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İSAM

Enlightenment Cartography at the Sublime Porte: François Kauffer and the Survey of Constantinople

*Mary Pedley**

Bab-ı Âli'de Aydınlanma Haritacılığı: François Kauffer ve İstanbul Haritası

Özet ■ Bu makale, François Kauffer ve onun İstanbul üzerinde yaptığı ve onsekizinci yüzyılın son çeyreğinde şehrin ilk "bilimsel" haritasını üreten araştırma üzerine yapılmış bir çalışmadır. İstanbul için bir "ilk" olmasının getirdiği etkiye rağmen, Plan de la Ville de Constantinople et de ses faubourgs (İstanbul şehri ve banliyölerinin planı) adlı bu harita, Avrupa'da onsekizinci yüzyılda eski eser meraklıları ile askeri amaçlara hizmet eden büyük harita yapımı konusundaki gelişmelerin çerçevesinde ele alınıp yorumlanmalıdır. Haritanın detaylı içeriği antik çağ tarihi ile ilgilenenlere hizmet ederken, güvenilir ve doğrulanabilir olması da Osmanlı başkentinin giderek daha detaylı hale gelecek olan haritalarının çiziminde uzun süre önemli bir yere sahip olmasını sağladı.

Anahtar kelimeler: François Kauffer; Plan de la Ville de Constantinople et de ses faubourgs (İstanbul şehri ve banliyölerinin planı); Jean Baptiste Lechevalier; Marie-Gabriel, comte de Choiseul-Gouffier; Mühendishâne-i Hümâyûn; Aydınlanma döneminde haritacılık.

The *Plan de la Ville de Constantinople et de ses Faubourgs*, prepared by the French military engineer François Kauffer in 1776, revised in 1786, has repeatedly drawn the attention of scholars and map enthusiasts for being a "first": "le premier plan géométral d'Istanbul,"[1] "first map with a scientific scale,"[2] or "the first attempt to ap-

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1 Frédéric Hitzel, "François Kauffer (1751?-1801): ingénieur-cartographe français au service de Selim III," in *Science in Islamic Civilisation,* eds. Ekmeleddin İhsanoğlu and Feza Günergun (Istanbul: IRCICA, 2000), 233-43.

2 Ayşe Yetişkin Kubilay and İlber Ortaylı, *İstanbul Haritaları, 1422-1922* (Istanbul: Denizler Kitabevi, 2010), 116.

ply [mathematical survey] methods to a city in the Middle East,"[3] to cite just a few of the descriptions. Superlatives such as "first" (along with "oldest" and "only") always add to a map's economic value and reputation in the world of map collectors and connoisseurs, but they turn on the caution light for map historians, who, ever wary of novelty, invariably see precedents and connections with other trends in the history of cartography, a subject, like all histories, of fluid developments and multifarious sources. Kauffer's plan of Constantinople and its environs may be seen in a larger context of cartographic developments during the long period of the European Enlightenment, during which several trends affected the process and products of mapmaking: technological change in on-site surveying methods, most particularly the use of the telescope and angle measuring instruments; the shift in scientific inquiry to ascertain more precise longitude and latitude measurements to locate places on the earth's surface, sociological shifts which exerted an influence on who performed surveying and mapmaking and how they were trained, and the intellectual tastes of antiquarians who eagerly sought to place the sites of ancient monuments and events within an accurate geographical framework. Kauffer's plan, while a legitimate "first" for Constantinople, was very much a product of its time, both in the method of its creation and in its intended audience, which was west European and antiquarian. Its impact on the nineteenth century visualization of the Ottoman city is a testimony to its "readability," an achievement predicated on the new norms and standards adopted by both producers and consumers of maps during the European Enlightenment.

The biography of François Kauffer (c1751 – 1801) has been established by Frédéric Hitzel.[4] The engineer was the scion of a family with Piemontese roots; his early training, although not well documented, is said either to have been at the École Militaire in Metz or within the Corps des Ponts et Chaussées in the Lorraine (or both). These facts, though meager, define Kauffer's training as a surveyor and cartographer in the European tradition of military mapping, whose techniques of large scale surveying were undergoing significant changes in the course of the long eighteenth century.

As a young man in his early twenties, Kauffer met his contemporary, Marie-Gabriel, comte de Choiseul-Gouffier (1752-1817), perhaps through mutual military connections (the comte was a *maître de camp general* by 1776) or through their links to the Lorraine, where Choiseul-Gouffier's father, Gabriel Florent de Choiseul-Beaupré, held properties and enjoyed strong familial connections with

3 Ian Manners, *European Cartographers and the Ottoman World 1500-1750: Maps from the Collection of O. J. Sopranos* (Chicago: Oriental Institute Museum of the University of Chicago, 2007), 78.

4 Hitzel, "François Kauffer."

Figure 1: *Plan de la ville de Constantinople et ses Faubourgs*; courtesy of the University of Michigan Map Library.

the court of Stanislas Leszczynski, duke of Lorraine, former king of Poland, father-in-law to Louis XV.[5] In 1776, Choiseul-Gouffier invited Kauffer, among others, to accompany him to Greece and Turkey in search of sites of ancient history and literature, memorialized in his well known *Voyage pittoresque de la Grèce*.[6] On this enlargement and refinement of the Grand Tour, the cultural rite of passage for young nobility in the Enlightenment, Kauffer acted as Choiseul-Gouffier's "secretary" as well as being *ingénieur géographe,* a function which matched and complemented the surveying skills of two other members of the retinue, Jacques Foucherot (1746-1813), also a graduate of the École des Ponts et Chaussées, and Jean-Baptiste Hilair (1753 – post 1822), painter and designer.[7] This team of skilled artists and draftsmen was responsible for recording accurately the location and topographical descriptions of the sites they visited and the routes they took. They had the good fortune to sail on the French frigate *Atalante*, captained by the marquis Joseph Bernard de Chabert (1724-1805), already established as a "scientific" naval officer who had displayed his mapping and charting skills of the waters of the St Lawrence River around Newfoundland in North America in the 1750s, prior to the Seven Years' War, establishing his membership in the *Académie royale des Sciences*.[8] In this instance, Chabert was charged with rectifying charts of the Aegean coastline using astronomical observations and triangulation techniques. He was seconded by two young officers who later helped Choiseul-Gouffier in his mapping exercises during his ambassadorship: Jean François Truguet (1752-1839, then a simple garde-marine, later Admiral of France) and a lieutenant Racord.[9] For Kauffer it was a fortuitous voyage, which allowed him to hone his surveying skills alongside these skilled seamen, who were themselves supervised by one of the most able marine surveyors in France at the time.

5 Frédéric Barbier, *Le rêve grec de monsieur de Choiseul: Les voyages d'un Européen des Lumières* (Paris: Armand Colin, 2010), 39. The count changed his name from Choiseul-Beaupré to Gouffier upon his marriage to the daughter of the marquis de Gouffier.

6 Marie-Gabriel, comte de Choiseul-Gouffier, *Voyage picturesque de la Grèce,* vol. 1 (Paris: [Barbou], 1782); vol. 2, part 1 (Paris: [Eberhard], 1809); vol. 2, part 2 (Paris: J.J. Blaise, 1822 [posthumously, as Choiseul-gouffier had died in 1817]); full publication record in Barbier, *Le rêve grec,* 284-286.

7 Barbier, *Le rêve grec,* 52, 56-58, 59; Hitzel, "François Kauffer," 234.

8 Joseph Bernard, marquis de Chabert de Cogolin, *Voyage fait par ordre du roi en 1750 et 1751, dans l'Amérique Septentrionale, pour rectifier les cartes des côtes de l'Acadie, de l'isle Royale & de l'isle de Terre-Neuve; et pour en fixer les principaux points par des observations astronomiques* (Paris: l'Imprimerie Royale, 1753). In addition to his scientific work, Chabert was an active naval officer who participated in the War of American Independence under the commands of Admirals d'Estaing and de Grasse.

9 Barbier, *Le rêve grec* , 56-58.

The full title of the published version of Kauffer's plan provides a bit more detail about his survey of Constantinople: *Plan de la ville de Constantinople et de ses faubourgs, tant en Europe qu'en Asie / levé géométriquement en 1776 par Fr. Kauffer; vérifié et augmenté en 1786 par le même Fr. Kauffer et par M. Le Chevalier….* Kauffer's original survey of 1776, performed with fellow engineer and architect Foucherot, must have been cursory, since Choiseul-Gouffier did not spend more than a month in Constantinople (late August to September 1776) during his nine month tour; the majority of his time had been spent among the islands and the sites along the Aegean coast, with brief stops along coasts of the Dardanelles and the Sea of Marmara (Figure 1).[10]

When Choiseul-Gouffier returned to Constantinople as French ambassador in 1784, he once again invited Kauffer to join his retinue. Other members of his "scientific" and military entourage included François Cassas (1756-1827), another engineer trained in the Corps des Ponts et Chaussées, the young astronomer Achille Tondu, and several military engineers who were already in Constantinople, viz., Antoine Joseph Lafitte-Clavé (1740-1794) and Charles François Frérot d'Abancourt (1758-1801), Le Roy, Durest, Gabriel Monnier de Courtois, all of whom brought surveying and mapmaking skills to the Ottoman capital. Their talents were valued by the Grand Vizier, Halil Hamid Pasha (served 1782 to 1785), who sought to improve military defenses and reform military training of the Ottoman army, activities in which the French military presence played a significant role.[11]

This group formed the heart of what Frédéric Barbier has called "une académie au palais," the French embassy in Pera.[12] One of Choiseul-Gouffier's first tasks was to re-organize the palace gardens to accommodate an observatory, then to build a second one at the embassy's summer residence on the high ground of the village of Tarapia, well north of Constantinople. Observations from both places allowed a meridian line to be established, from which other cartographic and astronomical measurements could be made, and the longitude of the city determined (Figure 2).[13]

10 Compare the manuscript: "Carte de la ville de Constantinople et du canal de la Mer Noire, / Levée sur les lieux en octobre et novembre 1776 et dessinée à Paris ce 20 aoust 1782 par François Kauffer ingénieur géographe. 1776;" Bibliothèque nationale de France (BnF hereafter), Rés Ge AA 3865.

11 Auguste Boppe, "La France et le 'militaire Turc,'" *Feuilles d'Histoire du xvii au xx siècle* 4/7 (January-June 1912): 386-402; 490-501, esp. 491.

12 Barbier, *Le rêve grec*, 194.

13 Ibid., 194-195, quoting Choiseul-Gouffier in correspondence with Pierre François André Méchain, director of the Paris Observatory.

Figure 2: Detail of Pera; courtesy of the University of Michigan Map Library. The Observatory is near the French embassy; the tomb of Bonneval is marked below the Swedish embassy.

In the embassy Kauffer functioned as secretary and what might be called a military attaché, serving the interests of the French government and the antiquarian interests of the ambassador, for whom he continued to survey ancient sites and prepare illustrative maps, especially in the region of the Troad. For his longer survey of Constantinople in 1785-86, he was joined by a visitor to Constantinople, the same age as himself and Choiseul-Gouffier, who shared in the latter's passion for Homer and the search for ancient Troy. Jean Baptiste Lechevalier (1752-1836) had precociously taught at the college d'Harcourt in Paris, Choiseul-Gouffier's school; he was recommended to the ambassador by Charles

Maurice Talleyrand (1754 – 1838), a fellow Harcourtien and future foreign minister to Napoleon and Louis XVIII. Lechevalier was not only a competent classicist but also a student of the astronomer Méchain.[14] Thus both Lechevalier and Kauffer were well equipped with the astronomical and mathematical skills necessary to execute a geometric survey of the city, which they undertook during six months from December of 1785 to the spring of 1786. Lechevalier described their methods in his *Voyage de la Propontide et du pont Euxin*:

> L'ingénieur Kauffer, aux talens duquel je rends ici un nouvel homage, a partagé avec moi les dangers de ce travail difficile ; et pendant près de six mois qu'il a duré, il ne s'est pas écoulé un seul jour que nous n'ayons l'un et l'autre bravé la peste pour découvrir un monument, ou pour en fixer la position.
>
> Le 6 décembre 1785, nous sommes entrés pour la première fois dans l'enceinte de Constantinople, par la porte appelée *Zindan-Kapoussi.* Notre premier travail a été de prendre le nom de chaque édifice remarquable, d'en étudier les formes extérieures, et d'y observer quelque signe distinctif, afin de pouvoir le reconnaître de loin dans nos opérations topographiques…..[15]
>
> Le 24 mars 1786, nous mesurâmes sur la plaine de l'Okmeidan une base de huit cents toises. Cette opérations a été suivie de vingt stations principales, dont je joins ici les relèvemens, plutôt pour inspirer de la confiance dans nos travaux, que pour en faire remarquer l'importance et les dangers….[16]

Lechevalier described the triangulation of each of the twenty stations surveyed from the base line established "between the edge of a woods exterior to the map, near the vineyeards of St Dimitri, and the boundary that one sees on the road of Okmeïdan at the Eaux Douces…."[17] The men took angular measurements of many familiar monuments and distinctive natural features: Mt Bourourlu behind Scutari on the Asian coast; the church of St Dimitri; the minaret of the Itchoglans [Galata Saray], the beacon of Asia, the Galata Tower, the mosque of Hagia Sophia, the Mosque of Sultan Ahmed, the Burned Column (*Çemberlitaş sütunu;* column of Constantine or "hooped column" which had burnt in the city fire of 1779*)*, the Nuruosmaniye, the Mosque of Ali Pasha, the mosque of Beyazid,

14 Lechevalier served on the Méchain survey of the meridian; Ken Alder, *The Measure of all things: The seven year odyssey and hidden error that transformed the world* (New York: The Free Press, 2002), 268, 271.

15 J.B. Lechevalier, *Voyage de la Propontide et du Pont Euxin*, 2 vols. (Paris : Dentu, l'an viii [1801]), vol. 2, 172.

16 Ibid, 174.

17 Ibid, 174.

the Süleymaniye, and several remarkable trees which served as sighting points throughout the city.

The triangulation points and the baseline are visible on the *Carte de Constantinople/ Levée par F. Kauffer; et J. B. Lechevalier, l'an 1786*, the first published form of Kauffer and Lechevalier's work.[18] Kauffer's plan of Constantinople appeared again in print in 1822 when it was inserted in Part One of Volume Two of Choiseul-Gouffier's *Voyage pittoresque de la Grèce*.[19] Both versions of the plan are drawn at the same scale (c. 1:17 200) and use the same format of a north to northeast orientation. While the longitude for Hagia Sophia is denoted (longitude 26° 35' 24" east of Paris),[20] both maps lack a longitude and latitude grid, nor do they mark magnetic north. Both maps were engraved in Paris, so it is unlikely that Kauffer supervised either publication as he remained in Constantinople after the departure of Choiseul-Gouffier in 1792 for Russia, until his death in 1801. Without the original manuscript, it is difficult to determine the editorial additions and deletions made during the preparations for printing.

While in Constantinople, Kauffer participated in the French contribution to Ottoman reforms to their military training. He built models of fortifications for the newly established school of mathematics and fortifications (*Mühendishâne-i Hümâyûn*), and assisted in the topographical surveys of the Bosphorus, the Black Sea, and the Dardanelles and Sea of Marmara being executed by French officers during the 1780s.[21] He continued to help in the antiquarian researches of Choiseul-Gouffier by accompanying three English travelers and the son of the Dutch ambassador along the Sea of Marmara in 1791. For the Ottomans specifically, he prepared a very large (590 x 1260 mm) "Map of the northern lands of the Ottoman domains" (Memālik-i ʿOsmānīyeniñ aqṭār-i şimāliyesi kharītasıdur) which provided names of cities and localities written in Ottoman Turkish.[22]

The French Revolution pushed Kauffer, like Choiseul-Gouffier, to leave Constantinople. He departed in August 1792, traveling incognito with an

18 Plate I, Lechevalier, *Voyage de la Propontide*, vol. 2, preceding page 170 or title page.

19 See note 6 above.

20 On the version of the map produced in Lechevalier's work, the latitude of Hagia Sophia is also marked, 41° 1' 27" and the longitude as 26° 55' 0" – a transcription error?

21 Hitzel, "François Kauffer," 237.

22 Ibid: BnF Ge A 1212. Hitzel speculates whether the Paris version is indeed a copy of an original still in Istanbul. My thanks to Gottfried Hagen for the correct translation of the title of this map, which is catalogued as "Turquie d'Europe et une partie de la Turquie d'Asie."

interpreter from the embassy. He reached the French border but was arrested and imprisoned. Freed through the intervention of the members of the council general of the Lower Rhine, Kauffer thought it more prudent to return to Constantinople, where he could act as intermediary and agent for Choiseul-Gouffier and the French royals in exile in Russia. Briefly working under the protection of the Russian and Austrian embassies, he then seized the opportunity to offer his services to the Ottoman government, for whom he worked from 1793 until his death in 1801. During this time he functioned as an engineer (*mühendis Kufer*) and cartographer, his works well outlined by Hitzel. Mitia Frumin's recent research in Russian archives has revealed that Kauffer also worked for the Russians; in 1799 he provided maps and plans to the Russian ambassador, who suggested an annual salary for the engineer six times more than the he was being paid by the Sultan.[23]

Kauffer's wide range of cartographic work in a foreign land for a variety of patrons makes him an excellent exemplar for several trends in eighteenth century large scale cartography in the modes of military mapping, topographical surveying, urban mapping, and antiquarianism. His life and work parallels the pattern of mobility throughout Europe of engineering and surveying talents, across national borders and with shifting allegiances which depended greatly on local circumstances. The network of knowledge and transfer of skills that took place in a variety of locales and in both formal and informal settings informed and expanded local scientific knowledge and practices in new and unprecedented ways.

Kauffer as a military cartographer and engineer

Kauffer brought to Constantinople mapping skills he had learned in his training as a French military engineer, for whom large scale surveying was an intrinsic part of their training. Topographical mapping at a large to medium scale, usually larger than 1:100 000 (high to medium resolution) exhibits aspects of the physical and/or cultural character of a place or region and is based on direct observation

23 Mitia Frumin, "François Kauffer (c1751-1801): le destin d'un cartographe français au service de l'étranger," *Le Monde des Cartes* [Comité français de la Cartographie] 207 (March 2011): 95-106; also published in English as "François Kauffer: At home among strangers, a stranger at home," *Oriental Archive* [Moscow: the Institute of Oriental Studies of the Russian Academy of Sciences] 24 (2011): 15-23. My thanks to the author for sending me copies of these papers.
As the Russians and Ottomans were at that moment allied against the French, who under Bonaparte had invaded Ottoman Egypt, it is difficult to say whether this cartographic act represented a diplomatic imperative, an act of espionage, or mere self interest on the part of Kauffer.

and measurement of landscape, including representation of relief. It uses many of the same tools and design techniques as geodetic surveying, property mapping, boundary surveying, urban mapping, and large scale marine charts (e.g., harbor charts, coastal surveys and views). Such large scale maps often remained in manuscript, with limited circulation. The extent to which these aspects of large scale mapping were practiced in the Ottoman Empire during the eighteenth century by Ottoman surveyors, architects, and engineers is the subject of several articles to appear in the forthcoming Volume Four of the *History of Cartography: Cartography in the European Enlightenment*.[24] Throughout the century, the military at various times incorporated foreign techniques and personnel, but it was not until the final decades of the century that military colleges were established with a coherent curriculum which followed a structure that was becoming common throughout Europe.

In Europe, the need for large scale surveying responded to several trends which were intrinsically related: changes in patterns of warfare, rationalization of national and provincial borders, urbanization, and changes in property valuation. Starting with the last of these, large scale surveying was used to assess the value of land, analyze the quantity and quality of its resources both above and below ground, and determine ownership for the purposes of taxation and revenues. Urban mapping met the needs of growing cities and the related concerns of civil government and the demand for public works, for planning expansion, for determining optimal water supplies and building good communication networks with roads, rivers, and canals. All required an understanding of the landscape. Boundary surveying aided the diplomatic establishment of borders between provinces, regions, states, along "natural frontiers" requiring large scale, increasingly precise topographical surveying to confirm and delineate boundaries. But the most important change was in warfare, which demanded an increasingly detailed knowledge of landscape. The use of artillery and bombardment in siege warfare had revised entirely notions of fortification and military architecture, along with the engineering required to design and execute ever more powerful weapons, in turn requiring ever more defensive architecture. "Defensive cartography" marked the military cartography of the Renaissance, incarnate in the fortified city or the fortified border.[25] By the end of the seventeenth century, an "attack cartography" was developing, primarily under the genius of Sebastien Le Prestre, maréchal de

24 Co-edited by Matthew Edney and Mary Pedley, to be published by the University of Chicago Press.

25 John Hale, "Warfare and Cartography," *The History of Cartography*, vol. 3: *Cartography in the European Renaissance,* ed. David Woodward (Chicago: The University of Chicago Press, 2007), 719-72, esp. 723.

Vauban. By the middle of the eighteenth century, warfare had evolved into action based on movement and maneuver. Speed and surprise driven by an army on the move (articulated by Frederick the Great's *Principes généraux de la Guerre,* 1746) meant that knowledge of the terrain was paramount. The same military engineers who had mastered the mathematics of fortification architecture, of artillery trajectory, of the scaled plan, now would add the subtleties of landscape to their graphic arsenal.

The methods of large scale surveying were deeply rooted in science and mathematics. The gradual understanding and acceptance of Newtonian laws of motion and gravity, based on observations made with the telescope, led to new questions about the shape of the earth. More precise measurements of the well established Ptolemaic grid of longitude and latitude would help to determine and prove the true shape of the earth as an oblate spheroid. The efforts of geodesists from the Paris *Académie des Sciences* to measure carefully the precise length of a degree of latitude along an established meridian using triangulation and astronomical observation led to four important developments for large scale map-making. An astronomically established and carefully measured baseline along a north-south meridian was to become a feature of large scale maps. The orientation to true north, with magnetic variation noted, was another refinement that emerged from the comparison of astronomical observations with magnetized compass readings. The use of a definitive scale and its notation on the map also became standardized. Measurement by triangulation, a technique known since the Renaissance, became institutionalized as the standard method of large scale survey becoming routinely employed by large scale surveyors.[26] All these elements –north orientation, baseline measurement, triangulation, and scale– were the rubrics of "scientific" large-scale mapping of the Enlightenment, manifest in the "geometric plan."

The skills required for producing large scale cartography appropriate to all these modes of cartography –property mapping, urban plans, boundary surveys,

26 Triangulation was the basis for the national survey of France, under the direction of the Cassini family, and for later national surveys. M. Pelletier, *Les cartes de Cassini* (Paris: CTHS, 2002). For a fine example of the on-site training encountered by the engineers and architects in Choiseul-Gouffier's circle, see Alessia Zambon, "Une leçon de topographie par correspondence: les letters de l'ingénieur J. Foucherot et les levés du peintre L. F. S. Fauvel en Grèce," *Le Monde des Cartes* [Comité Français de la Cartographie] 27 (Mars 2011): 107-24. Foucherot was both an architect and, like Kauffer, an engineer trained at the École des Ponts et Chaussées; in the letters discussed here, he instructs the painter Louis Fauvel in simple methods of angle measurement as the latter continues to explore and draw the ancient sites of Greece, begun on behalf of the Count from 1782 to 1784, and continued during Fauvel's residency in Greece from 1786 to 1802.

military strategy– were developed in two ways: the apprenticeship system of the land surveyor, whose techniques and professional know-how were handed down from father to son, from master to apprentice, and through military institutions, which from 1600 began to be formalized and professionalized in almost every European country, including the Ottoman Empire, throughout the seventeenth and eighteenth centuries.

At the same time, two other means of training developed: the establishment of schools or academies and the formations of specific engineering or surveying Corps which provided "on the job" training. The formal beginning of such schools occurred under the aegis of Prince Mauritz of Nassau in Leiden where the mathematician Simon Stevin established his program of *Duytsche Mathematique* in 1600, in an effort to prepare engineers for struggle for independence from the Spanish Habsburgs.[27] In spite of the political reasons for its foundation, the military connections between the Low Countries and Spain and Portugal encouraged similar schools to be established both on the Iberian peninsula and in their American colonies.

By the eighteenth century, mathematical academies devoted to the preparation of surveyors and architects and military institutions establishing a professional Corps of engineers with surveying skills proliferated. The following table of selected military institutions and academies involved with training in surveying shows the chronological and geographic range:

1582 Madrid (academy of mathematics)
1600 Leiden (school of military engineering- Simon Stevin)
1647 Lisbon: school of fortification and military architecture
1675 Brussels: mathematical school under Sébastien Fernandez de Medrano
1676 Sweden: fortification Corps (Erik Dahlberg)
1685 Munich (Bavaria): school of engineering and artillery
1688 Paris: Dépôt de la Guerre; establishment of *ingénieurs géographes*
1689 Saxony: Corps of military engineers
1693 Portugal: Corps of engineers; Brazil (followed by military academies in Salvador, Rio de Janeiro, Sao Luĩs, Viana, Recife 1693, 1696, 1698, 1699, 1701)
1698 Moscow: School of mathematics (one year, burned down)

27 Charles van der Heuvel, "Le traité incomplet de l'Art Militaire et l'instruction pour une école des ingénieurs de Simon Stevin," *Simon Stevin (1548-1620): l'émergence de la nouvelle science* (Brussels: Brepols, 2004), 103-13.

1710 Genoa: Corps of military topographical engineers
1710 Spain: Corps of military engineers
1714 London: Corps of engineers
1717 London: drawing room for map preparation, Tower of London
1719 Vienna: military engineering academy
1720 Barcelona: academy of mathematics
1724 St Petersburg: cadet Corps
1732 Almeida and Elvas, Portugal: military academies
1734 Istanbul: military school of geometry (*Hendesehâne)* (closed 1750)
1735 Moscow: school of military engineering
1738 Sardinia: military Corps of topographical engineers
1738 Piedmont: office of topographical engineers
1739 Turin: school of theoretical and practical artillery
1739 Tuscany: Corps of military engineers
1741 Woolwich, England: military academy
1744 Dresden, Saxony: school of engineering and artillery
1747 Vienna: engineering Corps
1748 Mézières, France: *école du génie*
1757 Belém, Brazil: military academy
1760 Parma: Corps of engineers
1763 Malines (Austrian Netherlands): military academy
1775 Istanbul: military engineering college; closed 1776
1781 Naples: *Officina topografica*
1782 Hanover: school of engineering and artillery
1784 Istanbul: engineering school (*Mühendishâne-i Hümâyûn)*
1788 Prussia: academy of military engineering
1796 Spain: Corps of cosmographic engineers
1798 Lombardy: *Bureau topographique de l'Armée d'Italie* (Napoleon)

In this context the establishment in Istanbul of a military training school with the inclusion of cartography in the curriculum followed the trend of other European countries. In Constantinople, Claude-Alexandre, comte de Bonneval (1675-1744) opened a school of geometry (*Hendesehâne*) in 1734, which

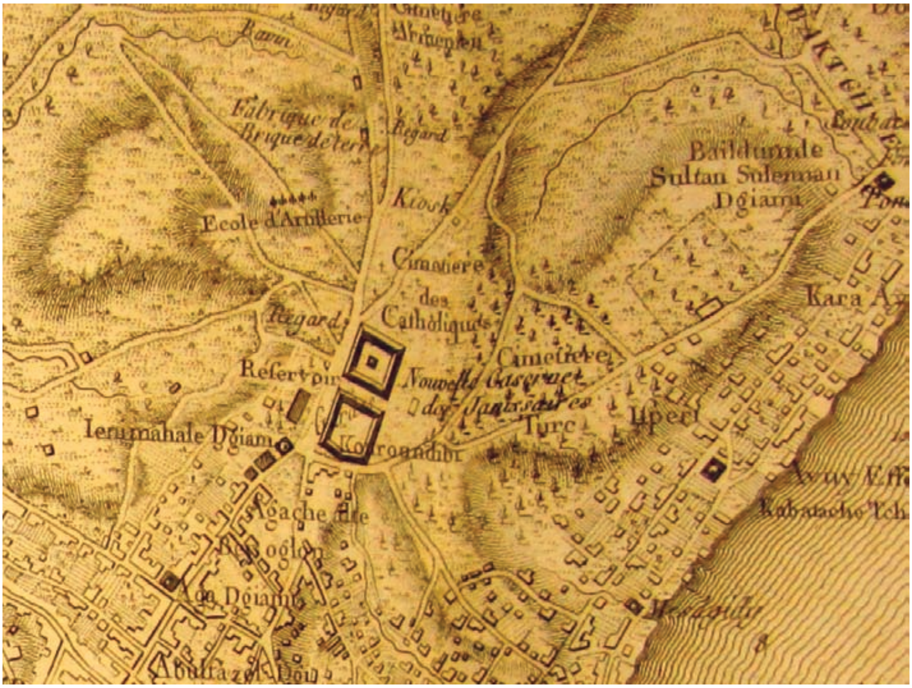

Figure 3: Detail of Pera, north of embassies with the Ecole d'Artillerie marked; courtesy of the University of Michigan Map Library.

was short lived but re-opened in 1744.[28] (His tomb in Istanbul is noted on the Kauffer plan in Pera, just north of the Galata Tower.) The baron François de Tott (1730-1793) similarly opened a school of mathematics in 1775, which was also closed after Tott's departure from Istanbul. Once again an engineering school, the *Mühendishâne*, was created with French encouragement in 1784, upon the initiative of the grand vizier Halil Hamid Pasha. Courses were conducted by the military engineering officers André-Joseph de Lafitte-Clavé and Joseph-Gabriel Monnier de Courtois, both graduates of the Ecole Royale du Génie de Mézières, both associated with the embassy of Choiseul-Gouffier. They established a curriculum that no doubt matched the course of study they had undergone in Mézières, which incorporated learning to survey plans, design forts, and to use the instruments of surveying outside in the open air in order to practice on terrain.

28 Frédéric Hitzel, "Une voie de pénétration des idées révolutionnaires: les militaires français à Istanbul," in *Mélanges offerts à Louis Bazin par ses disciples, collègues et amis: Varia Turcica XIX*, eds. by Jean Louis Bacqué-Grammont and Rémy Dor avec le concours de Frédéric Hitzel and Aksel Tibet (Paris: Editions L'Harmattan, 1992), 88.

An "école d'Artillerie" is marked on the Kauffer plan, just north of the embassies, near high ground (Figure 3).[29]

The Venetian priest Gianbattista Toderini visited the school during his sojourn in that city from 1781 to 1786, and described what he saw in the room where the students assembled:

> tapissée de cartes géographiques imprimées, turques et françaises, de dessins à la plume de différentes sortes de navires, et on y trouve un assez grand nombre d'instruments de navigation…. Différents atlas et cartes marines d'Europe…, un globe céleste qui marquait les constellations et les étoiles de première grandeur par des signes et des caractères turcs…. une sphère armillaire de métal faite à Pairs, quelques astrolabes arabes, des cadrans solaires turcs de plusieurs espèces, un très bel octant anglais de Jean Hadley, différentes boussoles turques avec la correction et à azimut, avec la chaise d'Irvin, le compas de Galilée, avec d'autres instruments de marine….[30]

He saw the astronomical tables of M. Lalande, with a Turkish translation, and other treatises on the use of the astrolabe, the sun dial and geometry. Such a room could be found in any military or engineering school in Europe in the latter half of the eighteenth century. It was for this school that François Kauffer prepared models of fortifications in plaster, on the model of the *plans-reliefs* of maréchal de Vauban to show the workings of a cannon siege.[31]

Textbooks for military surveying were often in manuscript, as student notebooks, but many were published. An important feature of these texts was their accessibility of style. It was said of the earliest of them, Sebastian Fernandez de Medrano's *El ingeniero* (first published 1687, reprinted until the 1790s), that it was written so that that the most ignorant and dullest could easily understand it. So too were technical works printed in Constantinople, taking advantage of the printing press installed by ambassador Choiseul-Gouffier at the French embassy; French engineering manuals and map surveying guides were translated into Turk-

29 Frédéric Hitzel, "Les écoles de mathématiques turques et l'aide française (1775-1798)," in *Histoire économique et sociale de l'Empire ottoman et de la Turquie (1326-1960)*, ed. by Daniel Panzac (Paris: Peeters, 1995), 812-25; esp. 815-18. Also analyzed by Virginia Aksan, "Breaking the spell of the Baron de Tott: Reframing the question of military reform in the Ottoman Empire, 1760-1830," *The International History Review* 24/2 (June 2002): 253-77.

30 Toderini, *De la literature des Turcs,* trans. M. l'abbé de Courmand, 3 vols. (Paris, 1789), I: 163-5; cited by Hitzel, "Les écoles de mathématiques," 815.

31 Hitzel, "Les écoles de mathématiques," 819.

ish and printed for distribution to the students.[32]

The most important aspect of this training was that a good part of it took place out of doors, similar to apprenticeship model. The earliest of the courses of applied mathematics, Simon Stevin's *Duytsche Mathematique*, consisted of a curriculum that included arithmetic, geometry, the problems of surveying, the practical application of theoretical knowledge outside the classroom. Students studied fortification in a similar way, first the theory and the mathematics, then the building of models, finally the exercises in the countryside, particularly in the summer where they could work on actual fortifications in the process of being rebuilt or improved. Stevin even stipulated the amount of time to be given to lecturing (half an hour) and to individual questions and help (half an hour). Most important, all the lessons were given in Dutch, not in Latin, the language of the university. A similar course was developed by George Prosper Van Verboom (b. Antwerp) a Flemish student in the Spanish Military college established in Brussels, 1675, by the Spaniard Sebastian Fernandez de Medrano. Like Kauffer, Van Verboom had been captured and shifted his allegiance, in his case to the Spanish crown (with a name change to Jorge). He developed this three year course in 1730, for the Academy of Mathematics in Barcelona, which had been established only ten years before, in 1720. Many elements of the course concentrated on mapmaking skills and field experience. Following in this tradition, students in Constantinople from the *Mühendishâne* were taken to the heights of Okmeydanı or further north onto the plain of Kağıthane at the base of the Golden Horn where they were taught to use the various instruments of surveying: the plane table, the level with telescope, the compass, the marine clock, the graphometer, and other angle measuring instruments.[33]

Such regularized training and similar patterns of courses and background created a universally understood activity and set of skills which were transferable from one national setting to another. This ease of transfer was aided not only by shared knowledge, but also by a shared language. In military training, the vernacular was preferred. Simon Stevin's course in Leiden, the earliest of the institutionalized surveying classes, was taught in Dutch. When George Verboom was recruiting engineers in 1717 for Spain, he required that they have practical experience and be Spanish "or at least understand Spanish."[34] Similarly in Constantinople, appropriate French texts were translated into Turkish, and a translator was

32 Ibid., 820-822; Boppe, 497.

33 Hitzel, "Les écoles de mathématiques," 818; Boppe, 497.

34 Martine Galland Seguela, *Les ingénieurs militaires espagnols de 1710 à 1803: étude prosopographique et sociale d'un Corps d'élite* (Madrid: Casa de Velazquez, 2008), 150.

on the school's payroll. A library was established within the school, containing Turkish works on science as well as European books translated into Turkish, such as the astronomical tables of Cassini and Jerome de Lalande and rare works lent by the sultan Abdulhamid from the libraries of the Seraglio, including the geography of Ptolemy dedicated to Pope Alexandre V. Of more recent vintage, there were translations of the treatises of Sébastien Le Prestre, maréchal du Vauban on mines, attack and defense of places; works of mathematics such as the *Théorie générale des equations algébriques* by Etienne Bezout; Jean-François Callet's *Tables de logarithms* and *Traités élémentaires d'arithmétique et de mécanique* (Paris, 1774), and the abbé Charles Bossut's *Cours de mathématiques à l'usage des écoles militaries* (Paris, 1782), all of which were translated into Turkish, although students who knew French could work directly from the French texts.[35]

A second common language was the graphic and textual language of the map itself, as well as its layout and design. With increased standardized training, with the application of the "rules of the textbook," an increasingly standardized graphic language of line, color, and rendition of features made the maps readable and usable by anyone of any tongue. Surveyors shared a language of representation: certain norms established, especially in the realm of military topography, by the *mémoire* of Vauban (1680) who established certain rules for color on manuscript plans: red for works that were finished and in stone; grey for earthworks (*terre* or *de gazon*), using a stronger shade for the full parapet than those places where the work has just begun; yellow for proposed works; dotted lines for older area to be replaced or incorporated by new structures. For Vauban, these rules of representation were to be followed in order to avoid confusion. While we do not have Kauffer's manuscript map from which the *Plan de la ville de Constantinople* was engraved, the regular use of hachures to show height, of stylized trees and a variety of stippling to show woods and fields, as well as standardized signs for mosques and other buildings, show his training in a similar graphic vocabulary.

A Cartographer without borders

Kauffer, like the other French engineers working in Constantinople in the last quarter of the eighteenth century, fits into the eighteenth century pattern large scale topographic surveyors by working in a country not of his birth. The presence of foreigners in the surveying work of various regions is not particularly surprising, as it represents skilled labor moving to where there is market demand. A twentieth century perspective often associates maps, particularly military maps,

35 Hitzel, "Les écoles de mathématiques," 820.

with sensitive and restricted material, and there is no doubt that nations periodically attempted to restrict access to geographical and chorographical information. But institutional control is difficult to maintain, especially with such mobile troops as engineers who often took their maps with them. Nor did nations always have the fiscal wherewithal to maintain a well trained and well equipped topographic Corps of surveyors. In times of war or other duress they turned to an international market to find talent.

There are many examples of cartographers in the guise of land surveyors or topographical engineers who crossed borders and worked for patrons not in the county of their birth. Reasons for such trans-national movement ranged from the simple search for work to the more complex expansion of empire, with its related mapping needs, as in the case of the Austrian Hapsburgs in northern Italy in the late seventeenth and early eighteenth century or the Spanish in the Low Countries in the late sixteenth century. In between these poles of attraction fall the reform movements of the eighteenth century, in which government ministries or corporate councils embarked on a program of reform and renovation of military training and organization. Examples of all three movements may be found throughout the eighteenth century.

The economics of the workplace could be found in small German states offsetting the costs of maintaining standing armies by trading their soldiers for revenue, as for example Hesse-Kassel which signed 30 subsidy treaties with other states between 1677 and 1815, mostly with England. Sweden and Finland hired German and Dutch engineers and sent an agent (Axel Magnus von Arbin) through the Low Countries to study French methods of mapping in 1751. In Austria, two Italians became the first directors of the Military Engineering Academy in Vienna: Leander Anguissola and Gian Giacomo Marinoni; similarly, Luigi Marsigli of Bologna mapped the Danube and the Austro-Hungarian border with the Ottoman Empire with his German colleague, Johann Cristof Müller. The English benefited from the expertise of Sir Bernard de Gomme, Dutch military engineer, who became the British Surveyor General of Fortifications in the latter half of the seventeenth century; he required his engineers to gain experience in foreign travel and to observe military practice on the continent. By mid-eighteenth century, the British army allowed the inclusion of foreigners in the 60th Regiment of Foot, in which Swiss, Dutch, French and German engineers participated alongside English and Hessian comrades.

Reform movements generated jobs for surveyors and engineers. Wilhelm, Marshal General Count de Schaumberg-Lippe, a German, born in London, who had served in the Dutch army in the War of Austrian Succession, with the Austrians in northern Italy, with Prussia in the Seven Years War, helped reform the Portuguese army in the 1760s at request of minister de Pombal by hiring foreign talent. In Spain, the Corps of Military Engineers was supplied with up to 23% of engineers from France and the Low Countries.[36]

As empires expanded, the need for better geographic information and the determination of boundaries became paramount. Italian cartographers served Portugal for the survey of the boundaries in Brazil after the Treaty of Madrid of 1750. Similarly, Peter the Great of Russia imported foreign talent, chiefly French and German, to survey and map the expanses of the Russian empire.

In this context the presence of French engineers in Constantinople, welcomed for their skills and experience, and Selim III's reforms for the New Order military were part of a larger European trend.[37] François Kauffer was one of many skilled surveyors and military engineers who moved outside of the sphere of their native land and found work where he could, making maps for those who asked and those who paid.

Kauffer as an urban cartographer

Kauffer's *Plan de la ville de Constantinople* sets out to delineate the urban fabric and its surroundings according to certain principles of large scale surveying and urban mapping of the eighteenth century, the standards for which had been re-set by the changed technologies of topography and geodesy. In the cartouche of his *Nouveau Plan de Paris* (1728), l'abbé Jean Delagrive set out the principles for the "new mapping" by asserting that "a city plan must respect the same rules as geographical maps," viz., it must be oriented to the north along a meridian (in the case of Paris, the meridian of the Observatory); the position of high places (such as belltowers or steeples) should be determined and verified by trigonometric calculation; the plan should be inclusive of both the city's core and its outer neighborhoods, all the streets shown with exactitude as to their breadth and course; it should be based on direct observation, never on copying or consultation of anterior plans (which were, according to Delagrive, "en quasi-totalité fautifs et

36 Galland Seguela, 144.

37 Hitzel, "Les écoles de mathématiques;" Virginia Aksan, "Breaking the spell of the Baron de Tott;" Virginia Aksan, *Ottoman Wars, 1700-1870: An empire besieged* (London: Pearson Longman, 2007), 180-213; Caroline Finkel, *Osman's Dream: The history of the Ottoman Empire* (New York: Basic Books, 2005), 389-94; Tuncay Zorlu, *Innovation and Empire in Turkey: Sultan Selim III and the modernization of the Ottoman Navy* (London: I.B. Tauris, 2011).

inexacts").[38] For Paris as for many other European cities, the "plan géométrique" became the dominant mode of graphic representation, with the urban view ceasing by mid-century.[39]

A dialect of the language of graphic representation also included the constant tension between plan and view, between the geometrically measured space, an arrangement imposed on nature, and the rendition of what the nature of the site actually looks like to the viewer. Courses in map making included classes in design and sketching, so that the topographical view became part of the surveyor's visualization arsenal. Finding ways to render the height of the land, as well as the quality of the land, was also important. As with the representation of fortifications –ichnographic (the plan as seen from above), orthographic (the vertical section or profile) and the axonometric (bird's eye view)– so too the representation of hills, valleys, and mountains involved the surveyor's choice of graphic rendition. These were measurement and design problems that featured in rendering the plan of a city.

As described in the *Voyage de la Propontide*, Kauffer and Chevalier defined the monuments to be used as points in the triangulation, measured carefully a base line, used the astronomical measurements made possible by the observatories in Pera at the French embassy and in the summer residence of Tarapia, and incorporated the measurements by the astronomer Tondu. The careful location of these monuments and the attempt to delineate street patterns is also described by Lechevalier:

> Les rues principales ont été levees avec exactitude; on a été moins scrupuleux pour celles du quartier des Sept-Tours, qui ne présentoient à cette époque qu'un amas de ruines; il auroit été plus qu'inutile d'employer une precision géométrique pour déterminer la directions de ces petites rues détournées, qui sont d'un moment à l'autre la proie des flames, et sont presque toujours rebâties sur un nouveau plan.[40]

While Lechevalier expressed frustration with the near impossibility of mapping all the small streets of the quarter of the Seven Towers, his dilemma is that of the eighteenth century urban map which takes as a goal to measure and describe exactly the road network and its relationship to the city as a whole. Like other

38 Jean Boutier, *Les plans de Paris des origines, 1493, à la fin du XVIIIe siècle: étude, carto-bibliographie et catalogue collectif* (Paris: BnF, 2002, rev. 2007), 238.

39 Boutier, *Plans,* 21.

40 Lechevalier, *Voyage,* 189-91.

eighteenth century plans, Kauffer also places the most striking monuments and delineates places of social or historical importance, from mosques, churches, synagogues, cemeteries and significant tombs, to embassies and areas of the city inhabited by various nationalities, industrial installations (e.g., the brickworks north of Pera, the cannon foundries along the Golden Horn), commercial establishments and warehouses, antiquities (ancient ports, sewers, tombs, columns, aqueducts). The landscape is not ignored, with hachures used to show relief and stippling used to show cultivated land. On the 1801 plan in Lechevalier's *Voyage*, simple arrows are used to mark the currents in the Bosporus and in the Golden Horn; on the 1822 plan found in Choiseul-Gouffier's *Voyage*, arrows show currents, emphasized by isobath lines in the water and with numbers representing sounding fathoms (*brasses)* and descriptions of the nature of sea bottom (*vase, gravier, sable*). The scale of the plan, however, at c1:17 200 does not allow for the high degree of detail praised by the l'abbé Delagrive for the new method of city mapping as found on his plan of Paris, but it is the same as Delagrive's map of Paris and its environs (*Environs de Paris levés géométriquement*, 1740, in 9 sheets). (This scale is very close to the standard scale at which most French military engineers surveyed their topographical maps, normally at c1:14 400 [i.e., one inch on the map equals approximately 1200 feet on the ground]).[41] The plan lacks an index, which was becoming a standard feature for urban plans in the eighteenth century, and more importantly (and surprisingly, given the scientifically verifiable interests of both Kauffer and Lechevalier) lacks a longitude and latitude grid. Nor is magnetic north shown. However, its longevity as a preferred plan for reproduction and its continued usefulness for archaeologists and historians interested in reconstructing the historical fabric of the city attests to its staying power as an accurate base map.[42]

Kauffer as an antiquarian

The same principles of topography, geodesy, and exactitude informed antiquarian interests of the period, chiefly because they incorporated the scientific

41 Monique Pelletier, "Un programme pour les ingénieurs militaires," *Le monde des cartes* [Comité français de cartographie] 132 (June 1992): 27-29, esp. 28.

42 Two relatively recent articles have studied Kauffer plan as a source for ancient and medieval topography: Jean-Luc Arnaud, "Le documents iconographiques: une source pour l'histoire, l'exemples d'Istanbul," *Les villes dans l'Empire ottoman: activités et sociétés*, vol. 1 (Paris: Editions du CNRS, 1991), 121-147, revised in 2009: http://hal.archives-ouvertes.fr/halshs-00423964/. Elisabetta Molteni, "The medieval harbour of Constantinople in 18th century cartography," paper presented at the 2nd Mediterranean Maritime History Network Conference, Messina/Taormina, Italy, May, 2006.

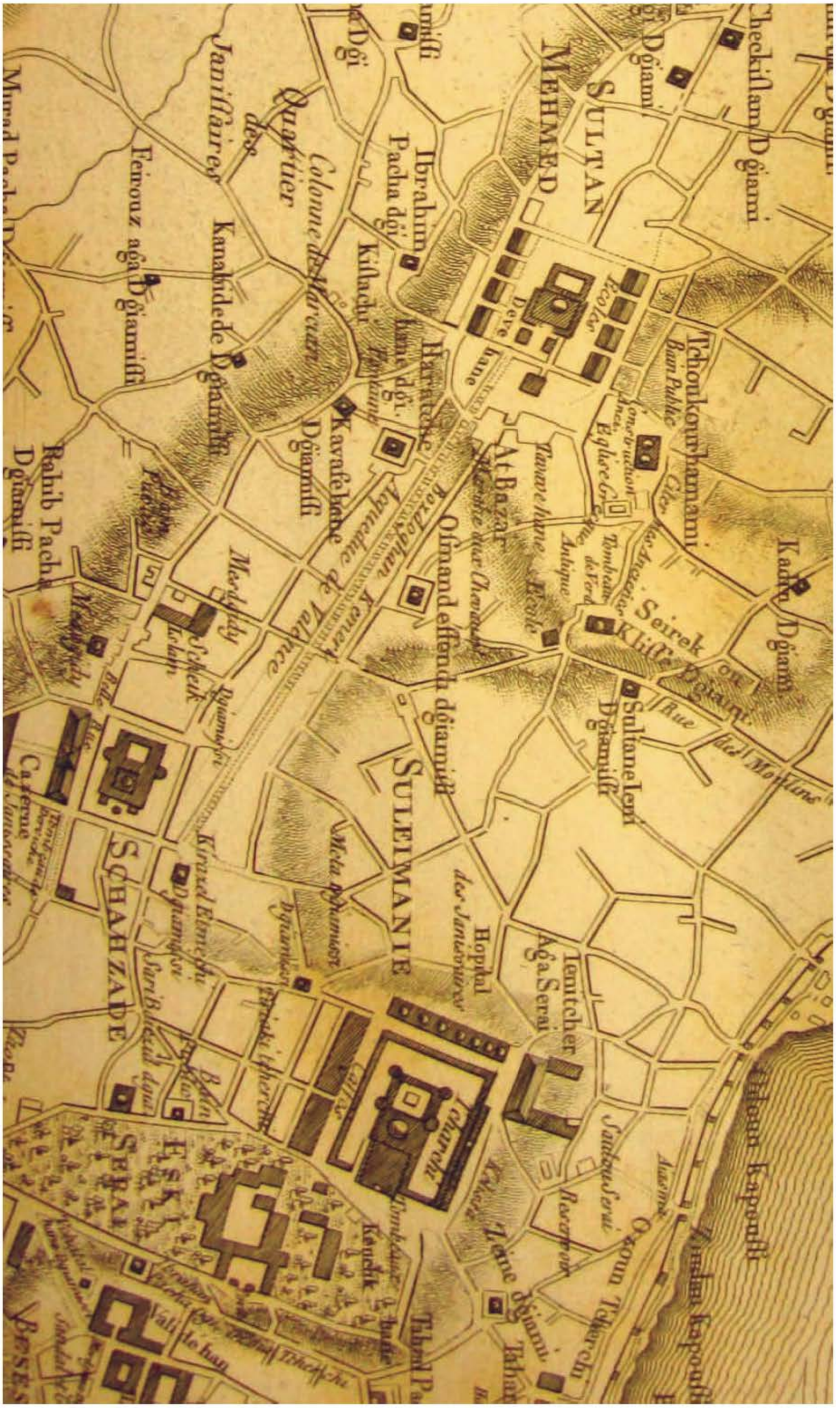

Figure 4: Area between the mosque of Sultan Mehmed II and the Süleymaniye with topography, streets, ancient and modern monuments marked; courtesy of the University of Michigan Map Library.

notion of verifiability. Just as Newtonian laws of gravitation and their effect on the shape of the earth demanded constant measurement and re-measurement to become accepted, so did the placement of ancient sites, based on literary evidence, require consistent measurement and re-measurement to become an accepted geographical "fact." Kauffer's antiquarianism doubtless developed in the shadow of Choiseul-Gouffier's passion for antiquity, matched by that of Lechevalier. They both operated within the historiographical movement of the late seventeenth century which relied not only on literature but also on the artifacts and topographical descriptions. The antiquarian sought to reproduce images of the landscape, the buildings, and the material objects of the past, and through these images create a means of analysis and discourse with which to determine validity and truthfulness. It was the application of the scientific method to a historian's research, and mapmaking was an integral tool for this approach.

The antiquarian emphasis of both Lechevalier and Choiseul-Gouffier may be seen in the details of Kauffer's *Plan,* wherein both contemporary monuments and ancient ruins are noted.

Kauffer's plan of the Plain of Troy, "superseded only by Spratt's survey of half a century later" (i.e., 1839),[43] was based on survey work done for Choiseul Gouffier, and after the latter's departure for Russia, for Count Ludolf, the Neapolitan ambassador to the Porte.[44] Choiseul Gouffier himself attested to the careful nature of Kauffer's working methods; he completed the survey "with trigonometrical operations figuring the terrains with rare precision."[45] Kauffer's work in the Troad must have been well known in Constantinople and copies were made and published well before the second and third volumes of the *Voyage pittoresque*.[46]

The Plan de la Ville de Constantinople in context

This very brief survey of François Kauffer's life and work within the context of European cartography of the eighteenth century demonstrates the remarkable abilities of surveyor engineers to keep working in a wide variety of conditions.

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43 J. M. Cook, *The Troad: An archaeological and topographical study* (Oxford: Clarendon Press, 1973), 24; 46-48 for a description of the map's coverage and publication.

44 Ibid., 47.

45 Choiseul-Gouffier, *Voyage Pittoresque,* vol. 2, 208; cited in Cook, *The Troad,* 48.

46 Cook, *The Troad,* 46-48: G. A. Olivier, *Atlas to Illustrate Travels in the Ottoman Empire* (London: T.N. Longman and O. Rees, 1801); E.D. Clarke and J. M. Cripps, *A map of the Plain of Troy and the District of Ida from a survey by Kauffer for his Excellency Count Ludolf* (London: Arrowsmith, 1803).

One aspect of this equipoise is that Kauffer seems to have profited little from his mapmaking endeavors, except for the brief period when (and if) he was paid for cartographic material by the Russians (see above). His *Plan de la Ville de Constantinople* is a case in point. Unlike other creators of significant city plans during the eighteenth century (e.g., Jean Delagrive, Paris, 1735; John Rocque, London, 1745; Giovanni Battista Nolli, Rome, 1748), Kauffer did not supervise the engraving, printing, and publishing of his plan of Constantinople, activities which were undertaken by his collaborator Lechevalier and by the posthumous editors of Choiseul-Gouffier (i.e., Jean Denis Barbié du Bocage and J.A. LeTronne) and by his close friend and Lorrainois co-patriot Antoine Ignace Melling, who used the plan in his *Voyage pittoresque de Constantinople et des rives du Bosphore* (Paris, 1819), also with the help of Barbié du Bocage in Paris. This fact alone sets Kauffer's plan apart from other geometrically surveyed city plans of the period. His work was not initiated by a city corporation with a plan for urban improvement in mind nor for the celebration of the city to enhance its reputation and glorify its history. Although created with all the tools and instruments necessary for it to be a useful document for urban planning, for expansion, for tourism and growth, the *Plan* had a much more limited purpose. It was designed to accompany and illustrate works of antiquarian research and to serve as an orientation to readers within the relative terms of the texts. This accounts for its lack of an index and a grid of longitude and latitude, and its relatively small scale (most city plans that provided details of streets and buildings were prepared at scales larger than 1:10 000).

Thus, in spite of its influence as a "first" for Istanbul, the *Plan de la ville de Constantinople et ses faubourgs* should be placed and interpreted in the context of antiquarian and military large scale mapping in eighteenth-century Europe. Its value rests on its verifiability: its triangulation points were well documented in Lechevalier's work; it was constructed on clearly defined baselines and angular measurements as well as astronomically observed locations. Its detailed contents served the purposes of authors interested in ancient history, but its goal of reliability and verifiability insured its place for a long time in the development of ever more detailed plans of the Ottoman capital.

Enlightenment Cartography at the Sublime Porte: François Kauffer and the Survey of Constantinople

Abstract ■ This article is a study of the work of François Kauffer and his survey of Constantinople, which produced the first "scientific" map of the city in the last quarter of the eighteenth century. In spite of its influence as a "first" for Istanbul, the *Plan de la ville de*

Constantinople et ses faubourgs should be placed and interpreted in the context of antiquarian and military large scale mapping in eighteenth-century Europe. Its detailed contents served the purposes of authors interested in ancient history, but its goal of reliability and verifiability insured its place for a long time in the development of ever more detailed plans of the Ottoman capital.

Keywords: François Kauffer, *Plan de la Ville de Constantinople et de ses Faubourgs*, Jean Baptiste Lechevalier, Marie-Gabriel, comte de Choiseul-Gouffier, *Mühendishâne-i Hümâyûn* (the [Ottoman] Imperial School of Engineering), Enlightenment cartography.