STUDIES IN OTTOMAN SCIENCE

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SUMMARIES

Editor

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THE DEPARTMENT OF HISTORY OF SCIENCE (ISTANBUL UNIVERSITY FACULTY OF ARTS) AND ITS ACTIVITIES FROM 1984 TO 1994

Feza Günergun

The Department of History of Science at Istanbul University Faculty of Arts was originally established as a chair within the Department of Philosophy by Prof. Dr. Dr. h. c. Ekmeleddin İhsanoğlu in 1984. It acquired departmental status in 1989, thereby becoming the first Department of History of Science in Turkey.

The idea and first attempts to establish a chair at Istanbul University that would initiate the teaching of history of science and researches in this field go back to 1980. Upon his coming to Istanbul to establish the Research Center for Islamic History, Art and Culture (IRCICA), E. İhsanoğlu had the opportunity to meet the scholars working on the history of medicine, pharmacy and technology and with the presidents of different universities. He submitted his idea of establishing a history of science chair to the President of the Istanbul University and his proposal was accepted. The chair for the history of science was officially established when E. İhsanoglu was appointed as professor in 1984. The chair started to give the history of science courses to undergraduate students of philosophy begining from the academic year 1985-86. These were: *Introduction to History of Science* (E. İhsanoğlu, F. Günergun), *History of Science* (E. İhsanoğlu, F. Günergun) *History of Turkish-Islamic Science* (E. İhsanoğlu), *History of Ottoman Science* (E. İhsanoğlu). These courses were opened successively, one in each academic year. Two new courses were opened in the academic years 1990-91 and 1991-92. These were: *Industrial Revolution* (Emre Dölen) in 1990-91 and *Science in the 19th and 20th Centuries* (E. Dölen) in 1991-92.

In the academic year 1991-92, upon the decision of the Philosophy Department, history of science courses ceased to be given as compulsory courses to philosophy students. After this academic year, they became electives for all students in the Faculty.

The Department started the first independent "Undergraduate Programme in History of Science" from the academic year 1992-93 onwards. The curriculum of this programme included, besides the courses on history of science, courses

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on sciences (mathematics, physics, astronomy), logic, sociology and history of philosophy. In 1988, a doctorate programme was started to train students from different backgrounds. The graduate programme started in 1989. Within this programme, which is still running under the supervision of E. İhsanoğlu, three students have already completed their studies and received their MA degrees. At the end of the academic year 1993-94 there were three doctorate and eight masters students in this programme. The first MA thesis was completed on 18 August 1993 by İ. Fazlıoğlu. This was, at the same time, the first thesis prepared on history of science at Istanbul University.

The Department of History of Science offers the following courses to graduate students: *Seminar on the History of Science* (E. İhsanoğlu), *Sources on the Ottoman History of Science* (R. Şeşen), *Industrial Revolution: Relationship Between Science and Technology* (E. Dölen), *History of Turkish-Islamic Science* (E. İhsanoğlu), *History of Ottoman Science* (E. İhsanoğlu), *Sociology of Science* (Baykan Sezer). In addition to these courses, the graduate students attend extra courses from other departments and faculties related to their research areas.

By 1994, the Department of History of Science continued its activities with one professor (Dr. E. İhsanoğlu, Director of the Department), one associate professor (Dr. F. Günergun, associate director), five research assistants (M. Kaçar, İ. Fazlıoğlu, A. Dölek, S. Karamustafa and G. Şahinbaş), and two lecturers (S. İshakoğlu, A. Albayrak).

The Department started organizing symposia from 1987 onwards.The first symposium (1st National Symposium on Turkish History of Science) held on 3-5 April 1987 was on the Ottoman scientific and professional societies. The second one, held on 2-4 September 1987 was the International Symposium on Modern Science & the Muslim World. Its main theme was the transfer of science and technology from the West to the Muslim world starting from the Renaissance until the beginning of the 20th century. Both symposia were organized in collaboration with the Research Center for Islamic History, Art and Culture (IRCICA) and their proceedings have been published.

From 1989 onwards, the Department staff undertook the organisation of other symposia jointly held with the Turkish Society for History of Science (TBTK), IRCICA and other national and international institutions. These were the IInd Symposium on the History of Turkish Science: Modern Commu-

nication and Transportation Techniques in the Ottoman State, 3-5 April 1989; Scientific Institutions in Islamic Civilization, 22-24 April 1991; Science and Technology in the Turkish and Islamic World, 3-5 June 1994; Science and Technology Transfer from Europe to Asia (1880-1950), 28-30 October 1994.

Before concluding, we have to mention here two institutions: the Turkish Society for History of Science (TBTK) and the History of Science Museum and Documentation Center (BIMDOK) to the activities of which the members of the Department have contributed since their foundation.

TBTK was founded in Istanbul in 1989 with the aim of carrying out research in history of science, especially Turkish history of science and related areas, to promote, diffuse and publish the researches conducted in this field, to increase the interest of scholars in history of science in Turkey, to draw their attention to various aspects of Turkish history of science, and to protect this heritage. Its founding president is E. İhsanoğlu. Amongst its founders are the historians of science from history of science departments of the universities in Istanbul and Ankara, as well as distinguished physicists, chemists, astronomers, physicians and pharmacologists. Since its foundation, a number of activities (symposia, conferences, publication of the TBTK Newsletter) have been conducted by TBTK, which represent Turkey in the International Union of History and Philosophy of Science (IUHPS). In the conferences jointly held by IRCICA and TBTK, the themes discussed were the Ottoman science and technology in its various aspects.

BIMDOK was established by E. İhsanoğlu within the Istanbul University in 1993. Some of the faculty deans and scholars of Istanbul University and the staff of the History of Science Department are members of this center. The center has been established for collecting the data and material on Turkish history of science and to pass this heritage to the coming generations. Plans for the establishment of an archive on the history of the Istanbul University within this center are under way.

EKMELEDDIN İHSANOĞLU: A BIOGRAPHY, AND OUTLINE OF HIS SCHOLARLY CONTRIBUTIONS TO HISTORY OF SCIENCE

Feza Günergun

Prof. Dr. Dr.h.c. Ekmeleddin İhsanoğlu was born in Cairo in 1943. He graduated from the Faculty of Science of Ain Shams University, Cairo in 1966. Still a university student, he worked in the National Library in Cairo for the cataloguing of Ottoman manuscript and printed works. From 1066-70, he served as a research assistant in the Department of Chemistry of the faculties of Engineering and Science newly established at the famous old Al-Azhar University where he obtained his M.Sc. degree. Meanwhile, he taught Turkish language and literature at the Faculty of Arts of Ain Shams University

Ekmeleddin İhsanoğlu came to Turkey in 1970. He served as an assistant at Ankara University Faculty of Science for five years. In 1974, he completed his Ph D studies at the chair of organic chemistry under the direction of Prof.Dr. Celal Tüzün. Together, they established the Organic Chemistry Research Institute. İhsanoğlu was a research fellow at Exeter University, England, from 1975 to77. In 1978, he became assistant professor in organic chemistry at Ankara University.He continued to teach and do research as a faculty member of Ankara University and Malatya University until 1980.

In 1980, İhsanoğlu was appointed Director General of the Research Centre for Islamic History, Art and Culture (IRCICA), a subsidiary organ of the Organisation of the Islamic Conference. Assigned the task of establishing the Centre and rendering it operational, İhsanoğlu initiated research projects on various aspects of the Islamic culture and civilisation falling within the fields of the Centre's objectives, including history of science. He launched IRCICA's Series of Studies and Sources on History of Science and was the editor of the first book in the series titled *Catalogue of Islamic Medical Manuscripts* (in Arabic, Turkish and Persian) in the Libraries of Turkey published in 1984. Other reference books and research works that he edited were published under the same series in the following years. One of the projects he initiated at IRCICA in the same field is a bio-bibliographic research on the history of Ottoman scientific literature. The research, which started in 1985, covers the scientific works

and authors in the fields of astronomy, mathematics, medicine, chemistry, zoology, botanics, military techniques, etc., from the foundation of the Ottoman State until the proclamation of the Turkish Republic. The first outcome of this project was a bio-bibliographic compendium on the History of Ottoman Literature on Astronomy.

Meanwhile, in 1984, E. İhsanoğlu established the Department of History of Science at the Faculty of Letters of Istanbul University. The Department gave undergraduate courses from 1985-86 onwards and also offered master and PhD programs. A few years later, in 1989, İhsanoğlu established the Turkish Society of History of Science (TBTK) which brought historians of science from all around Turkey together. The society is the unique institution of its kind in Turkey and represents the country in the International Union for the History and Philosophy of Science (IUHPS). İhsanoğlu took another step by establishing the Museum and Documentation Centre on History of Science (BIMDOK) at Istanbul University in 1993, for the purpose of collecting and studying artifacts and documents concerning the history of science in Turkey.

Hence, within a short period of thirteen years from 1980 to 1993, Ekmeleddin İhsanoğlu established four institutions active in research, publication, teaching and training in history of science, not including the Ankara University, Faculty of Science, Organic Chemistry Research Institute and other institutions working on Islamic culture of which he was among the founders. This is a manifestation of the importance he has always given to institutionalisation in academic and cultural activities. Ekmeleddin İhsanoğlu, started to publish works on Turkish culture and literature as early as the 1960s. It can be seen in the list of his publications on history of Science (pl. see the original article in Turkish) that his works deal primarily with Ottoman science. Some of the conferences organised by the institutions he chairs and some postgraduate theses he directs also focus on this theme. His aim is to contribute to an accurate assessment of the scientific activities of the Ottoman period, draw the attention of the researchers around the world to Ottoman science, and open a debate on the hypothesis that the Golden Age of Islamic science had ended in the eleventh century. Within the framework of these activities, İhsanoğlu coined the term "Ottoman science" referring to scientific activities realized throughout the Ottoman period on Ottoman territory, and convincingly argued for the general usage of this term in international academic circles.

In his publications on Ottoman science, he focuses on topics such as the introduction of modern science and technology to the Ottoman world, Ottomans'

contacts with Western science, scientific activities and education in the nineteenth century, institutions of science and scientific education, the relationship between science and religion, Ottoman scientific and professional associations, scholars and scientists, language of science and science education, and history of chemistry. In these works, he observed that Ottomans transferred European science and technology with a selective attitude, and that the theories of Basalla and Pyenson formulated in recent years to explain the processus of transfer of science from Europe to other regions of the world do not apply to the Ottoman case. İhsanoğlu pointed out that the ulema's attitude towards modern science was not a negative one and that it would be incorrect to link the regression of Ottoman state and society solely to this factor.

Prof. İhsanoğlu is also interested in such topics as the promotion of scientific mentality in society, scientific development policies, and statistical assessment of the state of scientific activities in Turkey and the Muslim world, which are all related to the study of history of science. He dealt with these issues in several conference papers, as well as within the framework of a research project he undertook at IRCICA on the Cultural Dimensions of Development in OIC Member States which resulted in a book published under his editorship. Furthermore, he wrote articles on various subjects ranging from studies on medieval Islamic science to necrologic articles about Ord. Prof. Dr. Süheyl Ünver, Turkish historian of medicine, and Ord. Prof. Dr. Aydın Sayılı, founder of the first history of science chair in Turkey.

İhsanoğlu is on the Editorial Board of periodicals specialized in history of science such as the *Newsletter of the Turkish Society for History of Science* (Istanbul) and *Acta Turcica Historiae Medicinae* (Istanbul) as well as academic journals such as *Arts and the Islamic World* (London), *Journal of Islamic Studies* (Oxford), *The American Journal of Islamic Studies* (Herndon, VA), *Al-Usur* (London, Riyadth). At the same time, he is a member of the following organisations and institutions: Turkish Society for History of Science, Turkey; Society for History of Medicine, Turkey; Society of Chemistry, Turkey; Institute of Islamic Research, Turkey; Foundation for Middle East and Balkan Studies, Turkey; Atatürk Supreme Council for Culture, Language and History/Atatürk Culture Center, Turkey;Global Forum, U.S.A.; Association of Muslim Social Scientists (AMSS), U.S.A.; Middle East Studies Association of North America (MESA), U.S.A.; Advisory Board of the Center for Middle Eastern Studies, Harvard University, U.S.A.; Royal Academy of Islamic Civilisation Research,

Jordan; Academy of Arab Languages, Jordan and Syria; National Council for Translation of Studies and Research, Tunisia; Société Internationale de la Philosophie et des Sciences Arabes et Islamiques, France; Egyptian History Society, Egypt; Société Internationale d'Histoire de la Médecine, France; Académie Internationale d'Histoire des Sciences, France; International Advisory Board and Experts Board of Al-Furqan Islamic Heritage Foundation, U.K.

İhsanoğlu's contributions to scholarship in the fields of Turkish and Islamic culture, history and art brought him international awards and distinctions. He was decorated with the medal of "Distinction of the First Order" of the Arab Republic of Egypt in 1990 for service in the field of Islamic civilisation. He received the title Dr.h.c. from Mimar Sinan University, İstanbul, in 1994, for fostering relations among Islamic countries and Turkey in the fields of culture and arts, and the scroll of honour of Türk Petrol Foundation, İstanbul, the same year, for his services in the field of culture.

Prof. Dr. Ekmeleddin İhsanoğlu continues to fulfill his functions in these fields as Director General of the Research Centre for Islamic History, Art and Culture (IRCICA); Secretary of the International Commission for the Preservation of Islamic Cultural Heritage (ICPICH), Organisation of the Islamic Conference; Head of the Department of History of Science, Faculty of Arts, Istanbul University; and, Chairman of the Turkish Society of History of Science (TBTK); Vice-president of the International Commission on Islamic Science and Technology of the International Union for the History and Philosoph of Science (IUHPS).

In this brief account of Ekmeleddin İhsanoğlu's scholarly activities, the emphasis was on his research and publications in the field of history of science. Still, I think the importance of his activities in this field would be better understood if they are considered within the framework of his entire work on various cultural, scientific, and literary topics which fully reflect the profile of a multidisciplinary scholar.

SOME NOTES ON STUDIES IN THE FIELD OF HISTORY OF OTTOMAN SCIENCE

Ekmeleddin İhsanoğlu

The history of Ottoman science is one of the least recognised and researched fields in the context of the history of science in the Islamic civilisation. This paper aims to draw the attention of historians of science to this wide and rich subject area which is relatively unexplored and is in need of their attention.

Ottoman science evokes the overall scientific activity carried out all through the Ottoman period which covers 600 years, from the end of the thirteenth century to the twentieth century and on the vast geography comprising Asia Minor, the Balkans and most of the Arabic lands on which the Ottoman Empire ruled for centuries. In the historical development of Ottoman science two main phases can be discerned. The first phase is the process through which the classical Islamic science developed during the Middle Ages, became predominant and whose influence continued until the last century, while the second phase is the process of modernisation under the influence of modern Western science.

In evaluating the scholarly research activity carried out in the vast subject area of Ottoman science, the following branches have been considered: astronomy, mathematics, medicine and related sciences, engineering, natural sciences and lastly scientific institutions. My purpose is not to provide a full bibliography of all research in this field but to give an idea about its main topics and orientation. In this summary, only the first and main studies and works on the subject will be mentioned and the reader is kindly asked to consult the article in Turkish for more details and subsequent research.

Among the works of general nature, the first and only comprehensive work covering Ottoman science in general is by Dr. Adnan Adıvar. The book *La Science chez les Turcs Ottomans* appeared in 1939 in Paris. Among bibliographical works on the history of Ottoman science, two works; namely *Osmanlı Müellifleri* (1915-25) by Bursalı Mehmet Tahir and *Türk Bilim Tarihi Bibliyografyası* (1850-1981) (1981) by A. Kazancıgil can be mentioned. A bio-bibliographical study on Ottoman astronomy has recently been completed by the Research Center for Islamic History, Art and Culture (IRCICA) and will soon be

published as the first volume of the project covering many subjects of the Ottoman science.

Concerning the history of Ottoman astronomy, the first study is an unpublished 19th century work in Turkish titled *On the Biographies of Astronomers in the Islamic World and the Ottoman State* written by Süleyman Sudi Efendi. The second one is the work titled *Asar-ı Bakiye* by Salih Zeki published in 1911. S. Zeki's other important work is *Kamus-u Riyaziyat* in 12 volumes which is a dictionary of mathematical and astronomical terminology. Fatin Gökmen, the precursor of astronomical research based on observation and experiment in Turkey and founder of the Kandilli Observatory (İstanbul) has also written on the history of Ottoman astronomy. On the other hand Heinrich Suter's book, *Die Mathematiker und Astronomen der Araber und Ihre Werke* (1900, reprinted 1982), deals with many Ottoman scientists. We come now, to the works of well-known Turkish scholar and historian of science Aydın Sayılı (1913-1993), whose book, titled *Observatory in Islam* (1960, reprinted 1981), I shall cite in relation to astronomy. Sevim Tekeli from the Ankara University focused her studies mainly on the history of Ottoman astronomy, specially on the works of the famous Turkish astronomer Taqi al-Din.

David King's book on Islamic mathematical astronomy and astronomical instruments published successively in 1986 and 1987 and his article titled "Astronomical Timekeeping in Turkey" should also be mentioned here. Muammer Dizer (1924-1993), former Director of Kandilli Observatory, also published several works on the history of Ottoman astronomy as well as the catalogue of the astronomical manuscripts in the Kandilli Observatory Library. The author of the present article, in his article "Introduction of Western Science to the Ottoman World: A Case Study of Modern Astronomy (1660-1860)", studies the introduction of modern astronomy (the Copernican system) to the Ottoman state and its reception.

Coming to the history of mathematics, besides H. Suter's work, we should evoke Salih Murat Uzdilek's *Tarih-i Riyaziyat* published in 1909. Another more recent book is *Hüseyin Tevfik Paşa and Linear Algebra* by Kâzım Çeçen. The book is a biography and study of the works of H. Tevfik Paşa, an Ottoman scientist who made original contributions to mathematics. Currently, Remzi Demir from Ankara University and İhsan Fazlıoğlu from İstanbul University are working on history of astronomy and mathematics in the Ottoman classical period respectively.

Among the scientific disciplines, medicine and related sciences such as pharmacology, dentistry and veterinary are those the developments of which have been studied most extensively. Scholarly interest in the history of medicine and related sciences started towards the end of the last century and grew continously. As it will not be possible to cover all of these studies here, I will content myself by bringing to your notice the pioneering figures. One of them is certainly A. Süheyl Ünver who published about 600 articles. Feridun Nafiz Uzluk, among his other articles, published two monographies about prominent Ottoman physicians Şanizade and Mustafa Behçet Efendi. E. Kadri Unat studied the history of bacteriology and virology and compiled a bibliography of medical parasitology in Turkey (1959). Bedii N. Şehsuvaroğlu, who published nearly 200 articles on history of Ottoman science and pharmacology, besides various aspects of this subject area, studied the history of quarantine. A number of works by Arslan Terzioğlu were published on the history of hospitals as well as on German-Austrian-Turkish relations in the field of medicine. The history of pharmacology benefited from the studies of Naşid Baylav (*Eczacılık Tarihi*, 1968) and Turhan Baytop (*Türk Eczacılık Tarihi*, 1985). Nihal Erk's and Ferruh Dinçer's studies on veterinary education should also be mentioned here. Lastly I would like to inform you about the *Catalogue of Islamic Medical Manuscripts in the Libraries of Turkey* published by IRCICA in 1984.

Few resarches exist on the history of engineering. Prof. Kâzım Çeçen published important books on the Ottoman water supply sytems in which those systems are studied in great detail. Feza Günergun, from the Istanbul University History of Science Department, works currently on metrology, specifically on the introduction of the metric system to the Ottoman State. Recently, IRCICA published the proceedings of the Symposium on the Transport and Communication Techniques in the Ottoman State (Istanbul 1989) which includes articles on engineering.

There are few articles published on the history of chemistry. Aziz İdris included an elaborate introduction on the history of chemistry to his book on medical chemistry *Kimya-yı Tıbbi* (1869). The second work is the *Annotated Bibliography of Turkish Chemical Literature (Printed Works 1830-1928)* published in 1986 by the present author.

Lastly we come to the Ottoman scientific institutions as a subject study. The work titled *Mirat-ı Mühendishane-i Berri-i Hümayun* by Mehmed Esad

presents the 102 year history of the Imperial School of Engineering from 1794 to 1896. A doctorate study by Mustafa Kaçar will, when completed, shed more light on the history of this institution. My work titled *İshak Efendi, a Pioneer of Modern Science in Turkey* focuses on the contributions of İshak Efendi who was the chief instructor of the Imperial School of Engineering. A study by Rıza Tahsin titled *Mirat-ı Mekteb-i Tıbbiye* (The History of the Imperial School of Medicine) relates the development of modern medical education established in the Ottoman State at the beginning of the 19th century. I shall mention lastly a book on Ottoman scientific and professional associations published in 1987 which comprises articles on the establishment and development of Ottoman professional associations in the field of medicine, pharmacy, engineering, architecture as well as on some Ottoman learned societies. As to the science education in Ottoman medreses - the classic institutions of learning- the PhD thesis of late Cevad İzgi should be mentioned. This young scholar studied the teaching of astronomy, mathematics, and natural sciences in the Ottoman medreses. Before concluding I wish to mention the activities (publications, symposia) carried out by the Turkish Society for History of Science in cooperation with IRCICA and the Istanbul University History of Science Department. This collaboration aims to throw more light on the history of Ottoman science and promote scholarly activity in this area from the viewpoint of different disciplines.

Up to the present, research in history of Ottoman science has mostly been of bio-bibliographical nature and focused mostly on the history of scientific institutions. Among all disciplines, the history of medicine and astronomy attracted the greatest scholarly interest. Another observation is that studies in the form of critical editions and analysis of the scientific texts in various disciplines are few and inadequate in comparison to the wealth of material on the subject found in different libraries. In sum, a two fold conclusion may be derived from my study towards an assessment of research activity on the history of Ottoman science. It transpires, on the one hand, that the subject has been approached by historians of science from different angles but the quality and quantity of existing studies vary from one discipline to the other; which shows that there remains a lot to be explored about Ottoman science. On the other hand, the subject offers a whole gamut of interesting issues to the benefit of scholarly research and therefore deserves to be considered as a distinct field of study.

IBN AL-HAWWAM (d.724/1324), HIS WORKS AND THE SECTION ON INSOLUBLE PROBLEMS IN AL-FAWAID AL-BAHAIYYA FI AL-QAWAID AL-HISABIYYA

İhsan Fazlıoğlu

Imaduddin (or Cemaluddin) Abu Ali Abdullah b. Muhammed al-Hawwam b. Abdurrazzaq al-Harbuwi al-Bagdadi al-Iraqi al-Harezmi al-Şafii, one of the VIII/XIVth century Muslim scientists, was born in Zilkade 643/March 1245 possibly in Baghdad and died in the same city in 724/1323-1324.

After completing his primary education, he learned the rational sciences, most probably in Baghdad, from Nasiruddin al-Tusi, the founder-member of Maragha mathematical-astronomical school. His relation to Maragha school was only confined to his being a student of Nasıruddin al-Tusi and he led an intellectual life independent of the Maragha school.

He has three books on mathematics and four books on tefsir, tasavvuf, ethics and medicine respectively. Ibn al-Hawwam also has "Fawaid" in mathematics which have come down to our age in different ways. Due to his works, he was one of the most prominent figures of his time both in rational and traditional sciences. One of his mathematics books is *al-Fawaid al-Bahaiyya fi al-Qawaid al- Hisabiyya* which was written in Isfahan in Şaban 675/January 1276 and was presented to Bahaaddin Muhammed al-Cuvayni. Another book on mathematics by al-Hawwam, *al-Risala al-Şamsiyya fi al-Qawaid al-Hisabiyya,* is a version of *al-Bahaiyya* and was probably prepared by Ibn al-Hawwam himself. The basic difference between these two works is that *al- Şamsiyya* is much more concise and practically oriented. His third book on mathematics is a commentary on the Book X of Euclides's *Elements* which deals with the geometrical study of irrational numbers.

The last chapter of *al-Bahaiyya* (Hâtime) is studied in detail in this article. Before summarizing this study, it will be appropriate to introduce Ibn al-Hawwam's mathematical works.

Al-Bahaiyya, can be placed within the Pythagorean tradition, a discipline based on number mysticism. In Islamic mathematics, number mysticism started after the translation of Nicomachos's *Introductio Aritmetica* by Sabit b. Kurra

into Arabic and was developed by Ihvan al-Safa. The mystic tradition was similar to "Theologoumenates Aritmetikes" in content. *al-Bahaiyya* can be seen as a follower of this mystic school in Islamic mathematics. In this work, Ibn al-Hawwam takes only hisab al-hevai as a subject and does not include hisab al-hindi. Therefore, within the two main hisab traditions of Islamic mathematics, aside from hisab al-muneccimin used by the astronomers, *al-Bahaiyya* follows the first one.

The algebra explained in *al-Bahaiyya* can be evaluated to be within the school of analytic algebra based on arithmetic established by al-Kereci. The aim of this school is to express an algebraic formulation with an analytic explanation, without basing it on the geometric ones for arithmetizing the algebra. As it is known, the geometrical and analytical approach to algebra present in Mesopotamia and Ancient Greece was synthetized in Islamic mathematics by Harezmi and Ebu Kamil: they used both methods in solving algebraic equations. Starting with al-Kereci, algebra began to be differentiated from geometry. Samawel continued this practise and finally algebra was competely arithmetized. Algebra of the fourth book and algebraic problems that Ibn al-Havvam solves in the fifth book of *al-Bahaiyya* totally belong to the analytic approach in algebra.

Al-Bahaiyya was prepared for advanced readers in the form of a "collection of mathematical principles" and displays the level of Islamic mathematics on hisab al-hevai, hisab al-muneccimin, rules of ratio, ilm al-misaha and ilm al-cabr wa al-muqabala. The work is of medium size and level, and recapitulates the mathematical knowledge of its time. For the history of mathematics in general and the history of Islamic mathematics in particular, the thirty three "insoluble problems" that Ibn al-Hawwam noted in the book are the most original aspects of this work. These problems present in the "Hatime" of *al-Bahaiyye* are studied in this paper.

Some problems of this kind, that are among the intederminate equations, had been dealt with by mathematicians like Diophantus, Ebu Kamil, Ebu'l-Wefa al-Buzcani, al-Kereci, al-Hazin, Samawel, al-Hucendi and Izzuddin al-Zencani before Ibn al-Hawwam. After Ibn al-Hawwam, especially Cemşid al-Kaşi was interested in such equations in Islamic mathematics. Bahaeddin al-Amili, in his *Hulasat al-Hisa*b, cited only seven of the Ibn al-Hawwam's thirty three problems under the heading of "insoluble problems". The most noteworthy of Ibn al-Hawwam's thirty three problems are the third and twenty, fourth problems

which deal with the particular case for n=3 and n=4 of the Fermat's last theorem which shows the impossibility of $x^n + y^n = z^n$, n>2 equation.

Al-Bahaiyya and its version *al-Şamsiyya* served as the two main text books in the mathematic al education and studies in Baghdad and Ispahan. Ibn al-Hawwam taught mathematics from these books. This educational activity led to the formation of a bright mathematician and physician called Kemaleddin al-Farisi (d.718/1319) who learned the al-Bahaiyya directly from Ibn al-Hawwam in Ispahan.

Al-Bahaiyya was commented on twice by two Muslim mathematicians in the VIIIth and XIXth centuries: *Esas al-Qawaid fi al-Usul al-Fawaid* by *Kamalad-din al-Farisi* and *Izah al-Maqasıd fi al-Faraid al-Fawaid* by Imaduddin al-Kaşi (d.after 745/1344). Although Imaduddin al-Kaşi stated in his commentary that he would prepare a separate treatise on the insoluble problems of *al-Bahaiyye*, no such treatise was found. Imaduddin al-Kaşi also wrote some independent commentaries on the some mathematical rules given in *al-Bahaiyya.*

Al-Bahaiyya and the two commentaries greatly influenced the later Islamic and Ottoman mathematical works on the teaching of mathematics. Ali al-Garbi (VIII/XIVth century) in his *Kitab al Mucizat al Necibiyye fi Şerh al-Risalet al-Alaiyye*, quoted from *al-Bahaiyye* and Kemaleddin al-Farisi's commentary; Cemşid al-Kaşi, in his well known work *Miftah al-Hisab*, took some of the algebraic problems directly from *al-Bahaiyye.* Molla Lutfi (d.900/1490), in his treatise called *Risale fi Tarif al- Hikme,* Cabizade Halil Faiz (d. 1124/1712) in his translation *al-Savlet al-Hizebriyye fi al-Mesail al-Cebriyye* and finally Kuyucaklızade Mehmet Atıf Efendi (d. 1263/1847) in *Nihayet al-Elbab fi Tercumet Hulasat al-Hisab*, all quoted from the commentary of Kemaleddin al-Farisi. Katip Çelebi (d. 1067/1657) in his uncompleted commentary titled *Ahsen el-Hediyye bi Şerh el-Risalet el-Bahaiyye*, compares briefly the *al-Bahaiyya* and *al-Muhammadiyya.* Taşköprülüzade (d. 968/1561) in his *Miftah al Sa'ade* ve *Misbah al-Siyade*, where he listed the books used by Ottoman scholars, mentioned in the section "hisab al-hevai" al-Farisi's commentary on *al-Bahaiyya* as the fifth book.

As the commentary of Kemaleddin al-Farisi and *Irşad al-Tullab ila İlm al-Hisab* (anonymous, reign of Sultan Beyazid the Second) shows, some of the problems of Ibn al-Havvam which were not present either in *al-Bahaiyya* or *al-Şamsiyya* were known by later mathematicians. Since there are no other mathe-

matical works by Ibn al-Havvam except the three books that have been mentioned, we may deduce the idea that his other problems have been transmitted to later generations through "Fawaid" tradition.

Lastly, we wish to point out that Salih Zeki (d.1921), an Ottoman mathematician and historian of mathematics, was the first to emphasize the importance of both Ibn al-Havvam's *al-Bahaiyya* and the two commentaries. He was also the first to point out the significance of these works within the history of Islamic mathematics and presented the first evaluation of Ibn al-Hawwam's works in his book *Asar-ı Bakiyye*.

THE TEACHING OF ARITHMETIC AND ALGEBRA AT THE OTTOMAN MEDRESES

Cevat İzgi

Arithmetic had been one of the sciences taught at the Ottoman medreses since their foundation. In some of the arithmetic books, the students could also gain some knowledge of algebra as these books contained chapters on algebra in addition to arithmetic. Though not mentioned as a seperate course like geometry and astronomy in Fatih's *Kanunname* on education, arithmetic existed in the curriculum.

Kevâkib-i Seb'a (1155/1745) states that the science of arithmetic was not taught as an independent course like geometry. According to this source, arithmetic was taught when passages on mathematical sciences such as astronomy and geometry in the Islamic theology books were studied. On the other hand, it is understood from the autobiographies that arithmetic books were generally read after Philosophy and Islamic theology, before the Hadith and the Quranic commentary.

There are records proving that arithmetic was also taught in "tekke"s and "zaviye"s. Arithmetic certificates, though very few, were given in the medreses. It is observed that Ottoman scholars of the nineteenth century learned also arithmetic and algebra from the specialists as well as in the preparatory and high schools (Idadis and Rüşdiyes). Cevdet Pasha, one of the nineteenth century Ottoman scholars who learned arithmetic both in the old and modern tradition, was one of them.

Ottoman scholars used mostly the arithmetic books written by the mathematicians of Islam. But in the Ottoman medreses, mainly the *Hulasatu'l-Hisab* of Bahauddin el-Amili and the *el-Muhammediyye fi'l Hisab* of Ali Kuşçu were used as text books. *Hulasatu'l-Hisab* was translated into Turkish by Kuyucaklızâde Muhammed Atıf in 1242/1826 during the reign of Sultan Mahmud the Second. The fact that this book was published three times in Istanbul in the following years proves that it preserved its importance in education.

In the teaching of arithmetic, many tools such as sand, wood, iron bars, paper and pen-cases were also used besides text books. The arithmetic books

were copied in the "Ellili medrese" in Istanbul and Anatolia. Some of these were read by ways of examination (by methods of bahs, tedkik, fehm, tahkik) and dictation (imla).

Ottomans started writing arithmetic books from the beginning of the 15th century onwards. Arithmetical texts were translated into Turkish later than astronomical texts, but earlier than geometrical texts. *Miftâhu'l-Hisab* (anonymous), *Risale fi İlm-i Hisab* (anonymous) and *Miftahu'l-Muşkilat* (Muhammed Musa-i Vafi) are examples. Arithmetic books that were prepared by the "muhasips" (book-keepers) and "divan katipleri" (secretaries of the Council of State) were usually written in Turkish. *Mecmau'l-Kavaid* (889/1484) by Hacı Atmaca is an example. The greatest work among Turkish books of arithmetic, that was written in the classical tradition, was Ali b. Veli b. el Cezairi el-Mağribi's (d. 1022/1614) *Tuhfetu'l A'dad* which was presented to Sultan Murad the Third (d.1595).

Independent books on algebra were also written besides the many arithmetic books which had chapters on algebra. In Ottoman medreses, algebra went hand in hand with arithmetic. Both arithmetic and algebra were present in the curriculum of "Darulhilafeti'l-Aliyye" (est. 1914). Thus, we can conclude that mathematics maintained its place within the medrese education, and the scholars of medrese continued to produce works on mathematics.

MÜNECCİMBAŞILIK (CHIEF ASTRONOMERSHIP) IN THE OTTOMAN STATE

Salim Aydüz

In this article, the rise of "müneccimbaşılık" (chief astronomership) in the pre-Ottoman period, its tranmission to the Ottomans and its development as an institution in the Ottoman State are examined.

Though we do not have enough reliable sources and information about the origins of the chief astronomership, its history can be traced back to the Abbasid times. It is known that in the Abbasid period, there were many astronomers in the court, but there was not an institutionalized structure. In the Ilkhanid period, during which "ilm-i nücum" reached its peak and many world famous astronomers were brought up such as Ulugh Beg, astronomy was given special importance in the court and some people having the title of "müneccim" (astronomer) were entrusted for the determination of "cülus" (accession to the throne) and battle times. But inspite of all this historical background, it was during the Seljukid period that "müneccimlik" (astronomership) achieved a more systematic structure and a position closer to its place in the Ottoman State. Seljukid sultans, like their Ottoman counterparts, took the astronomers and astrologers to war with them and gave them the task of preparing calenders. The question of the "origin of astronomership in the Ottoman State" can be solved by the consideration of this historical truth. Likewise, the main structure in the Seljukids was passed to the Ottoman State.

It is not very easy to fix a date when chief astronomership first appeared in the Ottomans; but the first calenders prepared by astronomers belong to the period of Sultan Murad the Second (1404-1451). It's also known that Mehmed the Conqueror (1430-1481) consulted the astronomers about the favorable date for the siege of Istanbul. Astronomers were highly respected and appreciated by all Ottoman sultans after this time.

Though it had a definite structure in the pre-Ottoman period, chief astronomership gained institutional status in the Ottoman times. The staff of this institution included "müneccimbaşı" (chief astronomer), "müneccim-i sani" (second astronomer), müneccim-i salis (third astronomer) and the "müneccimbaşı katipleri" (clerks of the chief astronomer).

Chief astronomers were chosen from among scholars qualified in astronomy and belonged to the "ilmiye" class. So their appointments and dissmissals were made just like the other officers', within the court. "Müneccim-i sani"s, who were also chosen from among the "ilmiye" class, helped the chief astronomer and they participated in the preparation of calenders. We know that there was also a title of "müneccim-i salis".

Astronomers, like other officials of the court, had incomes such as "arpalık" (a kind of fief), "cülus bahşişi" (tip given on the occasion of Sultan's accession to the throne), "atiyye" (bounty granted by the Sultan) and they also received an income from the horoscopes and calenders they submitted to the sovereigns. Since astronomers belonged to the "ilmiye" class, they were liable to the rules of this class about dressing but wore special costumes in ceremonies or when they were admitted to the Sultan's presence.

The duties of the chief astronomer included the preparation of calenders, fasting time tables and horoscopes. Besides these, there were various institutions working under the supervision of the chief astronomer. The "muvakkıthane"s (timekepper's offices) that worked on time keeping and the "Mekteb-i Fenn-i Nücum" (School of Astronomy) established by Hüseyin Hüsni Efendi (d.1840) were among them. The Observatory of Istanbul, established in 1577, worked under the directorship of its founder Takiyüddin Rasıd who was the chief astronomer from 1571 onwards.

The institution of chief astronomership was abolished in 1924 with the foundation of the Turkish Republic, and its activities were carried on by the newly established "başmuvakkıtlık" (chief time-keepership) which functioned until 1952.

THE BEGINNING OF THE MILITARY RENOVATION IN THE OTTOMAN EMPIRE

Mustafa Kaçar

The first renovation made by the Ottomans in the military field started with the "Humbaracı Ocağı" (Bombardier Corps) that was reorganised in 1735 by Claude-Alexandre Comte de Bonneval, a European officer (1675-1747) who took the name of "Humbaracı Ahmed Paşa" (Ahmed Pasha the Bombardier) after he converted to Islam. Humbaracı Ahmed Pasha and three French officers, also converts to Islam, trained three hundred young men, who were brought from Bosnia in reconstructed barracs in the Ayazma Palace in Doğancılar, Üsküdar. The main goal was to train these young men as military engineers. This was the first time that a military force in the Ottoman army, directed by a European specialist, started to learn the European military tactics.

The Bombardier Corps was formed of three "oda"s (divisions), each consisting of 25 "zabit"s (officers), 75 "nefer"s (soldiers) and was headed by an "alaybaşı" (colonel). There were set rules for officers and soldiers and also for the organisation, administration and for the use of financial resources. Considering that one officer was responsible of three soldiers, it can be easily said that there was strict training within the Bombardier Corps.

In chronicles such as *Suphi Tarihi* and *Atâ Tarihi*, it is stated that there was also a "Hendesehane" (School of Geometry) within this Bombardier Corps in Üsküdar. *Atâ Tarihi* states that the first teacher in this "Hendesehane" was Hacı Mehmed Efendi-zâde Said Efendi, the Müftü of Yenişehir, who taught geometry. As a result of archival research, we found out that Said Efendi was a "hoca-i mühendis" (teacher of engineers) at the second "oda" of the corps with a daily salary of 60 akçes. Said Efendi wrote a number of treatises on the instruments invented by the Europeans which were used to measure the range of cannons. Besides Said Efendi, there were other teachers in the Bombardier Corps. These were Kasımpaşalı Ali Ahmed Hodja who received a daily salary of 40 akçes and İstanbullu Süleyman b. Hasan. There was also Osman b. Abdullah as "hoca-i muallim". We know that "muallim-i resim" (teacher of arts) was İbrahim of İstanbul who had left his job paying 60 akçes in 1152/1739. Muhtedi Selim, who was the chief sergeant in the Bombardier Corps, also taugt the tech-

niques of military art (harp sanayi fenni) and his daily salary was 240 akçes; he was the "muallim-i ilm ve fenn-i sanayi-i ateşbazi". We did not find a document or information in the Ottoman archives proving that an institution called "Hendesehane" or an institution giving engineering education was established within the Bombardier Corps. However the fact that teaching officers like "hoca-i mühendis", "muallim-i resim", "hoca-i oda" were included in the staff, proves that mathematics was taught and engineering courses were given.

Although the Bombardier Corps did not last for long and lost its function after a few years, this new understanding of military training was important, as it constituted an example for the "mühendishane"s (engineering schools) which were established within the last fourth of the eighteenth century.

THE TEACHING OF MATHEMATICAL AND NATURAL SCIENCES IN THE DARÜLFÜNUN AND ISTANBUL UNIVERSITY FACULTY OF SCIENCE BETWEEN 1900 - 1946

Sevtap İshakoğlu

In Ottoman Turkey, the teaching of mathematical and natural sciences outside the medreses started in the modern engineering and medical schools founded beginning from the late eighteenth century. An attempt to teach these sciences apart from these institutions emerged in the middle of the nineteenth century with the idea of establishing the Darülfünun (University). In the first attempt dated 1863, conference-lectures on modern sciences were given. Although it may be thought that these courses were the very foundation of the Istanbul University Faculty of Science, in fact Darülfünun could not last for long. The conference-lectures which continued until 1865 attracted great interest, but since Darülfünun was not planned as an activity of higher education, it could not achieve real success.

Although the second attempt for establishing the Darülfünun (Darülfünun-ı Osmani, 1870) started with a different and more mature understanding, it also failed due to several difficulties. In 1874, Darülfünun-ı Sultani was established and mathematical and natural science courses started in Turuk u Maabir Mektebi (School of Civil Engineering) within this institution. These science lectures constituted the basis for engineering education.

In the first three attempts, lectures and courses on mathematical and natural sciences were never continuous. They gained continuity in 1900 in the Ulum-ı Riyaziye ve Tabiiye Şubesi (Department of Mathematical and Natural Sciences) that was established within the Darülfünun-ı Şahane (Imperial University) in spite of the unfavourable political conditions and limited facilities of the time.

After the declaration of the Second Constitution (1908), some measures were taken to improve the level of education in the Ulum-ı Riyaziye ve Tabiiye Şubesi. But since the graduates of this faculty did not have good job opportunities, interest taken in the "Fünun Fakültesi" (Faculty of Sciences) was comparatively less than the other faculties.

During the First World War (1914-1918), some scholars were recruited from Germany to teach at the Faculty of Science. The Institute of Chemistry in Yerebatan and the Institute of Geology in Vefa were established. The endeavours of the German scholars to acquire the necessary materials for these institutes were really noteworthy. When the war ended, these scholars returned to their own countries before their work was completed. After they left, the lessons were given by their Turkish colleagues.

In 1919, with the Darülfünun-i Osmani Nizamnamesi (Regulations of the Ottoman University), Darülfünun acquired a new scientific and administrative organization. Although the faculty again faced various problems, a new curriculum was prepared during the Independence War.

In the early years of the Turkish Republic, scientific and administrative autonomy and legal personage were given to the Darülfünun. PCN Class (Physics, Chemistry, Natural Sciences) was established within the faculty. "Muallimlik İhtisas Ruusları" (Teaching Certificates) were given for the training of teachers for secondary schools as well as certificates for chemical, mechanical and electrical engineering. The Faculty of Science also contributed to the education of engineering between 1923-1933.

In 1926, scholars were recruited from France to the Faculty of Science to improve education. Education continued with the support and contribution of these scholars and their Turkish colleagues until the University Reformation in 1933.

In 1933, Darülfünun was abolished during the University Reformation. Mass dismissal took place in the Faculty of Science as well as in other faculties of the Istanbul University. All Turkish instructors, except three, in the Faculty of Science were dismissed. It is hard to guess the criteria used for the dismissal. When the training and education of the dismissed are compared to the formation of those who remained, it gets even harder to understand this criteria. Scholars like Ligor Bey, Cevat Mazhar and Ömer Şevket, who were educated in Europe and had original scientific publications, were among the dismissed.

After this dismissal, the staff was strengthened by German instructors mostly of Jewish origin who fled from Hitler's regime and young Turkish scholars who returned to Turkey after completing their education in Europe. Thus, research and education continued with the contribution and under the directorships of these German scholars.

After the autonomy given to the university in 1946, the Faculty of Science was reorganised. The certificate system valid up to that time was abandoned for the branch and course systems.

During this period, which is referred as the "Golden Age" of the Faculty of Science (1933-1946), 41 Ph.D degrees were given (10 in mathematics, 2 in astronomy, 2 in physics and 8 in chemistry, 6 in zoology, 8 in botany, 5 in geology). A better evaluation of its scientific activity can be made through a more detailed examination of the histories of the disciplines.

Zeynep Hanım Konağı, where the Faculty of Science had been working since the Second Constitution (1908), was burned down in 1942. This event led to an interruption in the education and research activities. All equipment and instruments were destroyed by the fire, and the faculty had to continue its activities in a disorganized manner in different buildings.

As a conclusion, in the three Darülfünuns established in the second half of the nineteenth century, mathematical and natural sciences were taught in different faculties. But the foundation stone of today's Istanbul University Faculty of Science was the "Ulum-ı Riyaziye ve Tabiiye Şubesi" established in 1900 within the Darülfünun-ı Şahane (Imperial University). In the course of time, its name was changed several times, some courses were added or dropped, foreign instructors were brought, and new orders were applied until the University Reformation in 1933. After this year, the Faculty of Science continued its activities as the first and only Faculty of Science in Turkey for several years, laying down the foundation for later faculties of science. It was also the first institution to initiate the research tradition in natural sciences.

DARÜLFÜNUN FÜNUN (FEN) FAKÜLTESİ MECMUASI (1916-1933) (Journal of the Darülfünun Faculty of Science)

Feza Günergun

In Turkey, the first scientific and professional journals started to be published beginning from the middle of the nineteenth century. These journals were published both by individual efforts and by scientific and professional societies. Educational and military state institutions also published journals with scientific features.

In the second half of the nineteenth century, the Ottoman State initiated the establishment of "Darülfünun" as an institution for higher education. Though the first attempts in 1863, 1870 and 1876 could not achieve the desired success, education became continuous in the "Darülfünun-i Şahane" (Imperial University) founded in 1900. The "Darülfünun-i Şahane", which laid the foundations for today's Istanbul University, contributed to the Turkish higher education until the University Reformation in 1933 with its faculties of Arts, Law Medicine, Sciences and Theology.

It is estimated that the idea of publishing a scientific journal within the Darülfünun was put down during the reformation movement in the first years of the World War I. Within the framework of this reformation, four faculties of the "Darülfünun" (Arts, Sciences, Law and Medicine) started to publish journals in 1916. The journal of the Faculty of Theology appeared in 1925.

In this article, journals published by the Darülfünun Faculty of Science between 1916-33 will be examined. The *Darülfünun Fünun Fakültesi Mecmuası* (Journal of the Darülfünun Fünun Fakültesi), which started to be published in 1916, had two sections: "Tabiiyat" (Natural Sciences) and "Riyaziyat" (Mathematical Sciences). The journal, which came out every two months, ceased to be published in 1917 during the Turkish War of Independence. In the 12 issues that came out in 1916-17, 116 articles were published.

The Faculty of Science, restarted to publish a journal in September 1924 under the name of *Darülfünun Fen Fakültesi Mecmuası* (Journal of the Darülfünun Fen Fakültesi) which continued without interruption until the University Re-

formation in 1933. The journal, which was issued in Arabic characters formerly, started to be published in Latin characters and took the name of *Istanbul Darülfünunu Fen Fakültesi Mecmuası*" (Journal of the Istanbul Darülfünun Faculty of Science) from 1929 onwards. In the 27 issues between 1924-1933, 96 articles were published.

In the two periods between 1916-33, 212 articles were published in total: 85 in mathematics, 40 in chemistry, 33 in physics, 17 in zoology, 12 in geology, 7 in botany and 4 in astronomy. When the sources of these articles are examined, it is found out that most of them were articles introducing and explaining the new developments, theories and methods in European science. Among the articles based on research, the least number of original articles was in physics. Original articles in chemistry were on analytical chemistry. The most number of original articles were in zoology and geology. Those were the articles examining the fauna and geological structure of some regions of Turkey. As it was not always possible to find out whether the solutions of the problems belong to the author or not, the number of the research articles in mathematics could not be determined.

From 1924 to 1933 (for approximately ten years), the total number of articles published was 96 while between 1916-17 (in two years), this number was 116. There may be various reasons for the decrease. One may be that "Darülfünun" was considered to be mainly an institution for education and thus educational activities were given more importance.

In conclusion, the Journal of the Darülfünun Faculty of Science introduced the Turkish scholars with new developments in mathematical and natural sciences taking place in Europe and initiated the tradition of publishing a "scientific journal" within the university. Besides translations and compilations from European sources, it included original articles by Turkish scholars. The journal also gives us valuable information about the teaching staff of the Darülfünun Faculty of Science, their subject areas and the teaching activities in general.

An annotated list of the articles published in the journal between 1916-33 is attached to the Turkish text of this article as well as a table giving the distribution of the articles according to the subject areas and years.