THE MILITARY MARCH OF PHYSICS - II
TEACHERS AND TEXTBOOKS OF PHYSICS AND MECHANICAL SCIENCES OF THE 19th CENTURY OTTOMAN MILITARY SCHOOLS

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A previous article, *The Military March of Physics I*, had brought into focus the curricula of physics and mechanical sciences of the nineteenth-century Ottoman military schools and examined the historical evolution of physics courses in accordance with the major educational reforms held within these schools.[1] The present article, while dealing with physics and mechanics teachers, will investigate the physics and mechanics textbooks written by these professionals.

Teachers

The first teachers to teach physics and mechanics courses in the newly established Ottoman military schools were not specialists in these fields. This was unavoidable, since these schools did not have the luxury to employ adequate numbers of teachers for each field of science. In the nineteenth-century, people qualified in sciences and techniques were in demand not only for filling the teaching posts at Ottoman modern schools, but also for bureaucratic, military, and public services. The Ottoman state experienced problems in matching few numbers of qualified people with the increasing number of tasks. This situation led to a serious staff shortage problem for the modern schools. An example from the history of the *Mekteb-i Bahriye-i Şahane* (the Naval Academy) may well illustrate this problem. In 1840, the total enrolment of the *Mekteb-i Bahriye* was 230 students, and the total number of courses from the first to the fourth grade was 13. There was, however, only one assistant teacher and one geometry teacher to give all these courses.[2] Specialization could not be a priority under these circumstances. In my opinion,

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[1] Meltem Akbaş, "The Military March of Physics – I: Physics and Mechanical Sciences in the Curricula of the 19th Century Ottoman Military Schools," *Osmanlı Bilimi Araştırmaları /Studies in Ottoman Science*, vol XIII, Nr.2, 2012, pp.65-84.

[2] These courses were: arithmetic, literary composition, introduction to geometry, logarithmic calculations, land measuring, altitude measurement by octant and other instruments, plane trigonometry, nautical research (*tahkikat-ı bahriyye*), algebra, spherical trigonometry, astronomy, magnitude of stars, calculation of latitude and longitude. See A. İ. Gencer, *Bahriye'de Yapılan Islahat Hareketleri ve Bahriye Nezareti'nin Kuruluşu (1789/1867)*, Türk Tarih Kurumu Yayınları, Ankara, 2001, p. 251.

however, there was another factor which made the organization of these schools unsuitable for specialization in the first half of the nineteenth-century: a certain way of division of labour in teaching. The Maritime Council to which the *Mekteb-i Bahriye* was linked administratively, tried to solve the problem of understaffing mentioned above by appointing two additional teachers and two assistants. Thus, there would be four teachers in charge.[3] The allocation of courses among teachers becomes important here in order to understand the Ottoman mentality regarding the division of teaching work. The teachers were distributed into grades in such a way that each of them would be in charge of a single grade. It is obvious that they were not employed according to their expertise in a particular scientific field. The educational organization of the *Tıphane-i Amire* (Medical School) shows a similar pattern too. The physics course, for instance, was supposed to be taught in the first grade (i.e., the final year of the education) so it was taught by the teacher in charge of teaching the other courses of the same grade. Compared to the two above-mentioned schools, the *Mühendishane-i Berri-i Hümayun*[4] (the Military Engineering School) could depend upon more teaching staff. Beside teachers and assistants, there was also a different kind of staff peculiar to this school: translators whose main duty was to teach French. In the language courses, students were supposed to learn French by reading and translating from French science books.[5] However, even in the *Mühendishane*, courses were distributed according to the usual practice in which one teacher was responsible for one grade and the chief instructor for the final (highest) grade.

This mentality began to change around mid-nineteenth-century. Each school evolved at its own pace, with its own dynamics and work force. Nevertheless, extensive and radical educational reforms created major breakthroughs. The 1839 reformation in medical education with the establishment of the *Mekteb-i Tıbbiye* (the Military School of Medicine), the 1847-48 reformation of the *Mühendishane*, the re-organisation of the *Mekteb-i Harbiye* (the Military Academy) in 1845-47 and that of the *Mekteb-i Bahriye* in 1869 were important milestones in the history of military education. These

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3 *ibid*, p. 251.

4 Henceforth referred to as the *Mühendishane*.

5 For instance, the translator Hacı İzzet, who taught French grammar to the first grade students in 1839-40, also taught geometry and arithmetic in French. His source book was Étienne Bézout's (1730-1783) *Cours de Mathématiques à l'Usage des Gardes du Pavillon et de la Marine.* However, there was an arithmetic course in Turkish in the program, which makes us think that the primary role of the translator was not to teach the scientific content, but rather to teach French and to help students to understand scientific texts by themselves. See Ahmed Sırrı, *Mühendishane-i Berri-i Hümayun Nazırı İstihkam Feriki Saadetlü Ahmed Sırrı Paşa Hazretlerinin Sergüzeşti* (undated manuscript held in the private collection of Emre Dölen) pp. 27, 29-30.

changes of pattern are easily detected in the teacher-course correlation in the military schools after these major reforms.

In the *Mekteb-i Tıbbiye*, for instance, Derviş Pasha taught geometry, physics, and general chemistry between 1842 and 1843 whereas M. Lucien Rouet taught mathematics and physics (1843-1848). Serope Viçenyan taught physics between 1848/1849-1850 and gave only forensic medicine courses after 1850. Dimitraki Balasides started to teach physics after 1850 and this was his only course for a long period of time. Antranik Gırcikyan maintained this tradition, teaching only physics courses from 1879 to 1894.[6] This demonstrates a change in the partition of teaching work. Courses were allocated to teachers according to their expertise, and a specialization in physics emerged in the *Mekteb-i Tıbbiye* around the mid-nineteenth century.

The *Mühendishane* represents another case. The aforementioned reform proposal of Bekir Pasha reveals that there were neither physics and chemistry teachers at the school in 1848 nor the scientific instruments necessary for these courses. Bekir Pasha found a temporary solution to this problem by sending students to the *Mekteb-i Harbiye*.[7] First of all, this case indicates a change in the understanding of physics: physics could not be learned without experiment. It also represents a change in the mentality regarding the division of labour: instead of simply assigning an available teacher from the staff to teach physics, as it had been done previously, Bekir Pasha preferred to send students to another school where an appropriate physics teacher had been working. After 1860s, teacher-course correlation shows a pattern that might be interpreted as a move toward specialization. Between 1866/67 and 1872/73, physics and chemistry courses were taught by a single teacher, Ahmed Hilmi. He had one

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6 F. Günergun, "Derviş Mehmed Emin Pacha (1817-1879), serviteur de la science et de l'Etat Ottoman", *Médecins et ingénieurs ottomans à l'âge des nationalismes*, M. A. Dumont (ed), Istanbul, Institut Français d'Etudes Anatoliennes-Maisonneuve & Larose, 2003, pp. 171-183; 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. 115; 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, pp. 60-61, 68-69; 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; Y. I. Ülman, *Gazette Médicale de Constantinople ve Tıp Tarihimizdeki Önemi*, unpublished PhD thesis, Istanbul University, Istanbul, 1999, p. 109; A. Yarman, *Osmanlı Sağlık Hizmetlerinde Ermeniler ve Surp Pırgiç Ermeni Hastanesi Tarihi*, Surp Pırgiç Hastanesi Vakfı, Istanbul, 2001, pp. 782, 793; 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; BOA (Ottoman Archives of the Turkish Prime Ministry), A. MKT. NZD, 7/50; Y. Ö. Şirin, "Osmanlı Sâlnâmelerinde 1908 tarihine kadar tıp eğitimi", *Yeni Tıp Tarihi Araştırmaları*, Vol. V, 1999, pp. 208-323.

7 Mehmed Esad, *Mirat-ı Mühendishane-i Berri-i Hümayun*, S. Erdem (ed.), İTÜ Bilim ve Teknoloji Tarihi Araştırma Merkezi Yay. No.3, Istanbul, 1986, p. 79.

assistant who was in charge of assisting him with both courses.[8] Thus, specialization would be maintained after the assistant took over the teaching post. Records belonging to the years of 1881/82 and 1882/83 confirm that the system worked this way. The teacher of physics was also teaching chemistry or vice versa.[9] This means that physics and chemistry were considered sister disciplines at the *Mühendishane*. The mechanics course, on the other hand, was never under the responsibility of the physics-chemistry teacher; it was instead entrusted to the mathematical sciences' teacher. In 1872/73, for instance, İbrahim Edhem was teaching plane trigonometry, spherical trigonometry, geometry, and mechanics. The same teacher had been in charge of teaching algebra and mechanics in 1880/81.[10]

The period following the 1845-47 reform of the *Mekteb-i Harbiye* represents another attention-grabbing case. The first teachers of physics, chemistry, mechanics, and machinery included distinguished, well-educated scholars. Tahir Pasha, a teacher of mechanics and a number of mathematics courses, was a graduate of the *Mühendishane*. Following his graduation, he was sent to the United Kingdom to further his training. Upon his return, he was employed at the *Mekteb-i Harbiye* where he worked from 1847 to 1864/65.[11] Derviş Pasha, a teacher of physics and chemistry courses was also a graduate of the *Mühendishane*. Sent to London in 1834, he pursued his training in Paris where he attended *L'École des Mines* and took courses in chemistry, natural sciences, and mineralogy. After he returned to Istanbul in 1841, he worked at the *Mekteb-i Tıbbiye* (1842-43). He taught at the *Mekteb-i Harbiye* between 1845 and 1849, followingly he was sent to eastern Anatolia to assist to the drawing of the border between the Ottoman Empire and Persia.[12] The French military officer Mouginot, the teacher of a machinery course at the *Mekteb-i Harbiye* also taught other courses such as descriptive geometry, astronomy, and architecture.[13]

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8 *Devlet Salnamesi: 1283*, Defa 21, Matbaa-i âmire, İstanbul, hijri 1283 (1866); *Devlet Salnamesi: 1284*, Defa 22, hijri 1284 (1867); *Devlet Salnamesi: 1285*, Defa 23, hijri 1285 (1868); *Devlet Salnamesi: 1286*, Defa 24, hijri 1286 (1869); *Devlet Salnamesi: 1287*, Defa 25, hijri 1287 (1870); *Devlet Salnamesi: 1288*, Defa 26, hijri 1288 (1870); *Devlet Salnamesi: 1289*, Defa 27, hijri 1289 (1872).

9 *Devlet Salnamesi: 1299*, Defa 37, hijri 1299 (1882); *Devlet Salnamesi: 1300*, Defa 38, hijri 1299 (1882).

10 *Devlet Salnamesi: 1289*, Defa 27, hijri 1289 (1872); *Devlet Salnamesi: 1298*, Defa 36, hijri 1298 (1881).

11 Mehmed Esad, *Mirat-ı Mühendishane-i Berri-i Hümayun*, pp. 51- 52.

12 Günergun, "Derviş Mehmed Emin Pacha (1817-1879), serviteur de la science et de l'Etat Ottoman", pp.171-183.

13 H. Gök, *Arşiv Belgelerinin Işığında Kara Harp Okulu Tarihi (1834-1883)*, unpublished PhD thesis, Hacettepe University, Ankara, 2005, p. 116.

The second-generation teachers of the *Mekteb-i Harbiye* were selected among the accomplished graduates of the staff officer class who were taught by the teachers mentioned above. It seems that an effort was made to establish a specialization in science teaching during this period of the *Mekteb-i Harbiye*. Sabit Efendi became a physics teacher and wrote a book which would become the first physics book of the school.[14] Safvet Efendi was in charge of teaching chemistry and, after a while, he took on the role of teaching the machinery course as well.[15] Tahir Pasha continued to teach mechanics. Following this generation of teachers trained in Europe, the system seems to have decayed. After Sabit Efendi died in 1853 (or 1854), the school administration could not find a permanent physics teacher for about fifteen years. Until the assignment of Süheyl Bey in 1868/69, physics courses were temporarily taught by various teachers.[16] Süheyl Bey began teaching physics while he was simultaneously teaching artillery. After a while, however, he taught only physics courses. Since that time, assignments of physics courses to the teachers became stabilized and specialization was seemingly re-established.

The change in the understanding of the division of labour in teaching opened the doors for specialists who had already acquired their knowledge. Dimitraki Balasides, an Ottoman citizen who had studied physics in Europe had applied in 1850 for the physics teaching post at the *Mekteb-i Tıbbiye.*[17] Although he was neither a military officer nor a graduate in medical sciences, he taught at this school for a very long time. The teaching positions in physics were not always filled by people who came from 'outside' of the institution as it was the case with Balasides. Assistantship was another way of becoming a teacher and military schools frequently resorted to this method in order to train their own teachers. The career of Antranik Gırcikyan started in a similar way to that of Balasides, a 'civilian outsider'. Gırcikyan joined the teaching staff of the *Mekteb-i Tıbbiye* at a different level, namely, as an assistant. Gırcikyan was an Ottoman Armenian who had completed his higher education in natural

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14 Mehmed Esad, *Mirat-ı Mekteb-i Harbiye*, Şirket-i Mürettibiye Matbaası, Istanbul, hijri 1310, p. 229. Also see appendix, item 4.

15 Mehmed Esad, *Mir'ât-ı Mekteb-i Harbiye*, p. 229; G. Eser, *Mekteb-i Harbiye'nin Türkiye'de Modern Bilimlerin Gelişmesindeki Yeri (1834-1876)*, unpublished MA thesis, Istanbul University, p, 97.

16 In 1862/63, Safvet Bey was teaching physics and machinery. Before that year, he had taught chemistry and machinery courses. In 1863/64, Tevfik Bey (Vidinli Tevfik Pasha) gave physics and machinery courses. Before then, he had probably taught mathematical sciences only. Between 1864/65 and 1865/66, Monsieur Fleury and his assistant Hüseyin Bey were responsible for the physics and chemistry courses. M. Fleury gave only a chemistry course afterwards. Between 1866/67 and 1867/68, Hakkı Bey was the teacher of physics and artillery. Before, he had taught theoretical and applied descriptive geometry. *Hüseyin Tevfik Paşa ve "Linear Algebra"*, K. Çeçen (Ed.), İTÜ. Bilim ve Teknoloji Tarihi Araştırma Merkezi Yay. Sayı: 5, Istanbul, 1988, pp. 18 -22; Eser, pp. 93- 97,102-108, 113-114, 118.

17 BOA, A. MKT. NZD, 50/ 7.

philosophy (physics) in Paris. He came back to Istanbul in 1844 and started working at the *Mekteb-i Tıbbiye* as an assistant physics teacher in 1851. His job was to introduce physics instruments to students and explain their functioning. His career, however, followed an interesting path. He enrolled to the *Mekteb-i Tıbbiye* as a student having turned the age of 30 while he was still working as an assistant teacher. After graduating with a medical diploma, he was sent to Europe by the State to perfect his education. Before returning to Istanbul in 1866, he travelled to England, France, and Italy. Back to the country, he continued to teach physics as an assistant physics teacher at the medical school, but this time, he was a 'military insider'. After 1879, he was promoted physics teacher in the school.[18]

The history of employing assistant teachers goes back to the early nineteenth-century at least. The *Mühendishane* employed assistants whose duty was to supervise the students' progress and repeat the instruction given by the teacher when necessary. If there was a vacant teaching position, assistants could apply for this post and they were promoted teacher if their abilities were confirmed by the other teachers.[19] Since that time on, military schools continued to employ assistants they picked from among the graduates they considered as potential candidates for teaching posts. When the mentality regarding the division of labour started to change, 'the teacher-assistant system' began to operate as a mechanism not only to raise teachers in general, but also to train teachers in particular fields of science. This method helped to maintain continuity in science education and also contributed to the professionalization of a number of scientific disciplines. At the institutions where the assistant-teacher system was efficiently applied, younger generations could enter the profession of physics. A brilliant youngster Esad Feyzi (1874-1901) who had been enthusiastic about physics since his student days at the military high school followed such a path and became a physics assistant at the *Mekteb-i Tıbbiye* which provided him with the opportunity to pursue his interest.[20] While a

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18 M. Akbaş, "Between Translation and Adaptation: Turkish editions of Ganot's *Traité*' in *Science between Europe and Asia*, F. Günergun, D. Raina (Eds.), Springer, Boston Studies in the Philosophy of Science, Volume 275, Part 3, 2011, pp. 179-180.

19 Mehmed Esad, *Mirat-ı Mühendishane-i Berri-i Hümayun*, p. 17.

20 For the biography and his works on radiology, see S. Ünver, "Türklerde Radyolojinin Başlangıcına Dair," *Klinik Radyoloji*, (1), 1940, pp.5-10; S. Ünver, "İlk Röntgencilerimizden Dr. Esad Feyzi Hakkında (1874-1901)", *Klinik Radyoloji*, (3-4), 1942, p.54; N. Yıldırım, "Röntgen Şu'â'âtı ve Tatbikât-ı Tıbbiye ve Cerrahiyesi (Röntgen Işınlarının Tıbbi ve Cerrahi Uygulaması)", *Tarih ve Toplum*, Vol. III (16), April 1985, pp.70-72; Y.I. Ülman, "Medical Modernization in the nineteenth-Century Ottoman Empire with special reference to the introduction of Roentgen Rays in Turkey" in *Perilous Modernity: History of Medicine in the Ottoman Empire and the Middle East From the nineteenth-Century Onwards*, A.M. Moulin & Y.I.Ülman (Eds.), The Isis Press, Istanbul, 2010, pp. 105-118.

student in the final grade of the *Mekteb-i Tıbbiye*, Esad Feyzi used to work as a student assistant at the physics laboratory. Inspired by a French article on X-ray techniques, he wanted to experiment with X-rays. Supported by his physics and chemistry teachers and using the instruments at the laboratory, he managed to build a Roentgen device in 1896.[21] Together with Rıfat Osman (1879-1921), he moved the Roentgen device to the Yıldız Military Hospital to diagnose soldiers who were wounded during the Greco-Turkish War of 1897.[22] Esad Feyzi who performed these experiments while a student at the medical faculty, became an assistant physics teacher upon his graduation.

To conclude, I will attempt to provide a general view on the profile of nineteenth-century physics teachers in the Ottoman Empire. The biographical data of the teachers who gave physics and mechanics courses are limited. However, it is still possible to comment as based on the existing information. My interpretation concerns the teachers of the second half of the nineteenth-century. The first thing to state is that they were all males, since the military institutions were not open to females. Secondly, the majority of teachers were the graduates of these military schools and they were members of the land army or the navy. On the other hand, although it was not a common practice, a few civil teachers were employed at the military institutions as well. Dimitraki Balasides, Émile Lacoine, and Salih Zeki were civilian professors who were employed on account of their expertise in the physical sciences. Compared to Ottoman teachers, the number of foreigners who gave physics and mechanics courses was low.[23] They were either asked to work in the Ottoman Empire or came by their own initiative. They came to the country for various reasons; including teaching or the reorganization of education. None of them, however, came or was brought to the Ottoman Empire specifically to teach physics. The position of Lucien Rouet who worked at the *Mekteb-i Tıbbiye* seems exceptional since he was not a physician but a graduate of the École Polytechnique in Paris.[24] We do not have more information about his career preceding and following his employment at the *Mekteb-i Tıbbiye*. All of these foreigners

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21 A. M. Özden, S. Ünver, "Dr. Esad Feyzi Merhum ve Bizde X reyonu Üzerine İlk Araştırma", *Ölümünün 45. Yıldönümünde İlk Röntgencimiz Esad Feyzi*, Istanbul, 1946.

22 Ülman, "Medical Modernization in the nineteenth-Century Ottoman Empire with special reference to the introduction of Roentgen Rays in Turkey", p. 113.

23 At the *Mekteb-i Harbiye*, Mouginot gave a machinery course in 1847, Fleury taught physics in 1864/65 and 1865/66, and Zanovski taught mechanics in 1875/76. Émile Lacoine taught electricity to the navy officers in 1885. M. Lucien Rouet gave a physics course at the Mekteb-i Tıbbiye between 1843 and 1848.

24 Ülman, "Journal De Constantinople'a Göre Mekteb-i Tıbbiye-i Adliye-i Şahane'nin Galatasaray Dönemi", pp. 60-61, 68- 69; Ülman, "Mekteb-i Tıbbiye-i Adliye-i Şahane'nin 1846-1847 Öğretim Yılı Faaliyet Raporu", p.145.

temporarily gave these courses while teaching other courses or working in a completely different field.[25]

The background of the physics and mechanics teachers in terms of higher education was also diverse. Teachers, who had graduated from the Ottoman military schools, were educated in engineering, medicine, or military arts (artillery, navigation, etc.). The Ottoman State sent some of them – i.e., Derviş Pasha and Tahir Pasha- to Europe for further training and experience. But as far as we know, none of them were sent abroad specifically to be educated in physics. People like Balasides and Gırcikyan, who had received a special training in natural philosophy or physics in Europe, were probably supported by their families. My last observation is that many of these teachers, especially the ones who taught physics courses for longer periods, wrote or translated a physics book – and this will be the subject of the next part of this article.

Textbooks

Books were among the most significant instruments in the transfer of modern scientific knowledge in the Ottoman Empire. The number of science books showed a considerable increase throughout the nineteenth-century. A similar pattern is observed in the number of physics and mechanics books. This was a result of the establishment of modern schools and, in particular, of the introduction of physics courses to the curricula, since textbooks constituted the vast majority of physics publications in general. Taking into account the four military schools dealt with in this article, 17 textbooks on physics and mechanical sciences were identified.[26] All of them were written or translated by the teachers of the courses in which these books were used. These textbooks can be classified into three groups according to their subject fields: general physics books, mechanics books, and machinery books.

The title of the general physics books mostly includes the term ‘hikmet-i tabiiye’.[27] The meaning and the extent of the concept ‘hikmet-i tabiiye’ evolved along with the nineteenth-century. In the beginning of the century, Yahya Naci did not give an explicit definition of the concept in his treatise titled *Risale-i Hikmet-i Tabiiye* (item 1), but the content of his text and his approach permit us to surmise that he used this term as a synonym of ‘natural philosophy’ or even

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25 Fleury was a physician of the French Navy. He gave chemistry courses at the *Mekteb-i Harbiye* and, in addition to this duty, he temporarily taught physics for two years. Émile Lacoine, as we mentioned before, was an electrical engineer who worked at the Ottoman Ministry of Telegraphy. See Eser, p. 97; Günergun, “Salih Zeki ve Astronomi: Rasathane-i Amire Müdürlüğü’nden 1914 Tam Güneş Tutulmasına”, pp.117-118.

26 For the chronological list of these textbooks see Appendix.

27 Translating word by word, ‘hikmet-i tabiiye’ means the natural philosophy.

'science'. On the other hand, İshak Efendi (item 2) provided a definition for 'ilm-i hikmet-i tabii' which is very similar to the Aristotelian conception of physics.[28] The content of İshak Efendi's book and the way he distributed scientific disciplines under general and particular titles illustrate Ishak Efendi's conception of physics. He devoted separate chapters to mechanics, optic, heat, and electricity in his book, but he did not consider any of them as parts or sub-branches of *ilm-i hikmet-i tabii*. He put mechanics and optics under the heading of mathematical sciences, and considered heat and electricity as independent subjects. However, around the mid-nineteenth-century, the meaning of the 'hikmet-i tabiiye' has changed and this term was used for in Ottoman Turkish as the equivalent of *physics* in the modern sense of the word. For instance, according to the 1846-47 program of the *Mekteb-i Harbiye*, which briefly gives the contents of the courses, the scope of *hikmet-i tabiiye* included topics such as heat, acoustics, optics, electricity, and magnetism.[29] Thus, after mid-nineteenth-century, the books titled 'hikmet-i tabiiye' would mostly represent the typical general physics books covering the main topics of physics. Rather than illustrating a specialized knowledge of sub-disciplines, they were introductory textbooks.

Among the textbooks of the four military schools, there were six general physics books under this category: four of them were linked to the *Mekteb-i Harbiye*, and the other two were linked to the *Mekteb-i Tıbbiye* and the *Mühendishane*.[30] These books typically started with a chapter on the general properties of matter, followed by chapters on solids, liquids, and gases. Other physics subjects like heat, optics, electricity, magnetism, acoustics, and meteorology were not among the standard topics of all books. Either some or all of them were included in different physics books. For instance, Hafız Mehmed, in his *İlm-i Hikmet-i Tabiiye* (item 14), devoted space to an introduction to

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28 "*İlm-i hikmet-i tabii* is a science which examines the essence and property of beings existing in the nature (*tabiat*) where nature consists of all sensible existents. Sensible existents or the things percieved by human senses are merely material bodies. That is to say, the subject of *ilm-i hikmet-i tabii* is the essence and properties of material bodies". (Hafız İshak Efendi, *Mecmua-i Ulum-i Riyaziye*, vol. 3, p.2.) He divided 'ilm-i hikmet-i tabii' into two parts: 'ilm-i hikmet-i tabii-i mutlak' and 'ilm-i hikmet-i tabii-i mahsus'. 'Mutlak' means absolute or exact. 'Mahsus' means particular or special. He conceived 'ilm-i hikmet-i tabii-i mutlak' as an introduction part to the rest of the sciences where the properties and causes/absolute causes of the bodies are examined. Under this title, properties of bodies, motion, and forces were studied. 'İlm-i hikmet-i tabii-i mahsus', on the other hand, has a specific definition that is to examine the changes that occur in all material bodies in deed and to apply outside. This topic covered some of the natural sciences (organic bodies, animals, anatomy, sound, inorganic bodies: salts, rocks, mineralogy), the phenomena in the world of being and dissolution (phenomena related to the heat, light, water, air and wind) and under the title of 'new chemistry' (kimya-yı cedid) analysis and synthesis of bodies (elements, acids, etc.).

29 *Mekteb-i Harbiye-i Şahane'de Tahsil Olunacak Ulumun Müfredatı*, pp. 47-59

30 See appendix, items: 4, 9, 11, 12, 14, 17.

mechanics and the properties of solids (force, motion, mass, gravity, equilibrium, collisions, etc.), liquids (equilibrium of liquids, Pascal's law, the pressure of liquids, Archimedes' law, density, capillarity, etc.), and gases (air pressure, barometers, application of Archimedes law to gases, manometers, water pumps, etc.). On the other hand, the Turkish translation of Ganot's *Traité élémentaire* (item 11) includes the general properties of matter, mechanics, solids (force, gravity, mass, motion, etc.), liquids, gases as well as sound (acoustics), heat, optic, magnetism, electricity, and meteorology. Another textbook, *Hikmet-i Tabiiye*, which was written in collaboration with Hasan Fethi and Abdüllatif (item 17), represents a similar content and includes the general properties of matter, solids (force, motion and gravity), liquids, gases, heat, optics, electricity, and magnetism.

The second group consisted of mechanics textbooks. In the third volume of İshak Efendi's book (item 3), there was a part on mechanics which begins with the general properties of matter and giving introductory information about the basic concepts and principles of physics. Velocity, motion, and force were the subjects of the next part, and the following three chapters were devoted to the mechanics of solids (simple machines), liquids, and gases.[31] After the publication of İshak Efendi's work, four mechanics textbooks were published by the teachers of the *Mekteb-i Bahriye* (items 7, 16), the *Mekteb-i Harbiye* (item 6), and the *Mühendishane* (item 13). They were all introductory books to the mechanics of solids. These books covered subjects such as force (definitons, finding the resultant force exerted on bodies by vector analysis, etc), equilibrium (finding the center of gravity), motion (uniform, accelerated, and circular motions, motions of projectiles, etc.), and simple machines (pulleys, lever, wheel and axle, etc.). Ahmed Cemil's book (item 16) also included the equilibrium and motion of liquids. None of them, however, dealt with the mechanics of gases.

The third group of textbooks includes the books on the science of machinery. Four textbooks were published in this category; three of them were linked to the *Mekteb-i Bahriye* (items, 5, 8, 15) and one of them was linked to the *Mekteb-i Harbiye* (item 10). They dealt with the theory of heat and steam, as well as theoretical and practical knowledge of steam engines. The book written for the *Mekteb-i Harbiye* by Vidinli Tevfik and Saadeddin (item 10) also included an introduction to mechanics.

How did the teachers create these textbooks for the courses they were assigned to teach? An analysis of our list given in the appendix, shows that they

[31] E. İhsanoğlu, *Başhoca İshak Efendi,* Kültür Bakanlığı Yay., Ankara, 1989, p. 59.

used various methods to create the textbooks. One of these methods was to translate a specific book from a European language to Turkish. Among the seventeen textbooks, five were created by this method.[32] However, none of the translators specified the full bibliographic information of the source books. Only three of them gave the names of the authors (Longchamp, Ganot, Ripper) of the original book. The remaining two contented with specifying simply the original languages of these books by saying, "I translated this book from French (or English)". The source languages of these books were either French or English. The two books translated from English were linked to the *Mekteb-i Bahriye* and treated the theory or technology of steam, whereas the translations from French were more diverse in subject-matter (physics, mechanics) and in terms of the schools to which they were linked.

Another method for creating textbooks was to make a compilation from multiple source books. Four books can be classified in this category.[33] Once again, authors displayed a similar approach in giving the bibliographic information of the source books. Only the authors of one book (item 17) specified the names of source authors as Émile Fernet, Adolphe Ganot (1804-1887), and Jules Célestin Jamin (1818-1886). Another author, Ahmed Cemil (item 16), says simply that he compiled his mechanics book "from the works of American mathematicians". The sources of the other two books (items 2 and 3) are considered, by historians of science, to owe a great deal to the French sources.[34]

The third method of textbook production was to collect and publish lecture notes. For instance, Mehmed Tahir, the mechanics teacher of the *Mekteb-i Harbiye* created his *İlm-i Cerr-i Eskal* (item 7) by this method as did Ali Rıza with his *Fenn-i Mihanik-i Riyazi ve Makineler* (item 13). The ways of making of the remaining books in our list (items 8, 10, 12, 14) are still unclear. They could be either original or else produced by one of the methods mentioned above.

These books were written for specific schools which had different characteristics from one another. Do these books possess different characteristics as well? In other words, do they exhibit different approaches to physics/mechanics in relation to the schools to which they were linked? For instance, was a general physics book written for medical education different than the one written for the engineering school? The answer to this question is

[32] See appendix, items: 5, 6, 9, 11, 15.

[33] items: 2, 3, 16, 17.

[34] See appendix, item 2 and 3 and their footnotes.

both yes and no. An overall review of these textbooks has shown that the content of the textbooks of the nineteenth-century was flexible. First of all, the curricula of the schools did not always define the course contents in a detailed way and this helped teachers to have more control on the curricular content. Second, the content of a textbook was not necessarily exactly the same as the course content. On the contrary, examples suggest that more comprehensive books were more appreciated.[35]

In this sense, the teachers' initiative is an important issue here. Two textbooks from the history of the *Mekteb-i Harbiye* exemplify how the approaches of physics teachers could be different. Mehmed Said wrote the *Hikmet-i Tabiiye Tatbikatından* (item 12) for the first grade students of the infantry and cavalry classes of the *Mekteb-i Harbiye* (1885-86).[36] Students of these classes had acquired their preliminary knowledge of physics in the preparatory class. So, the author did not attempt to cover all elements of physics. The topics of physics he chose to deal in his book and the ideas which he displayed in the book's preface show that he made a special effort to present physical sciences within the framework of military applications. For instance, in the preface, he emphasized the importance of physical inventions during wartime. He notified how balloons and telegraphs contributed to communication with the outside world during the siege of Paris by German powers in the Franco-Prussian War (1870-71). Similarly, in the main text of the book, he selected topics that could be bound with the military practices: the theory of air currents and balloons was followed by the practice of making and filling balloons and ended up with 'the balloons employed in military observation'.

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35 For instance, Vidinli Tevfik Pasha, the teacher of the machinery course at the *Mekteb-i Harbiye*, collected his lecture notes and prepared the first part of his book for publication. He proposed his draft [to the commission of the military education] in order to be printed. But the commission, with its reply dated to 27.09.1869, told him that the printing would begin only after he delivered the second part of the book. So Vidinli Tevfik Pasha resigned his request and gave up the book. After a while, he was charged with other military tasks and was sent to Paris and America. It was the former assistant and new teacher of the course, Saadeddin Bey, who completed the second part of the book and got the permission for printing. The book could be published 5-6 years after the commission's reply. Referring to Salih Zeki, this anecdote was cited in *Hüseyin Tevfik Paşa ve "Linear Algebra"*, K. Çeçen (Ed.), İTÜ. Bilim ve Teknoloji Tarihi Araştırma Merkezi Yay. Sayı: 5, Istanbul, 1988, p. 35. Another example is A. Gırcikyan's translation from Ganot's *Traité*. In the preface, Gırcikyan set forth his motives for making the translation: one of them was the absence of 'rather detailed' physics books in Turkish. See Akbaş, "Between translation and adaptation: Turkish editions of Ganot's *Traité*' p. 182.

36 Mehmed Said *Hikmet-i Tabiiye Tatbikatından* (2 vols.). Vol.I: Mekteb-i Fünun-ı Harbiye-i Şahane Matb., Istanbul, 1877/78 (hijri 1294), 129 pages, vol.II: Mekteb-i Fünun-ı Harbiye-i Cenab-ı Mülükhane-i Matb., Istanbul, 1878/79 (hijri 1296), 46 pages. The book saw the press three times (the last edition was in 1887). I used the third edition of the first volume: *Hikmet-i Tabiiye Tatbikatından*, Vol: I, 3rd ed., Mekteb-i Fünun-ı Harbiye-i Şahane Matbaası, Istanbul, 1303 (1885/86), 82 pages.

Another case was *Hikmet-i Tabiiye* (item 17) from the *Mekteb-i Harbiye* authored by Hasan Fethi and Abdüllatif. This book was also written for first grade students, though it belongs to late nineteenth-century. The first salient difference between this book and that of Mehmed Said is their size. Hasan Fethi and Abdüllatif created a book of four volumes of more than 500 pages in total, which is obviously more elaborate than Mehmed Said's work. On the other hand, they were not interested in writing a 'military' physics book. In terms of their approach to physics, it is possible to find more similarities between Hasan Fethi's book and physics books written for a medical school or a civilian school.

CONCLUSION

Throughout the long history of the Ottoman Empire, the nineteenth-century was an unequalled period from the point of view of the history of science. In this century, drastic changes occurred in the understanding of education, sciences, and techniques. The number of publications related to sciences increased as never before. New institutions providing military or civil education were established and they greatly helped the introduction and teaching of modern sciences in the Empire.[37] The introduction of modern physics in the Ottoman Empire is one of the novelties of this century.

The present research shows that the discipline-building history of physics in the Ottoman Empire began with the introduction of physics and mechanics courses to the program of modern military schools. This happened before the publication of the first modern textbooks on physics and mechanics, and well before the emergence of teachers who specialized in these subjects. The history of pre-nineteenth-century science in the Ottoman Empire, put forth that there were individual efforts of the scholars to introduce the new subjects or methods from European science in some disciplines such as geography, astronomy and medicine.[38] However, as previous researches have shown, post-Aristotelian approaches to physics were not a subject of attention for Ottoman scholars before the nineteenth-century. Therefore, physics and mechanics owe much to the encounters with European science at the educational, institutional level.

This research also suggests that the *Mühendishane* -the oldest modern educational institution in the Ottoman Empire- was also the first school to

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37 For a more detailed account on the Ottoman history of science in the nineteenth-century, see 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, pp. 95-106.

38 Günergun, "Science in the Ottoman world", pp. 80-90; F. Günergun, "The Ottoman Ambassador's Curiosity Coffer: Eclipse Prediction with De La Hire's "Machine" Crafted by Bion of Paris", in *Science between Europe and Asia*, F. Günergun, D. Raina (Eds.), Springer, Boston Studies in the Philosophy of Science, Volume 275, 2011, pp. 103-123.

introduce physical and mechanical sciences in its curriculum. The 1806-1808 regulation of this school added a mechanics course into the program of the final grade. Physics was a subject of interest for some of the teachers, such as Yahya Naci and İshak Efendi. As a separate course, it only entered the official program of this school in 1848. There was a similar time lag between the introduction of mechanics and physics courses to the program of the *Mekteb-i Bahriye* as well: while mechanics entered the program in 1848, physics attained its place in 1869. This situation shows that Ottomans connected the practice of fortification, engineering, shipbuilding, and machinery to the knowledge of mechanics earlier than they did to physics. Seemingly, their understanding of mechanics and physics is behind this attitude. Mechanics, traditionally, was considered a mathematical science and, mathematical sciences played a central role in the training of engineers in the *Mühendishane* since its foundation.[39] The kinship of these sciences may have paved the way for mechanics and resulted in an earlier reception at the *Mühendishane*. However, the introduction of mechanics to the program of the *Mekteb-i Bahriye* did not occur as easily as in the case of *Mühendishane*. The traditional training of shipbuilders and machinery technicians in the Ottoman Empire was more practice-oriented rather than science-oriented. New shipbuilding techniques, however, changed the profile of the experts in the western world and supplemented the knowledge of geometry and the drawing skills with the knowledge of mechanics. The foreign experts employed in the Ottoman dockyards triggered the change in the understanding of shipbuilding and, as a result of a slow process; mechanics entered the curriculum of the *Mekteb-i Bahriye*.

The progress of physics, as the present research made clear, was closely connected with the major reforms which fundamentally changed the institutional organization of military schools. The mentality regarding the division of labour in teaching began to change with these reforms around the mid-nineteenth-century. This change put each school on an evolutionary path, creating the potential for specialization in scientific disciplines including physics. The *Mühendishane-i Berri-i Hümayun*, the *Mekteb-i Harbiye*, and the *Mekteb-i Tıbbiye* displayed patterns of specialization in physics, each in its own style. Within this diversity, when the workforce conditions were optimum, physics was either a unique field of specialization, or it shared its experts with chemistry. Mechanics, on the other hand, was still considered a mathematical science and could not be a unique field of expertise. The evolution of the mentality regarding the division of labour towards increasing specialization and

[39] D. Martykánová, *Reconstructing Ottoman Engineers: Archaeology of a Profession (1789-1914)*, Edizioni Plus, Pisa, 2010, p. 62.

the creation of some teaching positions provided opportunities for those who were trained in Europe. However, for the younger students of the military schools who had a special interest in physics, could take advantage of the teacher-assistant mechanism. This method helped to preserve the continuity in science education with a local workforce as well as to contribute to the professionalization of a number of scientific disciplines. At the institutions where the assistant-teacher system was efficiently applied, younger generations could enter the profession of physics.

The making of textbooks was a significant instrument for specialization in physics. The number of texbooks on physics and mechanical sciences increased throughout the nineteenth-century. The teachers of these courses produced textbooks using various methods: by translating a specific book from a European language to Turkish or by making a compilation from multiple source books. The source languages of these books were mostly French, but English books were also in demand, especially for textbooks dealing with the theory and technology of steam. An overall review of these textbooks showed that their contents could be flexible. Not all these texbooks provided a regular or standard content for physics or mechanics. Since the curricula of the schools did not always have detailed course contents, teachers could gain more control over their courses. Besides, the textbooks were not necessarily exactly the same as the course content. On the contrary, the more comprehensive the books, the more they were appreciated.

APPENDIX

The chronological list of the nineteenth-century Turkish physics and mechanics textbooks used in the four Ottoman military schools. The list includes only the first editions.

1) Yahya Naci, *Risale-i Hikmet-i Tabiiye*. 1809 (hijri 1224), 44 folios. (Manuscript)

Yahya Naci wrote this treatise to explain the physical and chemical principles of the functioning of firearms.[40]

2) Yahya Naci, *Risale-i Seyyale-i Berkiye.* 1812 (hijri 1227), 17 folios + 1 plate. (Manuscript)

[40] The educational role of these two treatises (item 1 and 2) written by Yahya Naci Efendi is ambiguous. There are no exact proofs showing that they were produced as textbooks or that they were used as supporting texts. However, the author Yahya Naci wrote them at the time when he was working as a teacher at the *Mühendishane*. In any case, they are the first modern physics texts in Ottoman Turkish. For a detailed analysis of the *Risale-i Hikmet-i Tabiiye* (1809), see E. Ademoğlu, "Yahya Naci Efendi ve fırlatılan cisimlerin hareketiyle ilgili eseri *Risale-i Hikmet-i Tabiiye* (1809)", *Osmanlı Bilimi Araştırmaları*, Vol. IV (2), 2002, pp.25-56.

This treatise introduces the properties of electricity with experiments. According to Günergun's research, the main source of this text is M.J. Brisson's (d. 1795) *Traité Elémentaire de Physique*.[41]

3) Elhac Hafız İshak, *Mecmua-i Ulum-i Riyaziye* (4 vols.). Matbaa-i Amire, Istanbul, 1831-1834 (hijri 1247-1250).

The chief instructor of the *Mühendishane-i Berri-i Hümayun*, İshak Efendi, wrote this collection of mathematical sciences. However, the book includes the natural sciences as well (physics, chemistry, biology, botanic, zoology, and mineralogy, etc). The third volume of the book is devoted to mechanics and optics. According to İhansoğlu's research, İshak Efendi resorted to E. Bézout's *Cours de Mathématiques à l'Usage du Corps de l'Artillerie* (1798) and *Cours de Mathématiques à l'Usage des Gardes du Pavillon et de la Marine* to write the mechanics part. Among the sources of the part on optics, Reynaud's *Traité Elémentaire de Mathématiques, de Physique et de Chimie* (1824) and *Traité Elémentaire de Mathématiques et de Physique* (1839). On the other hand, the fourth volume also includes physical subjects such as fire and heat (1st article) and electricity (2nd article).[42]

4) Kıbrıslı Sabit, *Hikmet-i Tabiiyye*, vol.I: *Ecsâm-ı Mevzunenin Havâss ve Keyfiyeti* (?). Istanbul (?), 1849- 1854 (?), the number of pages is unknown. Printed.

Kıbrıslı Sabit Efendi was a former student of and later successor to the eminent physics teacher Derviş Pasha in the *Mekteb-i Harbiye*. This book was unknown to us until recently, and we still lack a tangible copy, having only historical records to prove its existence.[43] According to *Takvim-i Vakayi* news, the book was in printed form (but probabily unbound) and was kept under the tag 'volume 1 of Physics, including the general properties of material bodies'.[44] It must have been printed between 1849 and 1854 as a first part of a complete physics volume and probably was interrupted due to the sudden death of Sabit Efendi.

5) Author unknown, *Mebâhis-i Fenn-i Buhar*. Trans. by Mehmed Salih, Mekteb-i Bahriye press, Istanbul, 1853/1854 (hijri 1270), 3+310 pages.

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41 F. Günergun, "Deneylerle elektiriği tanıtan bir Türkçe eser: Yahya Naci Efendi'nin *Risale-i Seyyale-i Berkiyye*'si', *Osmanlı Bilimi Araştırmaları*, Vol.IX (1-2), 2007-2008, pp. 19-50.

42 E. İhsanoğlu, *Başhoca İshak Efendi,* Kültür Bakanlığı Yay., Ankara, 1989, pp. 59-60.

43 These are Mehmed Esad's *Mir'ât-ı Mekteb-i Harbiye* (p. 229) and *Tasvir-i Efkâr news* (no: 63, 04.02. 1863, p. 3). The final editions of this book were put up for sale in 1863, because no suitable physics textbook were on the market for those who attended public physics courses in Darülfünun.

44 Quoted from *Tasvir-i Efkâr* (no: 63, 04.02.1863/ hijri 14 Şaban 1279, p.3), by N. Hayta, *Tarih Araştırmalarına Kaynak Olarak Tasvir-i Efkâr Gazetesi (1278/1862-1286/1869)*, T.C.Kültür Bakanlığı Yay., Ankara 2002, p. 210.

The book is about steam and steam engines. In the preface of the book, Mehmed Salih says that he translated this book from English but does not specify the name of the author or the source text. The book is written in a style of questions and answers.[45] Mehmed Salih was the director of the *Mekteb-i Bahriye* at the time he translated this book,[46] so the book was probably produced for the students of the *Mekteb-i Bahriye*.

6) Author unknown, *Cerr-i Eskal*. Trans. by: Mehmed Eşref, Mekteb-i Bahriye press, Istanbul, 1862 (hijri 1278), 203 pages+ 14 plates.

This is a mechanics textbook produced for the *Mekteb-i Bahriye* students. Mehmed Eşref, teacher of mechanics and mathematical sciences, translated it from French. But there is no further information about the original author and source text.

7) Mehmed Tahir, *İlm-i Cerr-i Eskal*. Mekteb-i Fünun-i Harbiye-i Şahane lithography, Istanbul, 1862 (hijri 1279), 304 pages + 13 plates.

This is the first mechanics book of the *Mekteb-i Harbiye*. Its author, Mehmed Tahir, the mechanics teacher of the school, created this text by compiling his lecture notes.

8) Mustafa, *Usul-i Fenn-i Makine* (2 vols.). Istanbul, 1865 (hijri 1283), vol.I: 1+153 pages, vol.II: 92 pages+ 16 plates.

The book is about the science of machinery. The author, Mustafa Bey, was the teacher of machinery courses and produced it as a textbook for the students of the *Mekteb-i Bahriye*.[47]

9) Longchamp (?), *Hikmet-i Tabiiye-i Riyaziye*. Trans. by Said Sami, Mekteb-i Fünun-i Harbiye-i Şahane press, Istanbul, 1872 (hijri 1289), 3+65 pages.

The title of the book implies that it is about mathematical physics. Said Sami translated it from an unknown source text which was written by an author named Longchamp (?). The translation was probably made as a textbook for the *Mekteb-i Harbiye*.[48]

10) Vidinli Tevfik; Saadeddin, *Fenn-i Makine.* Istanbul, 1874/75 (hijri 1291), 318 pages +18 plates.

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45 *Osmanlı Tabii ve Tatbiki Bilimler Literatürü Tarihi,* Vol. I, E.İhsanoğlu at al (Eds.), IRCICA, Istanbul, 2006, p. 178- 179.

46 *Osmanlı Astronomi Literatürü Tarihi*, Vol. I, E. İhsanoğlu et al (Eds.), IRCICA, Istanbul, 1997, p. 113; *Osmanlı Tabii ve Tatbiki Bilimler Literatürü Tarihi,* Vol. I, p.178; A. İ. Gencer, *Bahriye'de Yapılan Islahat Hareketleri ve Bahriye Nezareti'nin Kuruluşu (1789/1867)*, p. 282.

47 *Osmanlı Tabii ve Tatbiki Bilimler Literatürü Tarihi*, Vol. II, pp. 213-214.

48 *ibid*, Vol. I, p. 311.

Vidinli Tevfik and Saadeddin Bey were the two subsequent teachers of machinery lessons of the *Mekteb-i Harbiye*. Vidinli Tevfik wrote the first two parts, Saadeddin Bey, meanwhile, wrote the third part, completed the book and published it. The book is about mechanics, machinery sciences, and steam machines and prepared for the students of the *Mekteb-i Harbiye*.

11) Ganot, A., *İlm-i Hikmet-i Tabiiye* (3 vols.). Trans. by Antranik Gırcikyan, Mekteb-i Tıbbiye-i Şahane press, Istanbul, 1876 (hijri 1293), vol.I: 668 +44 pages, vol.II: 765 pages, vol.III: 52 double pages.

It is a general physics textbook. Antranik Gırcikyan translated it from Adolphe Ganot's *Traité élémentaire de physique expérimentale et appliqué* for the *Mekteb-i Tıbbiye*'s physics course. He used the 14th edition of the *Traité* for the translation, but he occasionally used the 13th and 16th editions as well.[49]

12) Mehmed Said, *Hikmet-i Tabiiye Tatbikatından* (2 vols.). Vol.I: Mekteb-i Fünun-ı Harbiye-i Şahane press, Istanbul, 1877/78 (hijri 1294), 129 pages, vol.II: Mekteb-i Fünun-ı Harbiye-i Cenab-ı Mülükhane-i press, Istanbul, 1878/79 (hijri 1296), 46 pages.

Mehmed Said wrote this book for students of infantry and cavalry classes at the *Mekteb-i Harbiye*. It includes selected topics from physics applied to military issues.

13) Ali Rıza, *Fenn-i Mihanik-i Riyazi ve Makineler* (2 vols.). Vol.I: Karabet press, Istanbul, 1888/89 (hijri 1306), 331 pages, vol.II: Mühendishane-i Berri-i Hümayun press, Istanbul, 1894/95 (hijri 1312), the number of pages is unknown.

The book is about mathematical mechanics and machines. Author Ali Rıza was the mechanics teacher of the *Mekteb-i Harbiye* and the *Hendese-i Mülkiye* (the civil engineering school). He wrote this book by compiling the lectures that he gave to the science section students of the staff officer class in the *Mekteb-i Harbiye* and to the students of the *Hendese-i Mülkiye*. He probably used some French books during the preparation of his book.[50]

14) Hafız Mehmed, *İlm-i Hikmet-i Tabiiye* (3 vols.)**.** Vol.I: *Mebhas-ı mihanik ve havass-ı ecsam-ı sulbe*, Şirket-i Mürettibiye press, Istanbul, 1893/94 (hijri 1311), 84 pages, vol.II: *Ecsam-ı mâyia*, Şirket-i Müretibbiye pres, Istanbul, 1893/94 (hijri 1311), 80 pages, vol.III: *Havass-ı ecsam-ı havaiyye cereyan ve sarfiyat-ı miyah*, Mahmud Bey press, Istanbul, 1894/95 (1312), 92 +3 pages.

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49 Akbaş, "Between translation and adaptation: Turkish editions of Ganot's *Traité*" pp.177-191.

50 In the book, the author sometimes put the French equivalents of some Turkish scientific terms within parentheses.

Hafız Mehmed wrote this as a general physics book for the Mühendishane-i Berri students.

15) Ripper, W., *Fenn-i Buhar*. Trans. by Ali Galib, Matbaa-i Bahriye, Istanbul, 1895 (hijri 1313), 192 pages.

It was accepted as a textbook for the students of the *Mekteb-i Bahriye* and the students of the Machine Factory of the Imperial Arsenal. The book is about heat, steam, and steam engines. In his own words, Ali Galip translated it from a book by William Ripper[51]. The source text must be William Ripper's *Steam* (Longmans, Green, and Co, London& Newyork, 1889, 202 pages.)

16) Ahmed Cemil, *Fenn-i Mihanik*. Mahmud Bey press, Istanbul, 1895/96 (hijri 1313), 4+260+80 pages.

Ahmed Cemil, by his own account, compiled this mechanics book from the works of American mathematicians. He produced the book for the students of the Mekteb-i Bahriyye.

17) Hasan Fethi; Abdüllatif, *Hikmet-i Tabiiye* (4 vols.). Vol.I (2nd ed.): Karabet press, Istanbul, 1895/96 (hijri 1313), 162 pages, vol. II (2nd ed.): Karabet press, 1895/96 (hijri 1313), 155 pages, vol. III (1st ed.): Karabet press, 1894/95 (hijri 1312), 87 pages, vol. IV (1st ed.), Cemal Efendi press, Istanbul, 1896/97 (hijri 1314), 136 pages.

This extensive general physics book was written by the physics teacher and assistant teacher of the *Mekteb-i Harbiye* for the first grade physics course of the school. In the preface, the authors specified that they referred to the works of [Émile] Fernet, [Adolphe] Ganot (1804-1887), and [Jules Célestin] Jamin (1818-1886).

Fiziğin Askeri Yürüyüşü-II: Ondokuzuncu Yüzyıl Osmanlı Askeri Okullarının Fizik ve Mekanik Bilimler Öğretmenleri ve Ders Kitapları

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

[51] *Osmanlı Tabii ve Tatbiki Bilimler Literatürü Tarihi,* Vol. I, pp. 515-516.

okulların ders programlarında fizik ve mekaniğin yeri daha önce, *Fiziğin Askeri Yürüyüşü I* adlı makalede ele alınmıştı. Bu makale ise, diğer iki eğitimsel öğeyi, fizik-mekanik bilimler öğretmenlerini ve onların yazdığı ders kitaplarını incelemektedir.

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

The Military March of Physics – II: Teachers and Textbooks of Physics and Mechanical Sciences 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. Place of physics and mechanical sciences in the curricula of these schools, has been examined in a previous article, *The Military March of Physics I*. The present article, on the other hand, examines the other two educational elements: teachers of physics and mechanical sciences, and textbook written by them.

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