He published his observations in *Briefe über Zustände und Begebenheiten in der Turkei*, Berlin, 1876. A Turkish translation of his work is *Türkiye'deki Durum ve Olaylar Üzerine Mektuplar*, *1835-1839*, Hayrullah Örs (trans. by), Ankara, 1960.

56 *Harp Okulu Tarihçesi: 1834-1945*, pp. 5, 6.

57 *Sıbyan Bölükleri* means "children troops" or "pupil troops", but Marmont preferred to call it "the school of guards". A. F. L. V. de Marmont, *The present state of the Turkish Empire*, F. Smith (trans. by), London 1839, p. 78.

58 *Harp Okulu Tarihçesi: 1834-1945,* p. 6; A. Özcan, 'Harbiye' in *Türkiye Diyanet Vakfı İslam Ansiklopedisi*, Vol. XVI, Istanbul, 1997, p. 115.

59 Marmont, p. 78-79.

practice was, however, very far from what the Ottoman authorities desired. The school of guards, directed by Namık Pasha, was moved to a more suitable place -Maçka barracks- in 1834.[60] The school received the official name of the *Mekteb-i Harbiye-i Şahane* (the Imperial Military Academy) following Sultan Mahmud II's visit in 1835.

During its early years, the education was not systematic and well-organized. Firstly, the attendees of the *Mekteb-i Harbiye* were not regarded as students but army soldiers. Their education began by learning how to read and write. Secondly, the criteria of success did not depend on completing one grade and starting another: it was similar to the madrasa system in which one should complete a book in order to pass and start another.[61] The school administration planned to teach advanced mathematics, science courses (physics, chemistry, mechanics), advanced military courses (ballistics etc.), and French. For ten years, however, this plan could not be put into practice due to the poor educational background of the soldiers and to the commitment to the traditional educational system.[62]

The second and probably the most important step in the history of the *Mekteb-i Harbiye* was taken between 1845 and 1847 under the patronage of Sultan Abdülmecid. A new curriculum and regulation were prepared, a new building constructed, new teachers hired, and new scientific instruments brought. Derviş Pasha (1817-1879) was summoned to the school. He was also appointed to teach physics and chemistry, and assigned to write textbooks on these subjects.[63] The teaching staff was supplemented by military officers-teachers brought from France and Prussia.[64] A four-year education was established and a new advanced class for staff officers was added to follow this four-year curriculum. Derviş Pasha and the French officers Mouginot, Magnan, and Dubreuil prepared a curriculum for this class based upon the model of the École Spéciale Militaire de Saint Cyr.[65]

According to the new curriculum, students of the *Mekteb-i Harbiye* took three different courses in general physics and mechanical sciences: *mechanics*

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60 Özcan, p. 115.

61 H. Gök, *Arşiv Belgelerinin Işığında Kara Harp Okulu Tarihi (1834-1883)*, unpublished PhD thesis, Hacettepe University, Ankara, 2005, p. 86.

62 Mehmed Esad, *Mir'ât-ı Mekteb-i Harbiye*, p.17.

63 F. Günergun, 'Derviş Mehmed Emin Pacha (1817-1879), serviteur de la science et de l'Etat Ottoman' in *Médecins et Ingénieurs Ottomans à l'âge des nationalismes*, M. A. Dumont (ed), Institut Français d'Etudes Anatoliennes-Maisonneuve & Larose, 2003, p.176.

64 Gök, p. 116.

65 Gök, p. 113, 123; Günergun, 'Derviş Mehmed Emin Pacha (1817-1879), serviteur de la science et de l'Etat Ottoman', p.176.

(20 lectures); *types of machines and apparatus* (10 lectures); *physics* (40 lectures).[66] *Physics* was an introductory course to the general subject of physics except for the topics of motion and equilibrium. The course started with the general properties of bodies and fundamental concepts (weight, volume etc.), followed by solids, liquids, gases, heat, meteorology, acoustics, optics, electricity, and magnetism. *Mechanics*, on the other hand, covered subjects such as force, motion, and the working principles of simple machines (levers, wheels, inclined planes, etc.). The third course, *types of machines and apparatus*, mainly focused on mechanical instruments or machines and, to some degree, its content overlapped with *mechanics* course. The difference between the second and third courses consisted in the method of classifying the instruments. The latter classified the instruments according to the motions they executed: the nine types of motion were introduced, and the working principles of the mechanical instruments associated with these motion types, were explained. For instance, pulleys were examined under the title of "continuous uniform motion along a continuous line." Besides, this course also covered the steam machine and locomotive.

Education at both the military preparatory schools and the *Mekteb-i Harbiye* was reorganized in 1877. For this purpose, the programs of various European military schools were examined. Taking into account the needs of the Ottoman army, a new curricula was designed. According to this reorganization, students who wished to attend the *Mekteb-i Harbiye* should first complete a four year education in the military preparatory classes and then pass the requisite entrance exams.[67] If they were accepted, they could continue their training in either infantry or cavalry classes. The duration of education was two years. After graduation, in case they wanted to attend the four year advanced class to become staff officers, they had to pass entrance exams once again.[68]

According to the new regulation, students of military schools would first study physical and mechanical sciences in their preparatory education; they would took simple mechanics courses in the third grade and physics in fourth. Knowledge of physics and mechanics were among the mandatory fields

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66 *Mekteb-i Harbiye-i Şahane'de Tahsil Olunacak Ulumun Müfredatı*, 117 pages. The publication date of this text is unknown. As a result of critical analysis of its introductory part and contents, I have identified 1846 or 1847 as the most probable dates. A more detailed argument can be found in M. Akbaş, *Osmanlı Türkiyesi'nde Modern Fizik (19.yüzyıl)*, unpublished PhD thesis, Istanbul University, Istanbul, 2008, pp. 119-122.

67 For the 1877 program of all classes of the *Mekteb-i Harbiye*, see Mehmed Esad, *Mir'ât-ı Mekteb-i Harbiye,* pp. 102-130. See also, *Devlet Salnamesi: Hijri 1294*, Defa 32, Halil Efendi Matbaası, Istanbul, 1294 (1877), pp. 346-351.

68 Mehmed Esad, *Mir'ât-ı Mekteb-i Harbiye,* pp. 102-130.

evaluated in the entrance exam of the *Mekteb-i Harbiye*.[69] On the other hand, the physics education received in infantry and cavalry classes was rather brief. Only 12 lectures in the first grade were devoted to physics. Depending on the subjects considered necessary for the entrance exam of staff officers, we can estimate that the content of this course was limited to topics on sound, heat, light, and electricity.[70] The new program incorporated the teaching of physical sciences especially into the staff officers' class. These courses were: simple machines (1st grade, 46 lectures); application of physics (1st grade, 16 lectures); mechanics (3rd grade, 96 lectures); application of mechanics (4th grade, 64 lectures). [71]

The curriculum of the *Mekteb-i Harbiye* experienced another significant change in the closing decades of the nineteenth-century. The motivation behind this was the failure of the Ottoman armies in the 1877-78 Ottoman-Russian War. The dire consequences of the war led authorities to reconsider the structure of the Ottoman land armies as well as the education of military officers. The French system that had been influential at the *Mekteb-i Harbiye* for a long period of time, was now called into question.[72] On the other hand, Prussia, a rising power in Europe as well as a political and military ally, became a preferable alternative in the eyes of Sultan Abdülhamid II. Due to the request of the Sultan, Prussian officers were brought to review both the army and the military educational institutions including the *Mekteb-i Harbiye.*[73] Among them, Major Colmar von der Goltz was the real actor behind the most penetrating changes made in the *Mekteb-i Harbiye*. He restructured the school in 1885 according to the Prussian *Kriegsakademie* in Berlin.[74]

Before the coming of von der Goltz, the advanced class for staff officers had two sections: a "military section" and a "science section". While the former section focused on war and military applications, the latter gave weight to science and engineering. This system seemed problematic to von der Goltz. In order to improve the efficiency of staff officers during war time, he suggested that military tactics and applications must be the center of their training. In his reform proposal, the curriculum for staff officers omitted several of the existing science and engineering courses such as geometry, chemistry, mathematics, and

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69 *ibid*, pp. 107, 109, 111.

70 *ibid*, p. 116.

71 *ibid*, pp. 122-125.

72 Gök, p. 152.

73 One of the military commissions invited from Prussia arrived İstanbul in 1882. Its members were Colonel Kaehler, infantry lieutenant Kamphövener, artillery lieutenant von Hobe, and lieutenant Ristow. See Gök, p. 154.

74 *ibid*, pp. 154-156.

construction. However, military authorities objected to this proposal, as expectations of the State from the graduates of this class went beyond mere military works. They were considered as well-educated officers for bureaucratic and administrative posts too. So, von der Goltz's reform proposal was accepted, only with some modifications.[75] Consequently, the duration of education of the staff officers' class was reduced to three years after 1885. The number of physics lectures noticeably decreased, all mechanics courses were removed from the program, and only one physics course was kept in the 2nd grade of staff officer class.[76] Attention shifted to military practices and applications, and science lost its privileged place in the military education at the end of the nineteenth-century.

Fiziğin Askeri Yürüyüşü-I: Ondokuzuncu Yüzyıl Osmanlı Askeri Okullarının Ders Programlarında Fizik ve Mekanik Bilimleri

Osmanlı İmparatorluğu'nda fiziğin ve mekanik bilimlerin disiplin haline gelme tarihi, yavaş ve birikimsel bir süreç olmuştur. Bu süreç, ondokuzuncu yüzyıl reformlarının gözde kurumları olan modern askeri okulların kuruluşu ve gelişimiyle yakından ilgilidir. Bu makale, Osmanlı askeri okullarından Mühendishane-i Berri-i Hümayun, Mekteb-i Bahriye-i Şahane, Mekteb-i Tıbbiye-i Şahane ve Mekteb-i Harbiye-i Şahane'de ondokuzuncu yüzyılda verilen fizik ve mekanik bilimler eğitimini ele alan bir araştırmanın ürünüdür. Makalenin yazarı, üç eğitimsel öğenin bu dönem fiziğinin meydana gelmesinde temel teşkil ettiğini varsaymaktadır: Ders programı, öğretmen ve ders kitabı. Bu makale, bu öğelerden yalnızca birini, ders programlarını kapsamaktadır. Askeri okulların ders programlarında fiziğin ve mekanik bilimlerin yerini inceleyerek, Osmanlı devleti tarafından meydana getirilen büyük eğitim reformlarına paralel olarak, fizik derslerinin tarihsel evrimine odaklanmaktadır. Makale aynı zamanda, bu derslerin eğitim politikalarındaki değişimlerden ve amaçlanan mezun profilini yeniden tanımlanmaya yönelik teşebbüslerden nasıl etkilendiğini de ele almaya çalışacaktır. Ondokuzuncu yüzyıl askeri okullarının fizik öğretmenleri ve ders kitapları, 'Fiziğin Askeri Yürüyüşü-II' başlıklı ikinci bir makalede incelenecektir.

Anahtar sözcükler: Fizik eğitimi, fizik dersleri, mekanik dersleri, Osmanlı askeri okulları, Osmanlı İmparatorluğu, fizik tarihi, ondokuzuncu yüzyıl.

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75 Z. Güler, *Osmanlı Ordusunun Modernleşmesinde Von der Goltz Paşa'nın Rolü*, unpublished MA thesis, Mersin University, Mersin, 2007, p. 166.

76 Mehmed Esad, *Mir'ât-ı Mekteb-i Harbiye*, pp. 137-138.

The Military March of Physics-I:
Physics and Mechanical Sciences in the Curricula of the 19th Century Ottoman Military Schools

Discipline-building history of physics and mechanical sciences in the Ottoman Empire was a slow and accumulative process. It owed much to the establishment and advancement of modern military schools –the favorite institutions of the nineteenth-century reforms. This research article examines the education of physics and mechanical sciences at the Ottoman military schools of the nineteenth-century: the *Mühendishane-i Berri-i Hümayun* (The Military Engineering School), the *Mekteb-i Bahriye-i Şahane* (The Naval Academy), the *Mekteb-i Tıbbiye-i Şahane* (The Military School of Medicine), and the *Mekteb-i Harbiye-i Şahane* (The Military Academy). The author presupposes three educational elements that were essential in the constitution of physics in this period: The curriculum, the teacher and the textbook. The present article covers only one of them: the curriculum. Examining the place of physics and mechanical sciences in the curricula of these schools, it focuses on the historical evolution of physics courses parallel to the major educational reforms enacted by the Ottoman government. It also tries to unveil how these courses were affected by the changes in educational policies or by redefinitions of the intended profile of the graduates of these schools. Physics teachers and textbooks of the nineteenth-century Ottoman military schools, will be examined in a future article, 'The Military March of Physics-II'.

Key words: Physics education, physics courses, mechanics courses, Ottoman military schools, history of physics, the Ottoman Empire, the nineteenth-century.