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*Madrid, Treaty of (1750).* While the Treaty of Utrecht (1713–15) resolved Portugal’s territorial dispute with France over the northernmost border of its South American possessions, the Treaty of Madrid (1750) found Portugal negotiating its dominions in the Americas with its historical rival, Spain. Pope Alexander VI’s arbitrary division of the world between the two Iberian powers with a papal bull (1493, *Inter caetera*) and the Treaty of Tordesillas (1494) divided newly discovered lands between the Iberian neighbors only in the vaguest terms; the ownership of huge swaths of territory remained unknown. The complications arising from these early agreements increased in the following centuries, especially around three contested sites: the Amazon River region, a vast expanse of tropical forest and interconnected rivers; the area along the Paraná River, Portuguese America’s southwestern border with Spanish territory, where Jesuit missions perched precariously on a political precipice between the colonial regimes; and the southern coastal region, which included the Colônia do Sacramento, a small territorial outcropping in the Río de la Plata estuary that had been a center for contraband and had served as a negotiating chip between these two powers during many decades of geopolitical instability.

With the death of Spain’s Felipe V in 1746 and the accession of Fernando VI, married to the daughter of Portugal’s King João V, conditions ripened for boundary negotiations in South America. The Spanish were keen to reestablish sovereignty along the Río de la Plata, while the Portuguese wanted recognition of their possession of the Amazon River basin. Ambassador Tomás da Silva Teles was the main negotiator for the Portuguese in Madrid, but the Brazilian-born Alexandre de Gusmão, private secretary to João V, was the primary architect of the treaty, which was designed around two principles:

first, a general respect for the natural features of the landscape, following rivers and mountain ranges in order to outline divisions between the respective empires using easily discernible boundaries; and second, the idea of *uti possidetis, ita possideatis*, the principle that occupation and possession at the time of negotiation would determine the future boundary lines of contested territory. To represent this last principle graphically and to accompany the text of the treaty, Gusmão worked to create a map that would establish the areas under Portuguese control where boundary lines were to be surveyed and established: “Mapa dos confins do Brazil com as terras da Coroa de Espanha na America meridional” of 1749 (fig. 447).

The map, referred to as the “Mapa das Cortes,” ratified visually what would ultimately become the very real consequences of the Treaty of Madrid, which for the Portuguese (and later Brazil) meant the legal possession of Rio Grande do Sul, Mato Grosso, and the Amazonian provinces—regions that stood beyond the westernmost line of Tordesillas (fig. 448). The Spanish, in turn, acquired Colonia del Sacramento and consequently had to give up their possession of the Jesuit missions in the Paraguay River region (the so-called *siete pueblos de las Misiones Orientales*), founded between 1687 and 1707. All these negotiated agreements were represented in the 1749 Mapa das Cortes, which Gusmão sent to Madrid to serve as a visual guide to help Portugal in the negotiations. It was to function as the basis for negotiations as well as the template for the Luso-Hispanic boundary expeditions that would traverse the continent north and south later in the century. Some of the sources of the Mapa das Cortes are still in dispute, which has led to a polemical discussion over whether Gusmão intentionally diminished the size of Portuguese America in order to make it appear less menacing in the treaty negotiations, or whether he merely relied on sources (mostly Jesuit) that helped to create this impression. What is clear, in any case, is that various features of Brazil’s interior were shifted geographically in the Mapa das Cortes (such as the placement of the city of Cuiabá, situated on the same meridian line as the headwaters of the Amazon, a full 5° away from its actual position), which enabled Portugal



FIG. 447. "MAPA DOS CONFINS DO BRAZIL COM AS TERRAS DA COROA DE ESPANHA NA AMERICA MERIDIONAL," 1749. Manuscript, ca. 1:8,500,000. This map, commonly called the "Mapa das Cortes," served as the basis for the demarcation of territory between the colonial powers of Portugal and Spain in the diplomacy surrounding the Treaty of Madrid. The legend below the title of the map ex-

plains that yellow marks territory occupied by the Portuguese; pink, territory occupied by the Spanish; and area left white is not occupied.

Size of the original: 60 × 54 cm. Image courtesy of the Acervo da Fundação Biblioteca Nacional-Brasil, Rio de Janeiro (ARC.030.01.009).



FIG. 448. UNTITLED AND ANONYMOUS MANUSCRIPT MAP OF SOUTH AMERICA. Map shows the extent of Portuguese territory according to the Treaty of Madrid (1750), together with indications of the areas of Jesuit missions. The area in red, east of the demarcation line defined by the Treaty of Tordesillas, is indisputably Portuguese territory; the area in yellow covers Portuguese territories confirmed by the Treaty

of Madrid. This undated map accompanied a copy of a letter from Pedro Antonio de Cevallos to Ricardo Wall (San Borja, 20 February 1759).

Size of the original: 65.0 × 71.4 cm. Image courtesy of España, Ministerio de Cultura, Archivo General de Simancas, Valladolid (MPD, 04, 036).

to gain the upper hand in the negotiations that ensued, even though the map itself did not have any juridical force. No parallel map covering the same territory was produced by the Spanish prior to the boundary expeditions that followed in the wake of the treaty.

The Mapa das Cortes thus showed a vastly diminished Brazil, making it seem as if Portuguese aims were not quite so extreme in the negotiations that followed.

José de Carvajal y Lancáster, Spanish minister of foreign affairs and primary negotiator for Spain, initially wished to maintain the broad outlines of Tordesillas, but the Mapa das Cortes persuaded him to agree to certain changes, including Brazilian possession of Mato Grosso, Amazonia, and Rio Grande do Sul. The fact that the Mapa das Cortes did not include numbers for the longitudinal lines made it unclear where the original longitu-

dinal reference stood and how the map differed from the Tordesillas map (also vague in terms of which meridian it had used).

The Treaty of Madrid was ratified on 14 January 1750, and provided specific articles to guide the boundary surveys of the territories of the two Crowns (Cortêsão 1950–60, 4.1:460–78, 479–96). These articles created four teams of surveyors (*comisários inteligentes*) who operated according to detailed instructions appended to the treaty in 1751 (Cortêsão 1950–60, 4.2:263–78 [doc CIV]). By using astronomical measurements and instrumental techniques, they transformed the cartographic image of South America, and they also acquired knowledge about the natural landscapes through which they passed, including the customs, behaviors, religions, and governments of the native populations. These *comisários inteligentes* had been ordered to make the determination of the boundaries so that there would not be “the minimal doubt in the future as to where the [divisionary] line should pass,” but in certain cases they never even met one another across the newly created international frontier (Cortêsão 1950–60, 4.2:274).

Although most of the agreements contained in the Treaty of Madrid were revoked a decade later through the Treaty of El Pardo (1761), the broad outlines of the accord were reinstated by the Treaty of San Ildefonso (1777), which recognized many of the same boundaries as the Treaty of Madrid, but obliged Portugal to return the Mission district, the Colônia do Sacramento, and other territories in America and Asia to Spain.

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SEE ALSO: Boundary Surveying: (1) Portuguese America, (2) Spanish America; Portuguese America; Spanish America

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**Manuscript Reproduction.** See Reproduction of Maps: Manuscript Reproduction

### Map Collecting.

ENLIGHTENMENT  
AUSTRIAN MONARCHY  
DENMARK  
FRANCE  
GREAT BRITAIN  
NETHERLANDS  
OTTOMAN EMPIRE  
PORTUGAL  
RUSSIA  
SPAIN  
SWEDEN-FINLAND  
SWITZERLAND

**Map Collecting in the Enlightenment.** Map collecting during the Enlightenment was an activity embraced by an increasingly wide social range of participants, from monarchs and nobles down to the middling sort. Early in the era, maps and geographical texts were already crucial elements of the library of anyone with a claim to education. Pontificating in 1703 about the proper contents of an English gentleman’s library, John Locke opined that no such person could be without William Camden’s *Britannia* (1587), especially in its much expanded 1695 edition, and then observed simply that “a good collection of maps is also very necessary” (Locke 1997, 353). Larger map collections were generally organized by region and by place depicted. There was little discrimination between “current” and “antiquarian” maps: all were of interest in shedding light on the present and the past, and it was not certain that more recent maps were actually better than older maps.

The acquisition of cartographic collections was increasingly enabled by the same forces that exerted their influence on the map trade: the general growth of the European economies after 1650; the expansion of skilled copperplate engraving in many European capitals and the increased number of copperplate prints available on the market; an increase in the number of news journals and serials that incorporated maps or map discussion; the appearance of scholarly works and reviews; the new genre of bibliographic guides to maps, such as Johann Gottfried Gregorii’s *Curieuse Gedancken von den vornehmsten und accuratesten Alt- und Neuen Land-Charten* (1713) and Nicolas Lenglet du Fresnoy’s *Méthode pour étudier la géographie* (1716); the ability to travel because of more peaceful conditions after the Thirty Years’ War; and a growing awareness of the

effects of travel and exploration to foreign lands. The growing access to maps is indicated in the increasing frequency of map-related instructions found in private correspondence, such as that of Marie de Rabutin-Chantal, marquise de Sévigné, to her daughter to follow travels “*sur la carte*” (Sévigné 1785, 5:173).

Indeed, the increase in map consumption was satirized at midcentury by Laurence Sterne in his novel about Tristram Shandy (1759–67). The painful wound suffered by Shandy’s Uncle Toby during the siege of Namur in the Nine Years’ War led him to find welcome relief by acquiring a fortification plan of Namur (fig. 449) and by sticking a pin into the exact spot on the map where his injury occurred. This miracle cure was potent enough to lead him to collect all the plans of the fortified towns in Italy and Flanders important in that war, allowing him to follow news of battles as they were reported and to reenact sieges in the model fort he built on his bowling green (Sterne 1985, 108–9, 427–28).

Yet there is a difference between the possession of a few maps or perhaps an atlas in the home and the concerted acquisition of maps and atlases conforming to a preconceived program, which marked the serious pursuit of map collecting. Enlightenment map collecting had its roots in the same acquisitive desires that underpinned the formation of seventeenth-century *Wunderkammern* or *cabinets de curiosités*, study rooms or cabinets filled with all manner of curious objects and books. Such *cabinets* often included maps, globes, and other scientific instruments among the fossils, artifacts, stuffed animals, and curios from faraway lands (fig. 450). The same yen for accumulation infused the topographic collections of the eighteenth century, assembled by men and women of sufficient leisure and income to build, house, and collate the collection. These collectors exhibited the culture of virtuosity that marked the public sphere of the eighteenth century (Brewer 1997, 427–89). Those with the means required to create ambitious collections included the military, merchants, the professional classes (lawyers, diplomats, doctors, administrators), geographical practitioners, the gentry and aristocracy, and monarchs, such as Frederik V and his wife Queen Juliane Marie of Denmark or George III of Great Britain. Collecting could be simultaneously vocational and personal. For example, the Clinton brothers, Sir William Henry and Sir Henry, British generals engaged in conflicts at the end of the eighteenth century, assembled a collection of around 400 maps (now in the Stephen S. Clark Library, University of Michigan, Ann Arbor), which they used during both their military and diplomatic careers and also for personal study.

Nor should institutions be overlooked as collectors of maps and atlases. In addition to the large collections as-



FIG. 449. FRONTISPIECE TO THE THIRD EDITION OF VOLUME 1 (1760) OF LAURENCE STERNE, *THE LIFE AND OPINIONS OF TRISTRAM SHANDY, GENTLEMAN*, 9 VOLS. (LONDON: R. AND J. DODSLEY, 1760–67). William Hogarth, designer, and Simon François Ravenet, engraver. Uncle Toby smokes under the fortification plan of Namur, prominently displayed on the wall, part of his collection of plans of fortified towns in the southern Netherlands and northern Italy.

Size of the original: 14.8 × 9.0 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (C2 1760 St).

sembled by government agencies that made maps or that governed extensive territories, a variety of educational institutions, such as schools, colleges, religious establishments, and the newly formed public lending libraries, also collected maps as well as books. Institutional col-



FIG. 450. THE WUNDERKAMMER OF THE DIMPFEL FAMILY, REGENSBURG, BY JOSEPH ARNOLD, 1668. This collection of diverse objects includes multiple globes, at least one map (at the end of the table at right), and views of landscapes and buildings. Gouache with gold highlights on leather.

Size of the original: 14.9 × 19.1 cm. © Ulmer Museum, Ulm (Inv. Nr. 1952.2611).

lecting took place throughout Europe and in the colonies (Bosse 2008).

One aspect of map collections discussed in the following entries is the physical form in which such collections were stored or displayed. Not all collectors had the means to create special libraries or rooms with specially designed shelves or drawers for their collections, but a recurring method of organizing and safekeeping was to paste the maps, views, and plans onto folio sheets, arrange them in a particular order, and bind them into folio volumes. The term “atlas” was used by their owners to designate these complex collections and collations, and they represent a version of what we would include

in the term “composite atlas” (*atlas factice* or *Sammelatlas*). These atlases could comprise many volumes, for example, the 49 assembled by the British antiquary Richard Gough or the 501 compiled by the Bern lawyer Johann Friedrich von Ryhiner.

Collectors in the German states offer various examples of the varieties of this phenomenon. One of the first of these large atlas collections was that of August II, elector of Saxony and king of Poland (r. 1697–1733), whose “Atlas Royal” of 1,400 maps was bound in nineteen volumes; he also created the “Atlas Selectus” in twenty-five volumes for his grandson (Hantzsch 1904, 62–64, 69–71). R. A. Skelton (1972, 46) also pointed to

August II as the creator of the first separate map room in a library. An even larger map collection housed in a composite atlas is that of Bernhard Paul Moll, a Bavarian diplomat who was a counselor to several German legations in Vienna. A map collector from boyhood, Moll focused on collecting cartographic material that depicted the Habsburg Empire as well as lands related to it geographically and historically. His collection comprised nearly 13,000 maps, town plans, views, architectural drawings, and reproductions of inscriptions, placed onto 8,000 sheets bound into sixty-eight volumes, with five additional volumes of his own research notes and catalog. Moll divided his collection into two large groups: the “Atlas Austriacus” (which included Austrian lands, Czech lands, ancient Burgundy, Italy, and Hungary) and the “Atlas Germanicus.” The entire collection is now in the Moravian Library (Moravská zemská knihovna), Brno, in the Czech Republic and may be consulted online (Papp 2005). German scholar Christoph Daniel Ebeling of Hamburg had by 1799 collected nearly 20,000 maps specifically in support of his studies of the discovery, history, and contemporary geography of North America. After his death in 1818, his collection was purchased by Edward Everett for Colonel Israel Thorndike and presented to Harvard College (Brown 1940, 472–74; Skelton 1972, 52).

The fragmentary nature of the available evidence about collectors and their collections means that we generally know only about the more substantial accumulations of material that found their way into permanent institutions. For example, Richard Gough—who would observe that “a public library is the safest port” for any collection (Gough 1780, 1:xlvii)—acquired the thirteenth-century map of Britain that now bears his name from the posthumous sale in 1774 of the manuscripts collected by Thomas Martin, who had first displayed the map at a meeting of the Society of Antiquaries in 1768; but the map’s preservation was assured only when Gough’s own collections were deposited with the Bodleian Library in 1809 (Lilley and Millea 2011). Many other collections like Martin’s, both large and small, were undoubtedly dispersed after their creators’ deaths. Without substantial effort in the archives and auction records, our overall picture of early modern cartographic collections will therefore necessarily remain incomplete.

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SEE ALSO: Atlas; Consumption of Maps; Decoration, Maps as; Globe; Map Trade; Modes of Cartographic Practice; Public Sphere, Cartography and the

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**Map Collecting in the Austrian Monarchy.** The birth of the Österreichische Nationalbibliothek is traditionally regarded as 1368, when the canon Johannes von Trop-pau sent a magnificently illuminated manuscript of the gospel to the Habsburg bibliophile Albrecht III, duke of Austria. The oldest evidence that cartography was collected in Austria stems from the 1420s, when Georg Müstinger, the provost of the monastery Klosterneuburg and a prominent member of the so-called first Viennese school of mathematics and astronomy, sent for a manuscript of Ptolemy’s *Geography* from Italy. Under Emperor Frederick III, a small single-sheet copperplate engraving collection already existed in the Kaiserliche Hofbibliothek. During the sixteenth century, important cartographically interested Renaissance scholars like Conrad Celtis, Johannes Cuspinianus, and Wolfgang Lazius used the Kaiserliche Hofbibliothek and sometimes bequeathed to it their own books and cartographic items (Wawrik 1991–92, 141–43, 145).

During the seventeenth century the Hofbibliothek’s map holdings grew continuously, especially through purchases and inheritances from scholars’ or aristocrats’ libraries, through presentation copies (*Widmungsexemplare*) from authors, as well as through gifts. Also, Austrian archdukes who had spent their youths in Madrid at the Spanish court returned to Vienna with maps of regions of this world empire.

After the Thirty Years’ War (1618–48), scientifically interested and bibliophilic Habsburg rulers like Ferdi-

nand III, Leopold I, Charles VI, and Joseph II made significant acquisitions: in 1656, Ferdinand III purchased the library of the humanist Georg Fugger, which totaled 14,000 volumes including several works by cosmographer Johannes Schöner and exemplars of Ptolemy's *Geography* from 1482 and 1513 corrected by Schöner. After the extinction of the Tyrolean line of the Habsburgs (1665), the head of the library, Peter Lambeck, at the request of Leopold I, collected books and manuscripts from the Ambraser Kunstsammlung, founded by Archduke Ferdinand II of Austria, and transported them from Innsbruck to Vienna (Wawrik 1995, 210–13). Maps and atlases were among them.

The activity of collecting cartographically relevant objects reached its height in the eighteenth century during the Enlightenment. After the long years of war, Emperor Charles VI wanted to establish an era of peace in which artistic and scientific activities would have priority. In this spirit, he built the grandiose ceremonial room of the Kaiserliche Bibliothek (Österreichische Nationalbibliothek) from 1723 to 1726. Most of the important and wealthy art collectors were in Austria, such as military commander and politician Prince Eugene of Savoy, traveler and later Saxon librarian Philipp von Stosch, and Albert Kasimir von Sachsen-Teschen.

Among Eugene's acquisitions were numerous geographical works, travel reports, atlases, and maps—possibly a credit to his advisor, Pierre-Jean Mariette, whose forefathers had at times had a close professional relationship with Nicolas Sanson (Wawrik 1986). The most well-known item of Eugene's cartographic collection is the unique Peutinger map, a late medieval copy of a Roman world map from the fourth century. A further unique treasure was acquired by Eugene in 1730, the Atlas Blaeu–Van der Hem, a forty-six-volume baroque composite atlas (*Sammelatlas*) that was assembled mid-seventeenth century by the wealthy Amsterdam lawyer and banker Laurens van der Hem. Four volumes of the monumental work constitute the “Secret Atlas of the Dutch East India Company,” a selection of contemporary copies of the company's secretly held maps (Van der Krogt and De Groot 1996–2011, 5:225–416). After Eugene's death, his heiress sold the library encompassing 15,000 prints, 240 manuscripts, and more than 500 boxes of illustrations to Charles VI in 1736.

Stosch, a relative of the Austrian state chancellor Wenzel Anton von Kaunitz, lived in Rome and Florence for a long time (Kinauer 1950; Zeilinger 1995, 233–37) and acquired a very large collection of maps, plans, views, and architectural drawings, bound in a total of 328 portfolios. The sheets pertaining to Italy were a clear highlight. On the occasion of Stosch's death, the famous art historian Johann Joachim Winckelmann compiled a register listing over 28,000 printed and 2,550 manu-

script sheets. Eventually the Hofbibliothek acquired the gigantic collection; due to Empress Maria Theresa's chronic financial difficulties, the head of the library, Gerard van Swieten, is thought to have loaned her the purchase price of 8,500 florins (Gulden).

A third notable graphics collector, active from 1768, was Albert Kasimir, son of King August III of Poland and son-in-law of Maria Theresa (Koschatzky and Antoniou 1988). As a follower of the Enlightenment and Freemasonry, he conformed to a new collector's ideal, namely to bring together works of art, systematically order them, identify the relevant artists and engravers, and protect the works for posterity. His agents, active in many countries, acquired more than 30,000 prints in less than two years. His adopted son Charles, archduke of Austria, the victor over Napoleon at Aspern-Essling (1809), and his descendants continued the collecting activity at a limited level. In the 1920s, the private collection was nationalized as the Grafische Sammlung Albertina. At the same time 6,000 maps and several atlases were transferred to the Österreichische Nationalbibliothek's map collection.

Franz II, Holy Roman emperor and later Austrian emperor, was also an enthusiastic and knowledgeable bibliophile who single-handedly managed his collection until 1806. As emperor, he transformed this collection into the Habsburg estate and entailment library (*Fideikommissbibliothek*), to ensure that its assets would remain held by the family forever. While in Paris in 1814, the emperor personally arranged the purchase of some exemplars of Cassini maps from France. But above all he was concerned with acquiring maps of Austrian territories, such as the *Ducatus Carnioliae* (fig. 451) (Dörflinger 1984, 49). During the Congress of Vienna (1814–15) the emperor sometimes led his aristocratic guests through the collection personally. When he died in 1835, the collection totaled more than 3,000 maps and 9 globes (Wieser and Kittler 1987, 264).

In 1711 Emperor Joseph I added a military archive for the administration of documents, including maps, collected by the Hofkriegsrat since its foundation in 1556 (Paldus 1914; Hillbrand 1975). In 1776, this archive would become a central storage and work station for military cartography, especially because of the Austrian monarchy's Josephinische Landesaufnahme, implemented in 1764, which ultimately encompassed some 4,000 sections. Gifts from Joseph II as well as the acquisition of great numbers of maps from the property of Austrian field marshal Karl Alexander von Lothringen allowed the collection to grow quickly. Of historical interest were the military operations maps such as the twenty-sheet “Theatrum belli Rhenani” (1702–13) by the engineer-officer Cyriak Blödner that reflected the war's progression in southwest Germany at the begin-



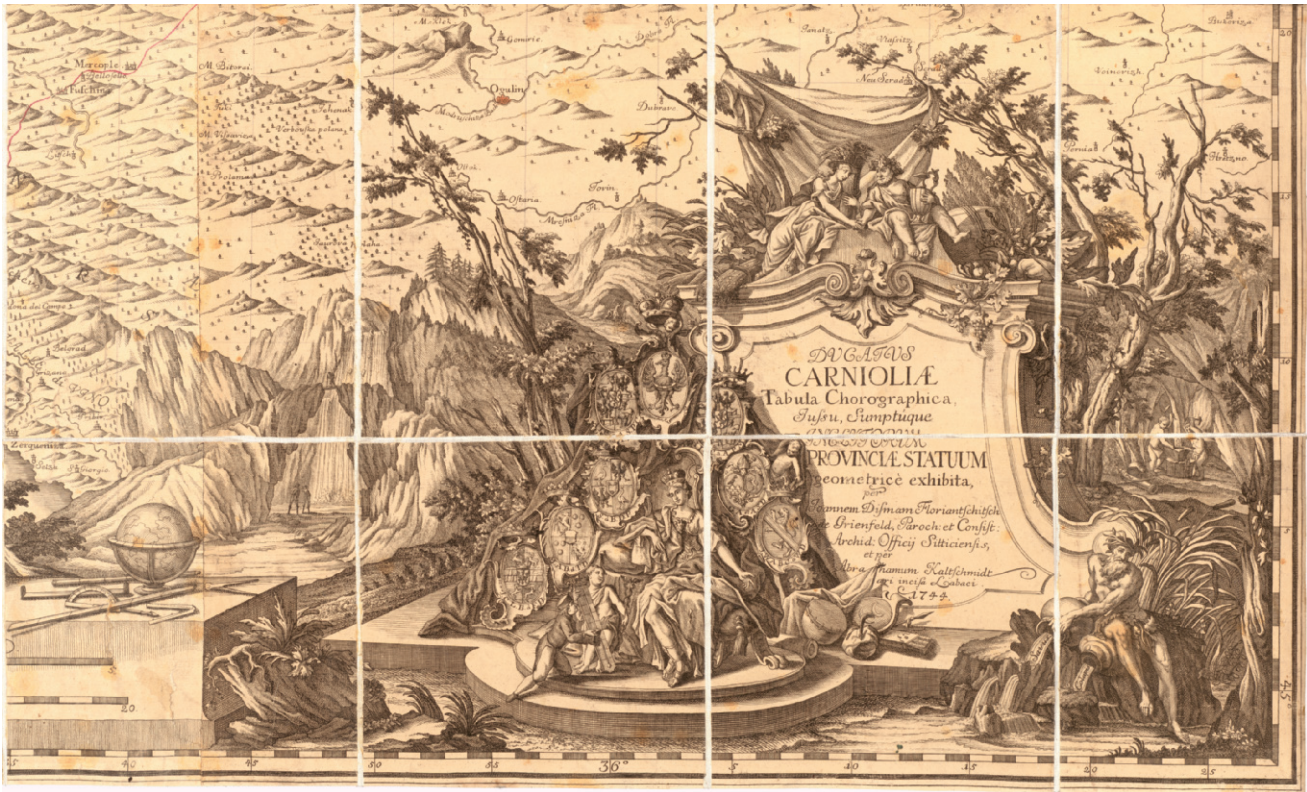


FIG. 451. DETAIL WITH THE CARTOUCHE FROM IVAN DIZMA FLORJANČIČ DE GRIENFELD, *DUCATUS CARNIOLIAE TABULA CHOROGRAPHICA* (LAIBACH, 1744). Colored copperplate engraving in twelve sheets, ca. 1:100,000. At the request of the representatives of the Duchy of Carniola,

Cistercian Father Florjančič (Floriantzschitsch) made this large map, based to some extent on up-to-date survey methods. Size of the entire original: ca. 182 × 190 cm; size of detail: ca. 46.0 × 75.5 cm. Image courtesy of the Kartensammlung, Österreichische Nationalbibliothek, Vienna (FKB C.44.a.2d).

ning of the eighteenth century. Also archived were maneuver, march, and deployment maps (*Marschroutenkarten*); encampment, siege, battle, and combat plans; and their corresponding land descriptions. In 1801, the map collection was incorporated into the war archive established by Archduke Charles as part of an army reform.

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SEE ALSO: Austrian Monarchy

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*büten und bewahren: Festgabe für Lothar Zögner*, ed. Joachim Neumann, 233–54. Gotha: Justus Perthes.

**Map Collecting in Denmark.** Map collecting in Denmark has not been the focus of any refined studies; for this brief survey we rely on descriptions of the collections themselves and descriptions in the large number of auction catalogs that exist in the Kongelige Bibliotek, which was established in the 1650s and luckily avoided the many fires in Copenhagen. By contrast, the Universitetsbibliotek, founded in the late fifteenth century, was devastated by a large fire in 1728 and again by fire in 1795. The castle at Christiansborg was burnt in both 1794 and 1884. As a result of these disasters, a large number of collections of maps were destroyed. For example, the Universitetsbibliotek lost the collection of the mayor of Copenhagen and Denmark's first important topographer, Peder Hansen Resen. As part of his effort to assemble his *Atlas Danicus*, Resen had collected maps and other topographical material in thirty-six large boxes. All the contents were destroyed except for a few items that had been loaned unofficially to readers (Ilsøe 1991). Fire also destroyed several private collections.

The Kongelige Bibliotek, lucky survivor of these conflagrations, holds several sixteenth-century atlases, donated or bought by Danish kings, such as special editions of *Civitates orbis terrarum* of Georg Braun and Frans Hogenberg, sea atlases by Lucas Jansz. Waghe-naer, and globes by Willem Jansz. Blaeu and others. The library also houses a significant collection of manuscript maps made by Johannes Mejer, appointed as cartographer to the king in 1647. Of particular importance to the history of map collecting, the library preserves a number of large map collections that were established in the eighteenth century, three of which are noted here. Many book collectors added maps and atlases to their collections but in smaller numbers than these three major collections, and those collections await further study (Ilsøe 2007).

The statesman Count Otto Thott maintained the largest of the three collections with more than 200,000 items, which were sold at auctions between 1785 and 1792; the catalog of the collection fills eleven volumes. The atlases in the collection included thirteen different editions of the *Theatrum orbis terrarum* of Abraham Ortelius, eleven editions of the work of Sebastian Münster, and fifteen editions of the work of Gerardus Mercator, among others. The catalog also contains information about the purchasers of the books and maps, making it possible to learn where some of the maps went and to whom, especially those sold either to the king, to the university, or to Daniel Gotthilf Moldenhawer, who was then head of the Kongelige Bibliotek. Thott, however,

did not mark his books with his own special numbers or letters, making it difficult to reconstruct his collection today from existing materials.

Thott's collection was followed in size by that of Johan Ludvig Holstein, Danish prime minister. His large map collection is also known through an auction catalog, but without annotations regarding purchasers. It has been discovered that two of the entries in the 1812 catalog refer to two composite atlases now in the library, part of the Holstein collection. Entry number 8709-73 describes an "Atlas major, auctore F. de Vit. vol. 1-64. Amstelodami" (Grønbæk 2001, 59); this is actually the largest composite atlas in the Kongelige Bibliotek, bound in sixty-five folio volumes containing more than 4,000 maps. Unfortunately, volume thirty-eight, containing maps of Denmark, is missing. It is not known whether Holstein collected this atlas himself or purchased it whole, since there is no sign of his name or other proprietary mark on any volume. The second composite atlas described in the auction catalog and now also in the same library was Holstein's atlas of 794 maps in thirteen volumes, each volume bearing his initials, "JLH," on the back. This atlas contains mostly town plans and maps covering the area around the cities.

The Holstein and Thott collections were joined in the Kongelige Bibliotek by that of Frederik V. He received a map collection as a baptismal present and continued collecting maps all his life, as did his queen, Juliane Marie. Their enthusiasm resulted in two very large composite atlases. The so-called Frederik den Femtes Atlas comprises fifty-five leather volumes containing 3,535 sheets, mostly copperplate maps and plans, and including more than 400 manuscript maps (Kejlbo 1969), covering the whole world and every country, including three volumes of maps of Denmark. Juliane Marie's composite atlas is divided into thirty-eight volumes with content similar to the king's collection but with little overlap in map titles; it is housed in the queen's private library at Amalienborg Castle (Kiaer 1966).

HENRIK DUPONT

SEE ALSO: Denmark and Norway; Map Trade: Denmark

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*Map Collecting in France.* Three convergent phenomena characterize map collecting in France during the Enlightenment. First, the growing supply of maps at the turn of the eighteenth century encouraged the development both of collections by amateurs and of a literature intended to guide them in their selections. Second, the spread of cartography as a tool impelled a growing number of specialists (geographers, engineers, and important state officials) to establish personal collections. Third, the growth of map use for administrative purposes spurred a trend to create great repositories of official maps (Bibliothèque du Roi, Dépôt de la Guerre, Dépôt de la Marine, Dépôt des Affaires étrangères), which drew in part upon the first two types of collections.

Mireille Pastoureau (1984) analyzed the first group of map collectors, the amateurs. Their number included great print collectors such as Roger de Gaignières who might allocate a large portion of their collections to topography (plans and views of cities, chateaux, and monuments; Casselle 1976, 159–72), sometimes even commissioning maps prepared in the field. Until the third quarter of the seventeenth century, amateurs depended on atlas maps available in the marketplace: the so-called Ptolemy maps, the atlases of Abraham Ortelius and the Dutch, and the Sanson atlases (ca. 1660). But as maps multiplied and became available as separate sheets distributed by competitors of the Sanson family (for example, Jean-Baptiste Nolin, Nicolas de Fer, Guillaume Delisle) the phenomenon of the *atlas du choix* (*atlas factice* or composite atlas) developed, composed with a specific focus in an acceptable price range, dependent upon the available stock of the geographer or map merchant. It very quickly became apparent that the amateur needed advice in choosing maps. Beginning in 1716, the geographer Nicolas Lenglet du Fresnoy provided a guide by publishing a list of the works of the “best” French geographers in his *Méthode pour étudier la géographie* (1716, 1:cxxv–cxxxii), including its “Catalogue des meilleures cartes géographiques” (3:439–552). For his putative atlas comprising seventy-five recommended maps, fifty-seven were by the Sansons and seven by Delisle (1:cxxvii–cxxxii). In the successive editions of the *Méthode* (1736, 1741–42, and 1768), new names appeared: le Père Placide, the Dutch firm of Covens & Mortier, Jean-Baptiste Bourguignon d’Anville, Gilles Robert Vaugondy and Didier Robert de Vaugondy, and Jean de Beaurain. In the middle of the century, Beaurain offered individualized atlases in several volumes stating on the title pages that they were “based upon the collection of the Sr. de Beaurain” and containing maps by various authors (including Nicolas Sanson, Alexis-Hubert Jaillot, Nolin, Delisle, Gilles Robert Vaugondy and Didier Robert de Vaugondy, Guillaume Dheulland,

and Georges-Louis Le Rouge). The mapseller Roch-Joseph Julien opened the first boutique in Paris offering a supply of maps from anywhere in Europe, thanks to his international network of correspondents. In 1763 he published his very complete *Nouveau catalogue de cartes géographiques et topographiques* aimed at helping the amateur consumer choose from the prodigious array of cartographic products available (fig. 452).

The second type of collection, that of the specialists, was conceived as providing veritable working tools or maps brought together for a specific purpose; these collections also multiplied and became more diverse. If ceded to public collections (e.g., the royal library, libraries of abbeys, cartographic depositories), they were often better preserved in the eighteenth century than they had been in the past and are more easily reconstructed than those of the amateur collectors. This is the case for collections assembled by scholars who specialized in geography, such as Michel-Antoine Baudrand and Jean-Nicolas de Tralage (who published maps under the names Tillemon, Tillemont, and Tillemontius), or professional geographers such as d’Anville. The Baudrand and Tralage collections were given to the libraries of religious institutions and that of d’Anville to the Ministère des Affaires étrangères. On the other hand, the collection of Jean-Baptiste-Michel Renou de Chauvigné, dit Jaillot, which comprised some eight to nine thousand items, was dispersed. On a smaller scale, *ingénieurs du roi* assembled map portfolios, typically including 150 to 200 maps, which they used as valuable theoretical and practical models (such as the Auclair collection assembled by the engineer Gourdon), but very few have survived unless they were bound together by their owners.

In this group of specialist collections were those of eminent members of the aristocracy or great state officials (Gaston d’Orléans; Jules-Louis Bolé de Chamlay; François-Michel Le Tellier, marquis de Louvois; Victor-Marie d’Estrées; Antoine-René de Voyer d’Argenson, marquis de Paulmy) who collected maps in the course of carrying out their duties. Like that of Gaston d’Orléans, the collection of the marquis de Paulmy, now held at the Bibliothèque de l’Arsenal, is only part of a vast collection of books (52,000 volumes) and prints (592 portfolios) that he acquired as a confirmed bibliophile. His interest in cartography was directly linked to his role as adjutant to his uncle Marc-Pierre de Voyer de Paulmy, comte d’Argenson, ministre de la Guerre, and to the various tours he made of the frontier locations and maritime forts of the realm between 1752 and 1755.

The collections of Emmanuel de Croÿ-Solre and Charles-Étienne Coquebert de Montbret show their interest in specific domains of research. Croÿ-Solre, an eminent member of the French nobility and *maréchal* of

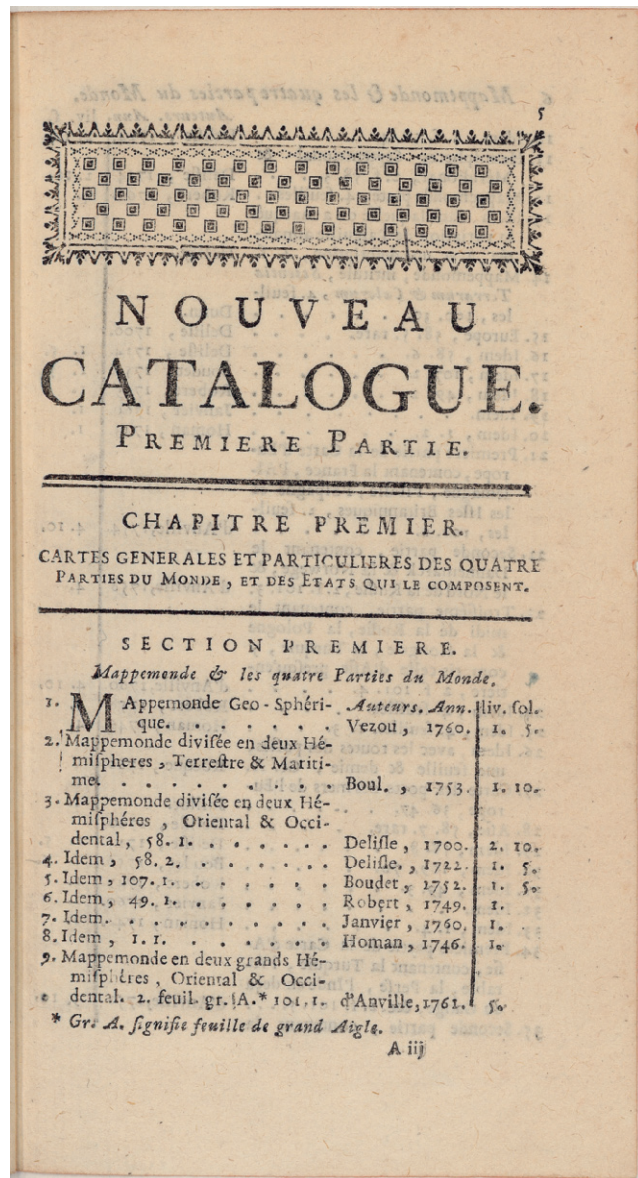


FIG. 452. PAGE FROM *NOUVEAU CATALOGUE DE CARTES GÉOGRAPHIQUES ET TOPOGRAPHIQUES*, 1763. The first page (5) from the catalog published in Paris by the mapseller Roch-Joseph Julien listing the world maps available from his shop in Paris with prices noted on the right. Julien was the first map dealer in France to offer his clientele a wide choice of foreign maps as well as maps by French geographers.

Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge FF 7402–7403).

France, became famous on the battlefield before making his reputation as a lover of the sciences. Impassioned by the discoveries of Louis-Antoine de Bougainville and James Cook, he assembled a large collection of maps that showed his taste for exploration. In 1773 he financed the second voyage of Yves-Joseph de Kerguelen-Trémarec

and commissioned from Didier Robert de Vaugondy a special map, the *Hémisphère austral ou Antarctique*, which emphasized the South Pacific voyages (Dion 1987). Coquebert de Montbret, for his part, occupied various diplomatic posts and the upper ranks of public administration under the Ancien Régime, the Revolution, and the Empire, notably in the Bureau de la Statistique (1806). He was also the editor of the *Journal des Mines* (1794) and a member of various scholarly societies. In 1823, he published a map titled *Essai d'une carte géologique de la France, des Pays-Bas et de quelques contrées voisines* with Jean-Baptiste-Julien d'Omalius d'Halloy. Coquebert de Montbret's collection of 868 maps, carefully inventoried and held today in the municipal library of Rouen, show their owner's interest in geology and mineralogy through their annotations and other marks of usage.

In the last third of the seventeenth century, the creation of official cartographic depositories began, constituted in large part of maps acquired by purchase, by gift of private collections, or by obligation of agents of the state to deposit their work. The Bibliothèque du Roi benefited from legally required deposits, which included *estampes* (prints) beginning in 1672 and maps expressly from 1713. Thus throughout the eighteenth century, the *portefeuilles du roi* (portfolios of the king) were supplied with the latest cartographic publications. In 1667 the Bibliothèque du Roi received the collection of Gaston d'Orléans, uncle of Louis XIV and an eminent soldier (2,000 maps mounted in 18 folio volumes). The creation at the end of the seventeenth century of the Cabinet des estampes brought together the great amateur collections, notably those of Michel de Marolles (in 1667), Gaignières (in 1716), and Michel Joseph Hyacinthe Lallemand de Betz (in 1753), which included large numbers of topographic subjects. During the Revolution, the Bibliothèque du Roi benefited from confiscations, notably those from ecclesiastical houses. Thus, the rich collections of the abbeys of Saint-Victor (the Tralage collection) and Saint-Germain-des-Prés (the Baudrand collection) entered the now-renamed Bibliothèque nationale. In 1828, the establishment of the Département des cartes et plans joined these last collections with the *portefeuilles du roi*, creating a collection of about 13,000 maps divided into 140 portfolios.

In the course of the eighteenth century, map depositories were established that were directly linked to ministerial archives. At the end of the seventeenth century, the marquis de Louvois, Louis XIV's *secrétaire d'État à la Guerre*, established the Dépôt de la Guerre as part of an effort to organize the archives and the items produced by his ministry. From 1690, high-ranking military officers were required to hand over all papers of public interest to the ministry. In 1730, a Dépôt des cartes et plans

(of the Ministère de la Guerre) was established, bringing together three types of maps: the documents drawn up by soldiers in the field and sent to Versailles to support their reports, the cartographic documents of every provenance assembled to help understand the terrain and to develop strategy, and finally maps of past conflicts produced as instruments of instruction. In 1742, twelve years after its creation, Jean-Baptiste Naudin, custodian of the depository, prepared the *État au vrai des cartes et plans qui existent actuellement au dépôt du bureau de la guerre*, which provided a picture of the collection: 1,087 manuscript maps and engravings grouped in 85 bundles or portfolios, concerning primarily the frontier provinces and the countries forming the theaters of operations. During the Revolution, under the direction of General Etienne-Nicolas Calon (1793), the Dépôt de la Guerre assumed complete control of all cartographic production and its diffusion. The Dépôt continued to enrich itself through revolutionary confiscations and seizures of foreign depositories.

The Marine similarly created an archival depository (1699) that preceded the Dépôt des cartes et plans de la Marine (1720), intended to collect, maintain, and better control hydrographic documents. An *ordonnance* of 1681 obliged merchant marine captains to send their logbooks to the office of the Admirauté. The Dépôt began to produce its own maps from 1737 with the publication of a map of the Mediterranean in three sheets. Later publications were supervised by Jacques-Nicolas Bellin, who arrived at the Dépôt in 1721 and became the first *ingénieur hydrographe de la Marine* in 1741. Besides benefiting from documents arriving from ports, the Dépôt was enriched by complete or partial collections of former officials (e.g., *maréchal d'Estrées*, 1742, or Michel Bégon, *intendant de la Marine*, 1772). In 1742, a stamp was created to mark the documents of the Dépôt.

Two other military depositories, straddling the work of the ministries of war and the navy, were established autonomously before being attached to the Dépôt de la Guerre. The Dépôt des fortifications brought together the memoirs, plans, and projects of the engineers (of the Génie) working in the departments of war and the navy. The Dépôt des fortifications des colonies was created in 1778 following a ministerial decision of 1776 to assemble a complete collection of plans surveyed in the colonies.

The Ministère des Affaires étrangères was late in establishing a map depository. In 1774 the Bureau des limites was put in place with a mission to collect from all over France cartographic materials related to the frontiers. The Bureau was also charged with copying maps necessary for the departmental service and with preparing a general map of frontiers, by conducting surveys of terrain if necessary. In 1778 the catalog numbered only

1

*Inventaire de la Collection Géographique de M. d'Anville, premier Géographe du Roi et Membre des Académies des Belles Lettres et des Sciences.*

*Mappe-mondes.*  
Deuxième Classe.

1.	<i>Recens et integra orbis Descriptio.</i> taille de bois	1	Orontius	10. au Dépôt
2.	<i>autre</i> Mappe-monde latine	1	Id.	4. au D.
3.	<i>La Sphère Automatique</i> travaillée par Ervasius par les Soins de M. Adrien Wroesen et suivant les calculs de Nicolas Stampioen. en latin et en français.	1	Ervasius Sc.	
4.	<i>Tabula Orbis cum descriptione ventorum.</i> taille de bois 1522	1	Éréc de Ptolémée de l'évêque	8. au D.
5.	<i>Tabula nova totius orbis.</i> taille de bois	1	Id.	1. Sig. au D.
6.	<i>Universale Descriptione di tutta la terra</i> conosciuta fin qui 1570	1	Bole forlan. Wronosc. Graveur, Claude Duchet formis	10. au D.
7.	<i>Orbis terrarum compendiosa Descriptio</i> année 1587 (Double)	1	Gerard mercator	6. au D.
8.	<i>Ancienne Mappe-monde latine</i>	1	Ant. del. graveur à Rome	9. au D.
9.	<i>Nova totius terrarum orbis Géographica Tabula</i>	1	h. bondius	6. au D.

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FIG. 453. "INVENTAIRE DE LA COLLECTION GÉOGRAPHIQUE DE M<sup>R</sup> D'ANVILLE." With 8,790 items assembled during his long career, the collection of Jean-Baptiste Bourguignon d'Anville is a rare example of a geographer's intact working map collection. It was acquired by King Louis XVI, who placed it with the Ministère des Affaires étrangères, where it remained until its transfer in 1924 to the Bibliothèque nationale. This inventory carries the stamp of the library of Jacques Augustin Hébert de Hauteclair, d'Anville's son-in-law. Page 1 lists nine *premières mappemondes*.

Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2044 [RÉS]/Arch 46 bis, f. 1).

several hundred pieces in seventeen portfolios. Their efforts were capped by the acquisition of the collection of d'Anville (8,790 maps) in 1780 (Pastoureau 1984, 10) (fig. 453).

CATHERINE HOFMANN

SEE ALSO: Anville, Jean-Baptiste Bourguignon d'; Dépôt de la Guerre (Depository of the War Office; France); Dépôt des cartes et plans de la Marine (Depository of Maps and Plans of the Navy; France); France; Map Trade: France

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**Map Collecting in Great Britain.** Map collecting, as opposed to book collecting, is first seen in England in the mid-sixteenth century. By the mid-seventeenth century there were statesmen, soldiers, and admirals who envisaged their professional concerns in spatial terms and tended to regard maps as information sources and instruments for decision making. There was a spectrum of institutions that collected maps and atlases ranging from the fully governmental, such as the Board of Ordnance (particularly from 1683 when the officers were specifically commanded to collect maps and plans), to the semiofficial, like the trading companies, and the effectively private, like the Oxford and Cambridge colleges. Antiquaries and academics like William Stukeley regarded maps as a way of illuminating the past—and particularly the British past—and acquired their own maps for research purposes. Finally, from about the 1650s there was a growing number of map publishers who created their own working collections. Dutch charts now in the Rotterdam Maritime Museum, and formerly

in Corpus Christi College Oxford, may once have been owned by an English chartmaker like John Thornton. His maps and advertisements, like those of other early English chartmakers and map publishers, demonstrate that they also owned some copperplates as well as maps and atlases of their Dutch and later British competitors.

In most cases, individual collections have long since been dispersed, leaving, at best, only catalogs or, more usually, informal lists. In a few cases, a fragment survives but not in its original arrangement. In the forefront of collectors after 1660 were British monarchs acting in a private capacity and not as nominal owners of the royal library, where atlases accumulated rather than being collected. A significant fragment of their working map collections from 1660 is preserved as part of George III's Geographical Collections shared between the British Library and the Royal Library at Windsor. These, and some volumes in the King's (i.e., George III's) Library in the British Library, reflect Charles II, James II, and George III's lively personal and professional interest in maps. The private map collections of George I and George II are in the Leibniz Library in Hanover (Barber 2014, 154–55). Cartographic interest percolated downward to ministers like William Blathwayt, a secretary to the council on Trade and Plantations whose extensive collection of official and semiofficial maps predominantly of the American colonies is now in the John Carter Brown Library, Providence. Francis Gwyn occupied a lower rung in the administrative hierarchy as under-secretary of state in the 1680s, but a part of his map collection is now in the British Library (Add. MS 16369–71).

Blathwayt began his career as a diplomat, and there were several other British envoys who seem to have had their own reference map collections, judging from surviving single items or from informed comments about the use of maps in their correspondence. Richard Graham, first viscount Preston, Charles II's ambassador to France in the 1680s, and Sir William Trumbull, who was active in the next decade, almost certainly fall into this group. Soldiers and sailors also had collections. A large part of the map and atlas collection of George Legge, first baron Dartmouth, is now in the National Maritime Museum, Greenwich, while that of William Augustus, duke of Cumberland, is split between the British Library and the Royal Library at Windsor, and that of the later-eighteenth-century military dynasty of the Clintons is now at the University of Michigan, Ann Arbor (Stephen S. Clark and William L. Clements Libraries). The maps and charts assembled in the mid-eighteenth century by Admiral Richard Howe, Earl Howe, are now also scattered through the British Library's collections.

The distinction between the professional and antiquarian map collector is difficult to draw in cases such

as Samuel Pepys, a secretary to the Admiralty whose extensive collection survives in Magdalene College, Cambridge, or his friend and mentor, the polymath John Evelyn. Toward the end of the next century, Alexander Dalrymple, the hydrographer to the East India Company and to the British Admiralty, assembled a large collection of maps in part for professional reasons but also because of his passionate private interest in the history of discoveries.

The interest in map collecting was more obviously linked to antiquarianism in the cases of the London bookseller John Innys, whose 113-volume collection is now owned by the earl of Leicester and housed in Holkham Hall in Norfolk, and Richard Gough, whose equally large collection, including the famous detailed late fourteenth-century map of the British Isles that is named after him, is now one of the glories of the Bodleian Library in Oxford. The outstanding example of the self-assembled multivolume “geographical atlas” is, however, that part of George III’s geographical collections known as the King George III’s Topographical Collection in the British Library, with an estimated 50,000 maps, views, and atlases (fig. 454).

Before about 1730 maps generally seem to have been

grouped with other prints or manuscripts and to have been pragmatically organized by place and event depicted but in no particular hierarchy. After that date, the great map collections tended to be hierarchically organized along geographical lines in accordance with the eighteenth-century Enlightenment love of classification. They also reflected the growing scholarly interest in geography and in scientific precision in mapping.

Map collectors could exercise a real influence on the evolution of cartography. Samuel Pepys’s personal interest and cartographic knowledge and sophistication, for example, made him determined to improve the quality of British official mapping by appointing skilled chart- and mapmakers. For the same reason, he supported the foundation of the Mathematical School at Christ’s Hospital in London (1673). George III also did what he could to the same end. As elector of Hanover, he was responsible for the detailed military surveys of his German dominions between 1764 and 1786 and, though unable to counter the reluctance of the British parliament to undertake a similar survey of the British Isles until the 1790s, he provided private support, for instance by sponsoring Jesse Ramsden’s giant theodolite, which enabled William Roy to survey the baseline

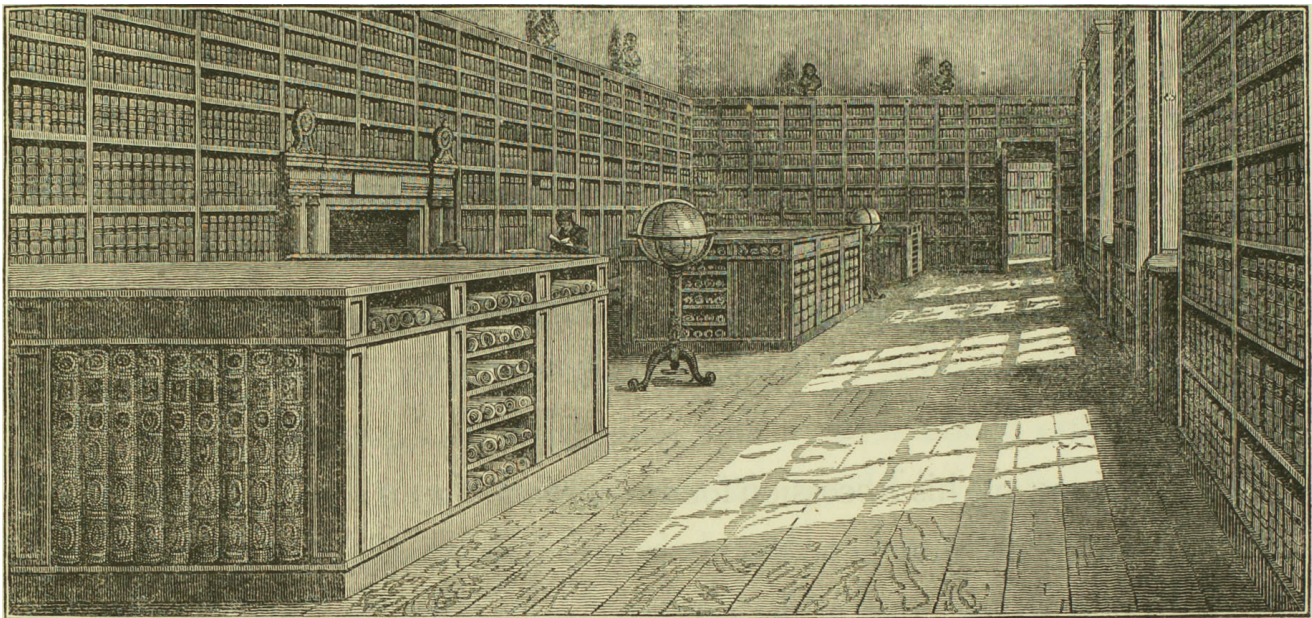


FIG. 454. ENGRAVING OF KING GEORGE III’S MAP LIBRARY AT QUEEN’S HOUSE (NOW BUCKINGHAM PALACE). From Frederick Augusta Barnard, *Bibliothecæ Regiæ catalogus*, 5 vols. (London, 1820–29), 1:i. The image is based on an 1819 watercolor (which seems to be lost) by James Stephanoff. The room dates from 1762–64 and was designed by George’s favorite architect, William Chambers; the image represents the room as it was in ca. 1800. Of particular note

are the solander boxes in the bottom shelf in the front, which contain the loose items from the king’s multivolume “General Atlas.” Many of the boxes—or at least their backs—are still to be seen in the British Museum’s Enlightenment Gallery, formerly known as the King’s Library.

Size of original: 8.2 × 17.8 cm. Image courtesy of the Harlan Hatcher Graduate Library, University of Michigan, Ann Arbor.

for the Greenwich-Paris triangulation. At a local level, wealthy and sophisticated map collectors were also able to exercise influence over the quality of the large-scale mapping of their country directly through both their individual patronage of local estate and county surveyors and through their membership in learned societies, which to varying degrees sponsored many of the larger projects.

PETER BARBER

SEE ALSO: Great Britain; Map Trade: (1) Great Britain, (2) British America

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**Map Collecting in the Netherlands.** The Republic of the United Netherlands assumed a prominent and progressive position in several modes of cartography during the seventeenth century. On the one hand, the Verenigde Oost-Indische Compagnie (VOC) and the West-Indische Compagnie (WIC) promoted the mapping of unknown or barely known areas of the world; on the other hand, the large publishing houses of Janssonius and Blaeu were competing to bring the most comprehensive atlas onto the market.

Research on the collecting of cartographic material in the seventeenth and eighteenth centuries is still relatively recent and fragmentary. The first important initiative was the work of Cornelis Koeman, who charted an unusually broad area: both the collection of geographical material by individuals and the production and purchase of commercial atlases from the sixteenth to the twentieth century. A more recent aid is the publication on microfiche of all book auctions, art sales, and commercial catalogs from the seventeenth and eighteenth centuries. Although these sources yield only limited information, they do make it possible to reconstruct, in

part, a number of collections. A reasonably detailed picture of the nature of collecting is thus possible.

Two closely related phenomena can be distinguished before 1650–1700: the collecting of atlases (and maps) and the creation of collector's atlases. The latter, often called "mirror" or "theater," became popular in the beginning of the seventeenth century and were histories of the Dutch Revolt illustrated with maps and prints. Cartographic collections consisted mainly of a multivolume atlas by Janssonius or Blaeu, enhanced by the addition of a celestial atlas, one or more maritime atlases, and several city books. These were relatively limited collections, which usually were an integral part of a private library.

This changed after the publication of Joan Blaeu's *Atlas maior* in 1662. This atlas consisted of nine to twelve volumes, but owners usually considered this only a starting point and supplemented them with as many as another thirty volumes of maps and prints. These multivolume atlases could be regarded as an integral part of the library, but more often they were treated differently from normal books and were stored in specially manufactured cabinets. Most of the atlases are now known only from auction catalogs, for example those of Johan Huydecoper, Cornelis Nicolai, and Jacob Cromhout. Complete or partially preserved are the atlases of Michiel van der Grijp (Rotterdam, Historisch Museum) and Frederik Willem van Loon (Amsterdam, Scheepvaartmuseum; Amsterdam, Universiteitsbibliotheek; The Hague, Koninklijke Bibliotheek); and the twenty-four volumes (of an original twenty-seven) assembled by the wealthy sugar merchant Christoffel Beudeker (London, British Library) (Simoni 1985). The atlas owners were invariably wealthy merchants whose collections were not limited to cartographic material but also included books, paintings, coins, or rarities. It is clear that their atlases were for external show and functioned not only as a source of information but also as a status symbol.

The atlases' strong focus on Europe is remarkable. The maritime maps and maps of parts of Africa, America, and Asia, which the VOC and WIC produced for their own use, found their way into individual collections only rarely. The most well-known example is that of the Amsterdam lawyer Laurens van der Hem, who, between 1660 and 1678, put together a forty-six-volume collection (see fig. 489), about half of which consisted of original material such as manuscript maps and topographical drawings of regions and places throughout the world (De Groot 2006). Through the publisher Joan Blaeu, also the official mapmaker of the VOC, Van der Hem was able to have copies made of the maps that were used for the company's intercontinental voyages. The collection did not have a professional purpose; like



many contemporaries, Van der Hem regarded collecting modern maps as an honorable pastime that befitted a gentleman. His collection attracted the attention of Prince Eugene of Savoy, who bought it, and it is today in the Österreichische Nationalbibliothek, Vienna. Van der Hem's composite atlas emulated similar collections elsewhere, such as those of Cosimo III de' Medici and Queen Christina of Sweden, who created similar atlases, which have been preserved (Florence, Biblioteca Medicea Laurenziana, and Vatican City, Biblioteca Apostolica Vaticana, respectively). Although the sales catalogs of publishers such as Cornelis Claesz. in the early seventeenth century and the Van Keulen family in the eighteenth century indicate that they offered manuscript maps for sale, little is known about the results of these commercial activities. Who purchased the maps, where the maps ended up, and how many of them have survived is still largely unknown.

Collecting in the eighteenth century was characterized by greater classification, efforts to be comprehensive, and an enormous increase in the scale of collecting with ever less emphasis on pomp. Collectors put together huge atlases in portfolios that consisted largely of easily obtainable prints. In contrast to the seventeenth-century atlases, these atlases were no longer colored and bound in luxurious bindings or kept in specially manufactured cabinets. The collectors were always conscious of further expanding their collections and thus kept the maps as loose leaves or in portfolios. Examples of these types of atlases are the *Grand theatre de l'univers* of the wealthy merchant and bibliophile Gosuinus Uilenbroek, consisting of 125 portfolios, and the 103-volume atlas of art lover and bibliophile Theodorus Boendermaker. Both were put up for sale in the early eighteenth century and then sold to the Portuguese ambassador; part of the latter collection remains in Portugal (Koeman 1961, 65). The collectors aimed to depict the world systematically with the help of topographical and geographical material available at the time. Their goals were, however, only partly realized. Because there was limited access to maps of other continents, Europe was heavily over-represented. An exception was the so-called Atlas Amsterdam, but this was no individual initiative. In 1691, the mapmaker Isaac de Graaf obtained a commission from the Amsterdam chamber of the VOC to create an atlas of the company's territories using all its available resource material. The result was a two-part atlas with 187 extremely detailed manuscript maps copied from the most recent and best VOC material.

Areas beyond Europe played only a small role in geographical and topographical collections of the eighteenth century, but collectors obtained an increasingly accurate picture of their own country and its surroundings. They hired draftsmen to chart all towns and areas of the coun-

try, and they traveled the countryside themselves to describe and draw the topography and history of places in as detailed a manner as possible. The atlases contained ever fewer maps, and consisted to a large extent of views of towns and buildings. The collectors were mostly amateur antiquarians with a keen interest in national history who not only compiled atlases, but also sought to publish topographic histories. Authors of these histories include Andries Schoemaker and his son Gerrit, Mattheus Brouërius van Nidek, Isaak Le Long, and Floris Jacobsz. Lijnslager, who compiled extensive atlases of the Netherlands or parts of it. After their deaths, their collections were broken up. The contents were initially dispersed to larger private enterprises, which in turn formed the core of the institutional collections founded in the nineteenth and early twentieth centuries. Thus, large collections of topography and history, such as the Atlas van Stolk in Rotterdam and the Stadsarchief Amsterdam, still preserve much of the material originally created and compiled by eighteenth-century antiquarians.

ERLEND DE GROOT

SEE ALSO: Map Trade: Netherlands; Netherlands, Republic of the United

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**Map Collecting in the Ottoman Empire.** The evidence for map collecting by the Ottomans is found almost completely in the collections of libraries inside the boundaries of the Ottoman Empire. Thus any research on this topic is largely dependent on the study of libraries and their holdings. Book collecting itself by the Ottomans was common throughout the empire, evidenced by collections in Istanbul, Anatolia, Serbia, Bulgaria, Medina, Egypt, and elsewhere (Erünsal 1985, 1991, 1996, 2001, 2004; Gümüşçü 2006; Rukancı and Anameriç 2006; Artan 1999; King, 1981–86 [Cairo]; Kenderova

and Ivanova 1999 [Bulgaria]; Erünsal 1996, 116n126 [Sarajevo, largely recently destroyed]). Researchers are slowly understanding how each library developed, usually under the aegis of an individual Ottoman who built mosques, madrasas, and personal libraries. The popular collecting of books is best evidenced by the collections now in the library of Süleymaniye in Istanbul, which houses, by recent count, 152 separate collections.

Map collecting by the Ottomans is much less well known, and, with the possible exception of the Topkapı Sarayı and Köprülü libraries, both in Istanbul, no other single extant library seems to have been the repository of maps during the period 1650–1800. The location of most maps in Turkey is known, but when or how they arrived in various collections is less clear. It is certain that almost all of them were made for the court circles and that few people saw them. Many maps also happened to be bound in books, mostly old books, a circumstance that can make their presence less obvious in library catalogs and may account for why so few of the many old maps that were made over the centuries exist today. Other avenues of research are the study of ownership seals on books and maps and the analysis of probate inventories, both of which might shed light on private map collecting in the period.

In order to assemble the evidence for the variety of maps that existed, as presented in other essays in this volume, an inventory of extant Ottoman maps and their locations is required. A major step in this direction is the slow painstaking progress made by the publication of *Türkiye yazmaları toplu kataloğu* (the union catalog of manuscripts in Turkey, 1979–), which has yielded fine results for maps in libraries in Istanbul but little for those outside of that city. Most of the maps discussed in this volume are in manuscript, although printing was an innovation of the period, as were maps painted on walls (Kut and Türe 1996; Renda 1988).

Most of the maps produced before 1800 either in Turkey or in any other part of the huge Ottoman Empire, which was at its greatest extent in this period, reside in the two collections within Topkapı Sarayı: the library (Goodrich 1993) and the archives (nothing has yet been published on the maps in the archives, but for the maps in the Başbakanlık Osmanlı Arşivi, Istanbul, see Aktaş 2000). The history of the imperial libraries is a complicated one that began with the establishment of the Ottoman capital in Istanbul in 1453 and the energetic Mehmed II (“Bibliothèque et musées” 1983, 1984; Pinto 2016, 219–78). Interest in books and maps varied significantly over the centuries. Some materials entered as gifts and loot; some materials departed as gifts and objects of theft. A large Ottoman manuscript world map was given by Sultan Murād IV to the Habsburg ambassador, Hans Ludwig von Kuefstein (1628–29), a year or

two after its completion. Based on an Ortelius-type map, perhaps that printed by Arnold Floris van Langren in 1594, it now hangs in Schloss Greillenstein in Austria, where it joins many other Ottoman maps that need to be studied in terms of their origins and sociopolitical context (Şengör and Kuefstein 2008). Some items disappeared from the scattered ill-protected libraries in the palace. (A few manuscripts with maps once in the palace are now in Paris, Bibliothèque nationale de France, and Dublin, Chester Beatty Library.) There were a number of separate libraries scattered around the palace, and sultans occasionally gave materials to libraries outside the palace, such as those that went to create the mosque library in Ayasofya or those now in the rare-book collection at the İstanbul Üniversitesi (Çağman 1987; Çağman and Tanındı 1986). The sultans following Mehmed II seem to have not collected maps but to have amassed them rather haphazardly and secreted them, such as the world maps by Pīrī Re’īs (Soucek 1996). A similar history applies to other libraries within the empire between 1650 and 1800. Two collections with both manuscript and printed volumes joined the Köprülü Kütüphanesi: those of Hacı Aḥmed Paşa in 1170/1756–57 and Mehmed ‘Aşım Bey in 1228/1813.

R. A. Skelton states that “deliberate and purposeful map collecting begins in the Renaissance, more precisely at the turn of the fifteenth and sixteenth centuries” (1972, 35). While considerable trade took place between Italian cities and Istanbul, the idea of collecting maps did not take root in Istanbul. Skelton enumerated several reasons for the emergence of map collecting in Europe around 1500: increased map production through printing, a growing variety of maps produced, the expanding interest in geography linked to maps stimulated by knowledge of new trade routes, patrons commissioning new maps, an organized book trade, and finally mapmakers themselves collecting maps. Perhaps only the third and fourth of these conditions existed in Istanbul and other Ottoman centers. An example of a failed effort to enter or create an Ottoman map market may be seen in the publishing entrepreneur in Venice who, thinking there might be a market for maps in the Ottoman Empire, commissioned the cordiform world map from one “Hacı Aḥmed” in 967/1559–60. Not printed until probably 1794, at least eleven impressions are known to exist, but none within the boundaries of the former Ottoman Empire (Arbel 2002).

Maps were acquired almost randomly, many by virtue of their location inside collectible books. Around the mid-seventeenth century, Muştafā ibn ‘Abdullāh Kātib Çelebi bought European atlases and owned other books with maps such as the “Tārīḫ-i Hind-i ğarbī” (History of the West Indies). Much may be gleaned from the examination of the transfer of a volume from one owner to

another, as in Kâtib Çelebi's case (Hagen 1998). Probate inventories provide some indication for private maps collected, such as those of Nevşehirli İbrâhîm Paşa and Kaymak Muştâfâ Paşa around 1700, but these collections may have also exhibited a sort of consumerism as well as an openness to existing knowledge (Artan 1999, 90–91). While the location or dispersion of these map collections is now unknown, the interest they reflect in newer geographic knowledge and the New World around 1700 is supported by the number of existing manuscript copies of the century-old "Târîh-i Hind-i ğarbî" from that period. Nonetheless, these copies of "Târîh-i Hind-i ğarbî" have no maps, even though the early manuscript copies often had two. It is also clear from the printed work of İbrâhîm Müteferrika that he had gathered together a significant collection of maps in order to produce those accompanying the printed version of Kâtib Çelebi's *Kitâb-i Cihânnümâ* (Saricaoğlu and Yılmaz 2008). Similarly, Kâtib Çelebi used a variety of cartographic sources, as his sketches in his copy of Sipâhîzâde Mehmed's work attest (Hagen 2006). More evidence for private collecting awaits further research to establish the provenance of the large number of old maps in libraries established in the two centuries since 1800.

The best evidence to date comes from the documented collections in İstanbul. Of the 152 individual collections in Süleymaniye Yazma Eser Kütüphanesi, twenty-nine existed in 1800, which comprised about 28,000 manuscripts and 800 printed books. At least ten of the pre-1800 collections hold cartographic items, nearly half of which were produced or printed in the eighteenth century. In the Süleymaniye Yazma Eser Kütüphanesi there are no separate maps; all are bound within books, but no itemized list for this or other libraries is complete at the time of writing. Five other old libraries in İstanbul are housed in separate buildings, though administratively dependent on Süleymaniye: Köprülü (founded in 1661), Atıf Efendi (1741), Ragıp Paşa (1763), Nuruosmaniye (1755), and Hacı Selim Ağa (1781). Stored in the Beyazıt Devlet Kütüphanesi is the collection of Şeyhülislam Veliyüddin Efendi (1783). The relatively few maps in books contained in these separate libraries of individuals may be contrasted with the governmental collections in which many cartographic items are housed: the Topkapı Sarayı Müzesi Kütüphanesi, the Topkapı Sarayı Müzesi Arşivi, and the Başbakanlık Osmanlı Arşivi.

The maps found in collections outside Topkapı Sarayı Müzesi are copies of a modest number of different though varied works: pre-Ottoman authors (Ibn Hâwqal, Claudius Ptolemy, al-İştâkhrî, al-Muqaddasî, al-İdrîsî, Ibn al-Wardî, and Ibn Khaldûn), water supply drawings (separate maps, all in Köprülü Yazma Eser

Kütüphanesi), European printed works, the works of Kâtib Çelebi, the "Kitâb-ı bahriyye" by Pîrî Re'îs, the "Ma'rifetnâme" by İbrâhîm Hâkîkî Erzurumî, and copies of three works printed by İbrâhîm Müteferrika.

Given the tens of thousands of manuscripts and many printed works in the libraries of İstanbul, what does the paucity of cartographic items mean? First, it may be that geography and cartography were not wedded, and that the study of place did not require maps, a condition similar to medieval Europe. Second, the visualization of space did not undergo a transformation parallel to the Western European experience of reassessing the value of Ptolemaic coordinates and applying mathematical and astronomical surveying techniques to mapmaking. The growing interest in mapping in eighteenth-century Europe touched the Ottoman Empire, but not greatly. Third, the court and its ministers were the major collectors of maps, excluding broader public exposure and ensuring that a commercial market for cartography simply did not exist. To all these suggestions must be added the caveats that the search for maps in libraries or other organized collections is incomplete. Because the definition of what constitutes a "map" varies, it is possible that items remain unaccounted for because they are not thought to be maps. There is much more to be learned from regional centers such as Sofia and Cairo, from archival documents such as probate inventories, and from the history of acquisitions of maps by more recently established libraries such as those in the universities throughout the old empire and institutions like İstanbul Arkeoloji Müzeleri Kütüphanesi and others outside the empire.

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SEE ALSO: Ottoman Empire, Geographical Mapping and Visualization of Space in the

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**Map Collecting in Portugal.** Following the War of the Spanish Succession, the reign of João V (1706–50) marked a renewal in Portugal's cultural and scientific life. The king ordered his diplomats in France, Holland, Italy, and England to acquire books, works of art, and scientific instruments as part of an ambitious program to enrich both the libraries of the royal palaces in Lisbon and Mafra and the university library of Coimbra (Biblioteca Joanina). In this context, many maps and other cartographic objects were purchased and acquired, including atlases by Pieter van der Aa and globes by Vincenzo Coronelli, the latter still part of the collection of the Sociedade de Geografia de Lisboa. Among the atlases in the Portuguese royal collection was one by Guillaume Delisle in 6 volumes, specially organized for João V by the French king's geographer (ca. 1721); Joan Blaeu's *Atlas maior* in 10 volumes; an atlas in 3 volumes by Jean-Baptiste Bourguignon d'Anville; an atlas by the abbé Jean de Vayrac, purchased in 1724 and repaired by d'Anville; and the so-called Boendermaker Atlas, named for its Dutch collector, in 103 volumes (many now lost) that included maps from different European nations and plans of Europe's most prominent cities as well as an exceptionally large quantity of engravings treating a broad range of topics (Mandrour-França 2003, 74–84). In addition, the collection contains several smaller, more portable atlases purchased at the behest of the king to prepare for a journey through Spain, France, England, Holland, Prussia, and Italy. This European tour, meant to take place between 1715 and 1717, never came to fruition. Nevertheless, this list provides some notion of the cartographic materials the king had acquired at this time, since the very diversity of atlases published before 1740 listed among the royal library's 80,000 volumes (all of which were sent to Brazil in 1808 following the transfer of the Court to Rio de Janeiro) suggest that they were purchased during João V's reign. On the other hand, not everything in Portugal was sent to Brazil. Many of the French and Dutch atlases that were part of the former royal libraries of Mafra and the Ajuda Palace likely date from the same period, not to mention the atlases at the Biblioteca Nacional de Portugal, remained in Portugal.

Alongside these collections, other groups sponsored or supported the collection of cartographic materials.

These included the high aristocracy, such as the marquesses of Abrantes, Fronteira, and Castelo Melhor; the erudite, such as the bishop Frei Manuel do Cenáculo Villas Boas and Diogo Barbosa Machado (whose collection is in the Biblioteca Nacional, Rio de Janeiro); the religious orders, including Jesuits, Franciscans, and Oratorians; and scholarly and military institutions, such as the Academia Real de História Portuguesa and the army and navy.

Aside from representing wealth and prestige, these maps, atlases, and globes were collected for specific purposes: to construct discourses of power, to discuss geopolitics, to help define jurisdictional spaces, and to plan warfare on land and at sea. During the reign of José I (1750–77), the role of maps as instruments of power was reinforced by the action of the king's favorite, Sebastião José de Carvalho e Melo, marquês de Pombal. During this period, cartographers, engineers, and architects produced and collected manuscript maps on local and regional scales to respond to state reforms or to exceptional circumstances, such as the reconstruction of Lisbon following the 1755 earthquake. In South America, boundary disputes with France and most importantly Spain following the Treaties of Utrecht (1713–15) fostered the collection of manuscript and printed maps of the contested regions, whether through the actions of Portuguese diplomats or the court itself. In the case of Brazil, it was necessary to produce maps of various regions and collect geographical information from explorers and backwoodsmen (*sertanistas*). The “Mapa dos confins do Brazil” (1749) (see fig. 447) was used as the basis of the 1750 Treaty of Madrid. The map itself was derived from several different manuscript and printed maps of varied scales, sizes, and purposes: from Charles-Marie de La Condamine's map of the Amazon River basin to written narratives and sketches by explorers from Mato Grosso.

The number of administrative map collections increased significantly following the Treaty of El Pardo (1761), which nullified the Treaty of Madrid (1750), especially those collections belonging to high-level Crown administrators, some of whom had served as governors of Brazilian captaincies. The relationship between colonial power (military, administrative, and economic) and map collecting in Portugal and Brazil is clearly found in the collections of Luís António de Sousa Botelho Mourão, fourth morgado de Mateus and governor of the São Paulo captaincy (1765–75); Luís Pinto de Sousa Coutinho, visconde de Balsemão, who governed Mato Grosso (1767–72); and Luís de Albuquerque de Melo Pereira e Cáceres, also governor of the captaincy of Mato Grosso and Cuiabá (1772–89). These collections consist almost exclusively of manuscript maps, either

originals or copies, in which the represented territories correspond to the captaincies of Brazil that the collectors governed. The one exception is the collection of the visconde de Balsemão, held today at the Biblioteca Pública Municipal do Porto, which contains many important printed maps and atlases relating to Europe and North America as well as maps of the northern, southern, and western portions of Brazil. The breadth of the visconde de Balsemão's collection likely derives from his later positions both as Portuguese ambassador to London and as minister of foreign affairs, not to mention the key role he played in preparing the new boundary treaty with Spain in 1777.

These collections of loose maps often included manuscript memoirs, journals, and route descriptions, as well as notes on boundary demarcations and astronomical observations. Often, they were part of important libraries, which frequently included many atlases. At the very end of the eighteenth century, three institutions were created in Lisbon that were designed, among other purposes, to consolidate, study, and safeguard cartographic collections: the Academia Real das Ciências (1779), the Real Biblioteca Pública da Corte (1796), and the Sociedade Real Marítima, Militar e Geográfica (1798). During the period of the Portuguese royal family's extended stay in Brazil (1808–21) and the occupation of Portugal by French and British armies, many of the cartographic collections were dispersed, ending up in archives and libraries in Rio de Janeiro, Paris, and London.

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SEE ALSO: Map Trade: Portugal; Portugal

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**Map Collecting in Russia.** Map collecting in Russia in the eighteenth century consisted mainly of accumulation and archiving. In line with the general development of Russian cartography, the period may be subdivided into two phases. The first phase saw the general gathering together of cartographic production in the country and the second concerned more deliberate aggregation and archiving.

The defining feature of the first phase was its official nature. Mapping management was concentrated in central and local governing departments (*prikazy*), who were the main customers of map production. The cartographic documents of the first period were mostly manuscript geographical drawings (*chertëzhi*). This type of map-making was stimulated by the land surveying statutes of the Sobornoye Ulozhenye of 1649 and continued from 1650 to 1690. As a consequence, hundreds of such map sketches were accumulated in the *prikazy*: the privy council of *Prikaz taynykh del*; the military *Razriyadnyy prikaz*; the foreign affairs *Posol'skiy prikaz*; the interior *Pomestnyy prikaz*; and the Siberian *Sibirskyy prikaz*. Sketchy descriptions of these collections were cited in inventories of maps (*rospisi chertëzham*) made in this period; six such inventories are known. Researchers have analyzed in detail these *rospisi* (Bagrow 1917, 1975; Kusov 1989, 2003; Postnikov 1985, 1996) and established the loss of the majority of maps mentioned. Two special catalogs describe more than a thousand surviving *chertëzhi* and cite eighteen archives, libraries, and museums where they are now kept (Kusov 1993; 2007, esp. table 2).

The works of Semën Ul'yanovich Remezov reflected the original national cartographic traditions but also symbolized the transition of Russian cartography into a new epoch. There are some indirect references that indicate Remezov collected *chertëzhi* during his life. Those who have studied his life and activities have paid scant attention to this part of his work. Remezov indicated in the prefaces to his atlases (1697–1711; 1701; 1702–30) that he had used earlier maps while compiling his new maps (fig. 455), but his collection has not survived.

In about 1700, a new stage of Russian political and economic activity began. More advanced cartography was an essential requirement for the growth of exploration, significant territorial expansion, creation of a new navy and army, and development of industry and trade. As in the seventeenth century, Russian cartography in the eighteenth century proceeded mainly under central government management, and the executive authorities enforced special control over map compiling, storage, and use.

The senate and the *Akademiya nauk* organized general and particular (regional) instrumental surveys of the country as a whole. Officers in the service of the quarter-

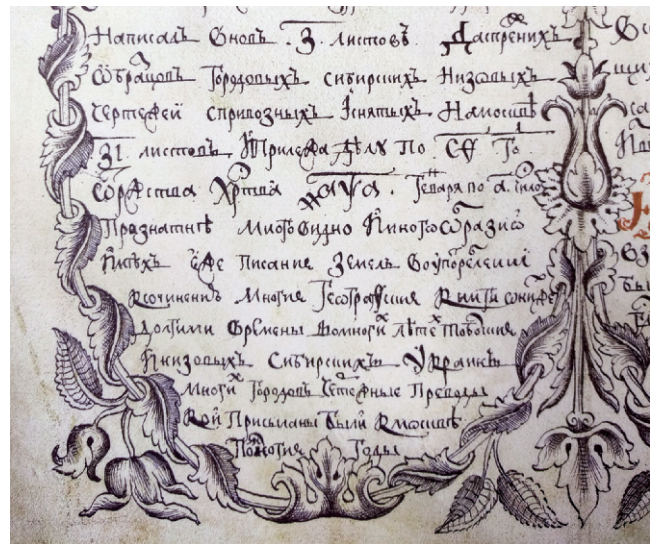


FIG. 455. REMEZOV'S SOURCES FOR COMPILING "CHERTËZHNAJA KNIGA." In this manuscript fragment of the preface to his "Chertëzhnaya kniga Sibiri" ([Tobolsk], 1701), Remezov referred to earlier map sketches he had used for compiling the atlas.

Size of the entire original: 54 × 38 cm; size of detail: ca. 15 × 18 cm. Image courtesy of the Rossiyskaya gosudarstvennaya biblioteka, Moscow (Manuscript Department, Ф.246.365).

master general and the General Staff compiled maps for the army. The *Admiralteystv kollegiya* charted the seas and rivers. The drawing office of the senate's land survey expedition, *Mezhevaya ekspeditsiya*, carried out general land surveying. By the end of the century, Russian cartography reached a European level of development, and the majority of significant cartographic documents created were printed, or otherwise replicated, and stored in archives, libraries, and museums. The most significant official collections were described in bibliographic works (Anonymous 1748; Gnucheva 1946; Kolgushkin 1958; Lemus 1961).

This map collecting was largely an official enterprise, but it is important to note several examples of early private collecting. Yakov Vilimovich Bryus, a statesman and the supervisor of mapping in the beginning of the eighteenth century, possessed a significant cartographic collection. He collected maps compiled in Russia, the majority of them created or revised under his supervision before printing. He also tried to purchase the best contemporary maps of Russia and other countries. In his will, his collection of 146 maps and 8 atlases was left to the *Geograficheskiy departament* of the *Akademiya nauk* in St. Petersburg. Peter I possessed a similar, valuable collection of maps that he gifted to the *Akademiya nauk* at his death. Joseph-Nicolas Delisle collected maps

in the Akademiya nauk during his stay in Russia, returning to Paris with more than 300 clandestinely removed maps and related documents (Fel' 1960, 180–83).

By the middle of the century, private map collecting had also developed within a framework of antiquarianism. Collecting valuable articles was common among many aristocratic families, and it became routine during the reign of Catherine II (r. 1761–96). The most famous owners of the private map collections were Nikolay Petrovich Rumyantsev, Aleksey Ivanovich Musin-Pushkin, and Vasilii Stepanovich Sopikov. Also well known were the collections accumulated at the beginning of the nineteenth century of Pëtr Mikhailovich Volkonskiy, Aleksandr Ivanovich Chernyshëv, Aleksandr Dmitriyevich Chertkov, Pëtr Yakovlevich Chaadayev, Pavel Mikhailovich Stroyev, Aleksandr Filippovich Smirdin, Avraam Sergeyevich Norov, Mikhail Petrovich Pogodin, and Sergey Dmitriyevich Poltoratskiy. But only the collection of Aleksandr Yakovlevich Lobanov-Rostovskiy, numbering 2,269 items, comprised only maps, and the General Staff eventually inherited it.

Rumyantsev's collection, which became the foundation of the state library, Rossiyskaya gosudarstvennaya biblioteka, Moscow, included more than five hundred cartographic works, with Remezov's "Chertëzhnaya kniga Sibiri" (1701) among them. The Musin-Pushkin collection included the "Kniga Bol'shomu chertëzhu" (1627), a manuscript text containing the topographic description of a strategic map of the Russian state, which was lost in the Moscow fire of 1812 (Goldenberg 2007, 1859, 1864–66). Mainly military and topographic maps were in the collections of Volkonskiy and Chernyshëv, most of which are now dispersed among numerous archives, libraries, and museums (Bokachëv 1890).

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SEE ALSO: Map Trade: Russia; Russia

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**Map Collecting in Spain.** From the Middle Ages, secular and religious nobility were the traditional owners of cartographic works in Spain. Spanish editions of Abraham Ortelius's *Theatrum orbis terrarum* (1588–1612), Johannes Janssonius's *Atlas novus* (1653–66), Joan Blaeu's *Atlas maior* (1659–72), and the lists of subscribers to works such as the Robert de Vaugondy family's *Atlas universal* (1757) (Pedley 1979) bear witness to a continuous demand, even though Spain lacked an indigenous cartographic industry. In addition to the cartographic patrimony treasured by the nobility, there is the patrimony of secular and religious institutions. In the vanguard was the Colegio Imperial, run by the Jesuits and incorporating the collections of the Academia de Matemáticas, founded in Madrid in 1582 by Felipe II, and the archives of the official cosmographer. Educational centers for missionary orders also accumulated considerable cartographic collections in their libraries (García López and Ortega Lamadrid 1960). Among the secular centers, universities stand out, especially those with the greatest reputations, such as Salamanca and Valencia. The enlightened spirit of the time encouraged the creation throughout the country of different secular associations and academies, from private groups such as the Sociedades de Amigos del País (1774) to official organizations such as the Gabinete Geográfico (1795) attached to the secretary of state. The evidence for the existence of private collections is scarce. The collection of Vincencio Juan de Lastanosa (fig. 456) (Hernando 2007) and those of some enlightened individuals, such as Jorge Juan (Navarro Mallebrera and Navarro Escolano 1987), have been studied.

The rhetorical variety that geographic knowledge employs explains the heterogeneous forms of cartography collected. Atlases were the most valued jewels acquired



FIG. 456. FIRST PAGE OF MANUSCRIPT CATALOG LISTING THE MAPS OF THE VINCENCIO JUAN DE LASTANOSA COLLECTION.

Image courtesy of Andrea Davis Kronlund/Kungliga biblioteket, Stockholm (ms. U-379, f. 96r).

outside Spain for the libraries of the nobility, convents, and universities. Francisco de Aefferden's *El atlas abreviado* (1696), illustrated with forty-two maps, is the first geography written in Spanish, but not until the second half of the eighteenth century did Spanish authors publish their first atlases (Hernando 2005). Examination of modern cartobibliographies reveals the publication of nautical and urban atlases in Spanish. Private library inventories from this period also note the existence of spheres and globes, which were considered mathematical instruments, but their presence in collections was unusual (Hernando 2014).

Regarding sheet maps not in atlases, such as wall maps or large regional maps, the wills and testaments of scholars and collectors often reveal ownership of a particular map, often depicting the region in which the deceased resided. Such is the case in libraries of some academicians, professors, and military men. The limited familiarity of the appraiser with cartographic collections relegated maps to the bottom of such inventories, where they received much less descriptive attention than

that given to books. Eighteenth-century appraisals reflect commercial criteria and social esteem quite different from that which prevails today (Patier 1992).

Practical motives or future uses of the information conveyed by maps justified the formation of a collection; less consideration was given to map collecting as an intellectual expression, an artistic contribution, or a symbolic image. A request for an atlas in a letter, or the urgent demand for some cartographic copies, can reflect the political, military, or administrative context of a collection's use. Although we lack significant records or accounts, we assume a similar use of collections in religious or commercial contexts.

Literary and graphic silences concerning rooms where maps hung on walls are quite telling. Although these lacunae may be construed as evidence for low esteem or limited familiarity with cartography, the publication of wall maps of Spain, Catalonia, Valencia, and Aragon prove the existence of a considerable demand.

The increased number of professionals specializing in cartographic production facilitated both the means and the growing taste for map collecting. The geographer Tomás López was able to gather a splendid collection (Patier 1992). Nonetheless, recent exhibits as well as inventories of library collections and the study of printmaking in Spain demonstrate that religious imagery dominated the market; engravings with scientific themes, including maps, do not stand out (Carrete Parrondo, Fernández Delgado, and Vega González 1982).

It is only in the nineteenth century that we find the first great collectors and discover true cartographic jewels in their collections. In the eighteenth century, the examples gathered seem modest: an inherited library with some atlases, an antique portolan chart guarded at a convent, or documents from an archive, and, except for atlases, their presence is not worthy of special consideration. The preservation of maps was not easy, and the most up-to-date versions needed to be imported, involving difficulties of time, cost, and accessibility.

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SEE ALSO: Map Trade: Spain; Spain

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**Map Collecting in Sweden-Finland.** Map collecting in Sweden-Finland in the period 1650–1800 was rarely a hobby, even for antiquarian reasons, but was mainly connected with professional activities. Maps were usually collected for reference and practical use.

After the Thirty Years’ War (1618–48), Sweden emerged as a great European military power. This meant that an increasing amount of war booty, including books and maps from libraries in Denmark, Germany, Poland, and Moravia, came to Kungliga biblioteket, to the universities and gymnasiums, and to some extent to military leaders themselves. It also meant increased resources for the Swedish nobility to purchase material in the expanding book market, especially in the Netherlands. This phenomenon continued until the death of Karl XII in 1718 and the end of Sweden’s preeminent position; nevertheless collection building, especially by private individuals, continued and even expanded, financed by landownership, trade, and industry. Some of the Finnish sources for this aspect of collecting are retrievable through the Henrik online database of books and their owners to 1809 in Finland, culled from estate inventories and auction records.

The principal sheet map collections in this period were those assembled within map producing bodies like Lantmäteriet (land survey), founded in 1628, the Fortifikationen (fortification administration), founded in 1635, Finska Rekognoseringsverket (Finnish reconnaissance authority), established 1776, or the hydrographical survey, going back to 1680, but not established as an independent agency until 1809. The Fortifikationen and the hydrographical survey would also collect foreign maps and atlases, when their tasks so demanded.

Although Kungliga biblioteket was largely destroyed in 1697 in the palace fire, King Karl XI’s luxury edition of Joan Blaeu’s *Atlas maior* (1662) survived. In the following century the collections were restored by pur-

chase, legal deposit (beginning in 1661), and donations, sometimes of antiquarian prestige objects.

Uppsala universitetsbibliotek, founded in 1620, was enriched by donations from the king and nobility, e.g., by Magnus Gabriel De la Gardie, Sweden’s greatest book collector in the seventeenth century, or his contemporary Clas Rålamb, who in 1656 was in possession of large parts of the confiscated library of the Jesuit College at Poznań, Poland, including a dozen atlases (Kungliga biblioteket, MSS., catalog Cod. Rål. fol. 178a). Later additions came from university scholars and foreign travelers. The main contribution was 4,500 maps in 1811 from the collections of Carl David Gyllenborg, a frequent buyer at auctions in Stockholm (Taube 1921; Davidsson 1956).

Lund University, founded in 1666 to consolidate Swedish rule in the recently conquered Skåne region, received a royal donation in 1684 including important cartographic works by Jacob Ziegler, Sebastian Münster, Abraham Ortelius, Gerardus Mercator, Willem and Joan Blaeu, Georg Braun and Frans Hogenberg, and Giovanni Antonio Magini. They had belonged to the history professor and royal councillor Emund Gripenhielm, which explains their antiquarian flavor (Richter 1959, 69–70).

In Finland, the Turku (Åbo) academy was founded in 1640. It inherited the library of the gymnasium founded in 1630, which consisted of twenty-one volumes, among them works of Münster and Peter Apian and two globes. The academy later acquired remarkable works ranging from Ptolemy to Pierre Louis Moreau de Maupertuis. After a fire in 1827, the academy moved and later became Helsinki University (Vallinkoski 1948–75). The library of the gymnasium of Viipuri (Viborg), founded in 1641, held maps from the sixteenth century. In 1735 a three-volume Blaeu atlas was bought and also three globes, probably for education and reference (Nohrström 1927).

In Sweden proper, around 1700 there were ten gymnasiums, the oldest being Västerås, founded in 1623. Their libraries usually contained some atlases, maps, and globes. Göteborg (Gothenburg) gymnasium, for example, in 1778 possessed some twenty books in geography and cosmography, the oldest being those of Apian, Münster, and Heinrich Bünting, but only three atlases, including the *Atlas historique* (1705–20) probably by Zacharias Châtelain, the *Atlas maritimus & commercialis* (1728), and work by Johann Baptist Homann. Printed catalogs for the gymnasium libraries of Göteborg (1778), Skara (1830), and Kalmar (1876) are in Kungliga biblioteket. The private gymnasium on Vingsö Island, founded in 1636 by statesman Per Brahe, held one work of Ortelius, one of Mercator, two globes (one celestial, one terrestrial), and seven mounted maps; the catalog is in the Växjö stadsbibliotek (MS. fol. 78).

There were also private collectors and collections. The best preserved private library from seventeenth-century Sweden is at Skokloster Palace, comprising the collections of Field Marshal and Admiral Carl Gustaf Wrangel and the noble families of Brahe, Bielke, and Scheffer. Wrangel was the first in Sweden to buy books through newspaper advertisements. The Wrangel collection contains several Blaeu and Janssonius atlases, works by Petrus Bertius and Georg Horn, as well as Robert Dudley's *Arcano del mare* (1647), whereas the Brahe collection has a wider range, including works by Jacob Aertsz. Colom, Nicolas de Fer, Pieter Goos, Jan van Loon, and Lucas Jansz. Waghenaer, as well as city views, wall maps, and globes. The largest collection is that of Carl Gustaf Bielke, one of the leading book collectors of his age, who stayed in contact with Amsterdam publisher François l'Honoré for a decade (Lindberg 1976).

The most conspicuous collector of the eighteenth century, Carl Gustaf Tessin (fig. 457), a great contributor



FIG. 457. UNDATED PORTRAIT OF COUNT CARL GUSTAF TESSIN BY JACQUES-ANDRÉ-JOSEPH AVED. Count Tessin, surrounded by his books, coins, and art, gives the globe a prominent place in his collection. Oil on canvas. Size of the original: 149 × 116 cm. © Nationalmuseum, Stockholm/Bridgeman Images.

to Kungliga biblioteket, owned some fifty atlases and portfolios, including, as recorded in 1742, the “Great Paris map glued to cloth with a mechanism to pull it up and down” (Kungliga biblioteket MS. S.12, p. 113r) but nothing by Ortelius or Mercator (Kungliga biblioteket, MSS., catalog Cod. U.401; original in Universitetsbibliotek, Lund, MS De la Gardie IX:6). Book collecting, including maps, in Sweden and Finland during the eighteenth century spread beyond the ranks of the nobility to civil servants, doctors, businessmen, and urban bourgeoisie. Through book auction records and estate inventories in Stockholm, we have evidence for thirty collections with more than twenty maps, with owners including King Adolf Fredrik, art professor Pehr Floding, physics professor Johan Carl Wilcke, and town judge Eric H. Ström. With their increasing domestic production and importation, sheet maps came to predominate in collections rather than the great atlases.

In Finland, our knowledge of private book collections is scanty. Among map owners were Bishop Jacob Haartman in Turku and history professor Henrik Gabriel Portman, a leading figure in Finland's cultural history, with six atlases and twenty-three maps. Land surveyor Gustaf Adolph Tuderus at Tampere (Tammerfors), owned a book collection of some two thousand titles, but only one atlas and fifty-two maps (Mäkinen 2005). The library at Äminne manor (catalog in the Kansalliskirjasto, Helsinki), was owned by courtier and diplomat Gustaf Mauritz Armfelt. It contained twenty maps acquired up to 1809, including Austrian, British, French, German, Russian, and Swedish examples.

In Sweden, by 1800, some clearly antiquarian items were being purchased, e.g., the library of bibliographer Carl Gustaf Warmholtz, auctioned in 1799, including ten atlases beginning with Ptolemy's *Geography* (1513). Prices were relatively high due to the presence of genuine collectors such as Count Gyldenborg. This is evident at the Engsä auction in 1803 (Carl Fredrik Piper family), where the prices paid for Blaeu's *Atlas maior* and an Ortelius atlas signal the arrival of antiquarian map collecting.

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SEE ALSO: Map Trade: Sweden-Finland; Sweden-Finland

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**Map Collecting in Switzerland.** Until the end of the eighteenth century, government activity in Switzerland, including the formation of official map collections, was organized by individual cantons. Official cartography was a function of the military and of the expansion of civil administration. Although largely undertaken with private support and at individual expense, many of the resulting maps and plans were kept—along with other official documents—at government offices and state archives to which only a limited circle of people had access. Significant manuscript map collections from the seventeenth and eighteenth centuries can now be found within cantonal archives, such as those in Zurich and Bern. Engineers and officers also compiled private collections, which in some instances have ended up in public collections.

A growing interest in publicly obtainable maps gave rise to an increasing number of private collections during the seventeenth century. The rise of widespread formal education in the eighteenth century led to further interest in cartographic knowledge by the Swiss public, which in turn led to cheaper maps for a broader range of customers. Such interest was sustained by the Enlightenment's concerns for the natural sciences and the new cartographic endeavors that resulted, such as precise baseline measurements and the first altitude measurements. In addition, maps were used as a basis for scientific research. Bern geographer and bibliophile Samuel Engel repeatedly cited the maps he had consulted as sources for his comprehensive studies of the longitudinal extent of Asia. Engel was a close relative of the renowned Albrecht von Haller and was his successor as chief librarian in Bern (Klöti 1994, 310).

As of 1700, one can discern efforts to definitively describe map holdings and reproductions in catalogs or bibliographies, and such cartobibliographic work intensified in the second half of the eighteenth century. Bern historian Gottlieb Emanuel von Haller, son of Albrecht, assembled a large map collection and compiled an index of maps of Switzerland and its parts in 1766; it was published by Anton Friedrich Büsching (Haller 1771). In a later work, Haller listed a number of mostly Swiss collections of maps and views of Switzerland. He reported that "the most outstanding [collections] I know are in Zurich, collected by the City Councillor [Johannes] Leu and Mr. Leonhard Ziegler; at the public library in Bern and also with the *Stiftschaffner* [administrator of the collegiate chapter of Saint Vincent] Joh[ann] Fried[rich von] Ryhiner; in Basel, with Pastor [Hiero-

nymus] Falkeisen and Mr. J[ohan] Rud[olf] Frey of the High Council and *Rechenrath* [finance council] and at the public library there" (Haller 1785–88, 1:2; Höhener 1995, 57–60; 2010b, 49–50).

The collection assembled by the Bern statesman and geographer Johann Friedrich von Ryhiner, donated to the Stadtbibliothek of Bern in 1867, is preeminent among the private map collections of eighteenth-century Switzerland. For Ryhiner, maps were an aid for the further development of geographic science. He acquired about 16,500 maps, topographical views, and plans, which he bound in 501 regionally and thematically organized volumes: the collection covers Switzerland, Europe, and the rest of the world and also includes celestial and world maps, historical maps, and miscellaneous others (Klöti 1994, 370–76; 2003, 1:11, 4:1,535–44). Ryhiner also wrote a detailed set of instructions, which remain unpublished, about acquiring, organizing, and cataloging a map collection (Klöti 1994, 288–324, 359–61). François Jacques Durand described Ryhiner's collection in glowing terms in 1795: "It would be difficult to find a more complete collection, and geographic maps so carefully chosen, than that of Mr. Ryhiner, *Councillor* of the Republic [of Bern]. It encompasses all of the rarest old maps, and all those of the most celebrated modern geographers" (quoted in Klöti 1994, 320). According to map historian Peter H. Meurer, in its significance and size the collection is comparable to the Philipp von Stosch collection in Vienna and the collection of Bernard Paul Moll in Brno (Klöti 1994, 322–23).

The Zurich collectors were Councillor Johannes Leu, son of Mayor Hans Jakob Leu, and paper miller and bookseller Leonhard Ziegler. After Johannes Leu's death, his collection was partially subsumed into the Ziegler collection. An index of 300 items in the Ziegler collection was published in 1780, while an unpublished catalog listed 907 maps and views. Ziegler's son donated the map collection to the Stadtbibliothek in 1854 (Höhener 2010a, 172; 2010b, 50). Also in Zurich, a group of military officers founded the Mathematisch-Militärische Gesellschaft in 1765; with the formation of its library in 1769, the society assembled an important map collection. The society's collection of 379 maps eventually came into the possession of Zurich's Stadtbibliothek in 1897 (Höhener 2010a, 172).

The Universitätsbibliothek in Basel also possessed a significant map collection in the eighteenth century, comprising some two hundred individual sheets, atlases, and books of geography and cosmography. In 1884 the library would acquire the significant collections of ecclesiastical historical documents and maps of Switzerland compiled by the *Antistes* (presbyter) Hieronymus Falkeisen (Hunger 2010, 66).

SEE ALSO: Map Trade: Switzerland; Switzerland

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### Map Trade.

ENLIGHTENMENT  
DENMARK  
FRANCE  
GERMAN STATES  
GREAT BRITAIN  
BRITISH AMERICA  
ITALIAN STATES  
NETHERLANDS  
POLAND  
PORTUGAL  
RUSSIA  
SPAIN  
SWEDEN-FINLAND  
SWITZERLAND

*Map Trade in the Enlightenment.* The map trade in eighteenth-century Europe concerned maps, charts, plans, and globes that were printed for sale. The stock of the trade comprised, in general, the products of geographical, urban, celestial, marine, and topographical mapping. Other modes of mapping might have gener-

ated printed maps, but not for commercial purposes. Maps of geodetic triangulations, if printed, accompanied published books or pamphlets that explained their importance and use. Certain maps were printed if a wider distribution was desired than manuscript copies could provide, even if to a restricted audience, or if consistency between images was important. Such conditions applied, for example, to certain land grant maps in British North America (Edney 2011) and to the *waterschappen* maps in the Netherlands, printed for the use of polder officials (Kain and Baigent 1992, 18–19; Koeman and Van Egmond 2007, 1267–68). Boundary maps could also be printed for restricted distribution, as in the case of Thomas Jefferys's maps of Nova Scotia for the boundary commission of 1750 (Pedley 1998). Thus, the act of printing should not be confused with publication. That was the task of the map trade, concerned with creating maps for commercial purposes, generally printing them from copperplates, and selling them for a profit within the broader marketplace for books and other printed goods that itself was part of a larger marketplace for luxury consumables.

**PARTICIPANTS** Participants in the trade therefore comprised three overlapping groups: creators, engravers, and distributors. The creators included the geographers, surveyors, and map editors who compiled cartographic material. The engravers inscribed the material on the copperplate; they were often identified on the maps themselves and are sometimes well known to historians. These roles were not always distinct: it was not unusual for engravers to learn the process of map compilation, as with the Homann Heirs or the members of the firm of Covens & Mortier, or for geographers to learn the craft of engraving as, for example, Tomás López, Samuel Mikoviny, and Giovanni Maria Cassini. Moreover, some institutions served as both creators and engravers. The distributors were usually mapsellers or printsellers or members of the book trade; they paid for the printing and publication of the map and housed the stock. Creators could also be distributors (e.g., Jean-Baptiste Bourguignon d'Anville in Paris), as could engravers (e.g., Thomas Jefferys in London). Other distributors were more strictly traders within the general marketplace, including provincial vendors who bought wholesale from the major production centers and sold retail to their local markets; these distributors are generally identifiable only through catalogs, newspaper advertisements, and related documentation. Any participant in this distributed network could undertake the publication of a map, whether individually or in concert with others, if they had the money to underwrite its creation. Ultimately, control of the trade rested with the owners of the copperplates from which the maps were printed,

for the plates represented capital investment and intellectual property.

Although anyone could make a map for publication, the map trade relied heavily on geographers and surveyors for the raw material of the printed map. Geographers compiled maps at various scales by analyzing and rendering both graphic and literary sources into map form and by editing existing maps with information based on more recent observations and descriptions. On the printed map, the geographer or editor might remain anonymous, particularly on maps copied or revised from previous material. With sufficient funds to serve as capital, a geographer could be his own publisher, supervising the engraving of his work and maintaining control of the copperplates, selling the maps from his own address and keeping the profits. In countries or regions where state support or local patronage for geographers was absent or where map or book publishers controlled the capital and resources of printing, the incidence of geographers as publishers was rare. In general, geographers were also teachers of mathematics, history, and geography and in this context wrote on geographical and historical topics that led to specific map publishing projects. In France, the most eminent self-publishing geographers were the Delisle family, Philippe Buache and his successors, d'Anville, and the Robert de Vaugondy family. Their printed maps were often accompanied by cartographic memoirs explaining the sources and process of compilation. Similarly, geographers like López in Spain and Vincenzo Coronelli and Giovanni Antonio Rizzi Zannoni in Italy controlled their own map production.

In the Ottoman empire in the late seventeenth century, Evliyā Çelebi described the mapmakers among the guildsmen in Istanbul. He specifically mentioned eight shops where fifteen mapmakers were employed, well versed in several languages, especially Latin, who sold their works to seamen (Özdemir 2008, 138–42).

Military engineers and private surveyors also provided the map trade with raw material. In Great Britain, engineers controlled their own work and might sell it to map publishers, as in the case of John Montresor to Mary Ann Rocque or Samuel Holland to Jefferys (Pedley 2005, 130–31). In France, some engineers became map publishers, such as Jean de Beaurain and his son Jean-Baptiste Jacques de Beaurain, Georges-Louis Le Rouge, and Roch-Joseph Julien. The work of military engineers was particularly valuable for the production of theater of war maps and for commemorative battle maps, as for example the maps published by Eugène Henry Fricx in the Southern Netherlands; Fricx compiled the work of military engineers from both French and Austrian sides during the War of the Spanish Succession (1701–14). Private surveyors provided the basis for much of the county mapping in Great Britain.

Institutions also participated in commercial cartography as map publishers. Private trading companies such as the East India Company, the Compagnie des Indes, and the Dutch Verenigde Oost-Indische Compagnie (VOC) employed hydrographers (Alexander Dalrymple, Jean-Baptiste-Nicolas-Denis d'Après de Manneville, and the Van Keulen family, respectively) to produce charts for sale, sometimes in atlas form (d'Après de Manneville's *Le Neptune oriental*; Van Keulen's *De Nieuwe groote lichtende Zee-Fakkel*). France's Académie des sciences provided astronomical observations used in the compilation of both geographical maps and larger-scale topographical maps. The French navy's Dépôt de la Marine issued two major atlases for commercial sale during the eighteenth century. Similarly, the Akademiya nauk in Russia supported the publication of the *Atlas Rossiyskoy* (1745). The Calcografia Camerale in Rome included maps of various sorts in its publication program. Portugal's Academia Real de História Portuguesa, Real Academia das Ciências de Lisboa, and Sociedade Real Marítima published maps both separately and to accompany the printed works of these institutions. Sweden's Kungliga Vetenskapsakademien promoted the publication of globes, and the Kongelige Danske Videnskabernes Selskab supervised, executed, and published the large-scale survey of Denmark.

The role of engravers in the map trade cannot be overemphasized. Not only were their skills integral to the transfer of the manuscript map to copperplate, many also learned how to compile maps from other cartographic sources or how to copy maps skillfully. The skills required for engraving maps included the ability to engrave the meridians and the parallels of the projection accurately, together with the geographic outlines of coasts, borders, and rivers, to render topography with sensitivity, and to engrave italic and Roman letters legibly and clearly. In several regions, engravers dominated the map trade (Netherlands, German States, Great Britain) because they owned and controlled the copperplates from which maps were printed. In Great Britain, engravers of maps often used the title "geographer," and they even received royal warrants under that title, yet in this context the title referred not to scholarly contributions to the study of geography but to their work as tradesmen who possessed a diverse stock of maps that could meet their patrons' needs.

**LIMITATIONS** Three major impediments to the map trade were: national policies of secrecy and security, which viewed maps as sensitive information to be limited in accessibility; the scarcity of a skilled workforce, especially engravers; and the capital required to meet the large expense of engraving and printing.

National policies of secrecy particularly affected the

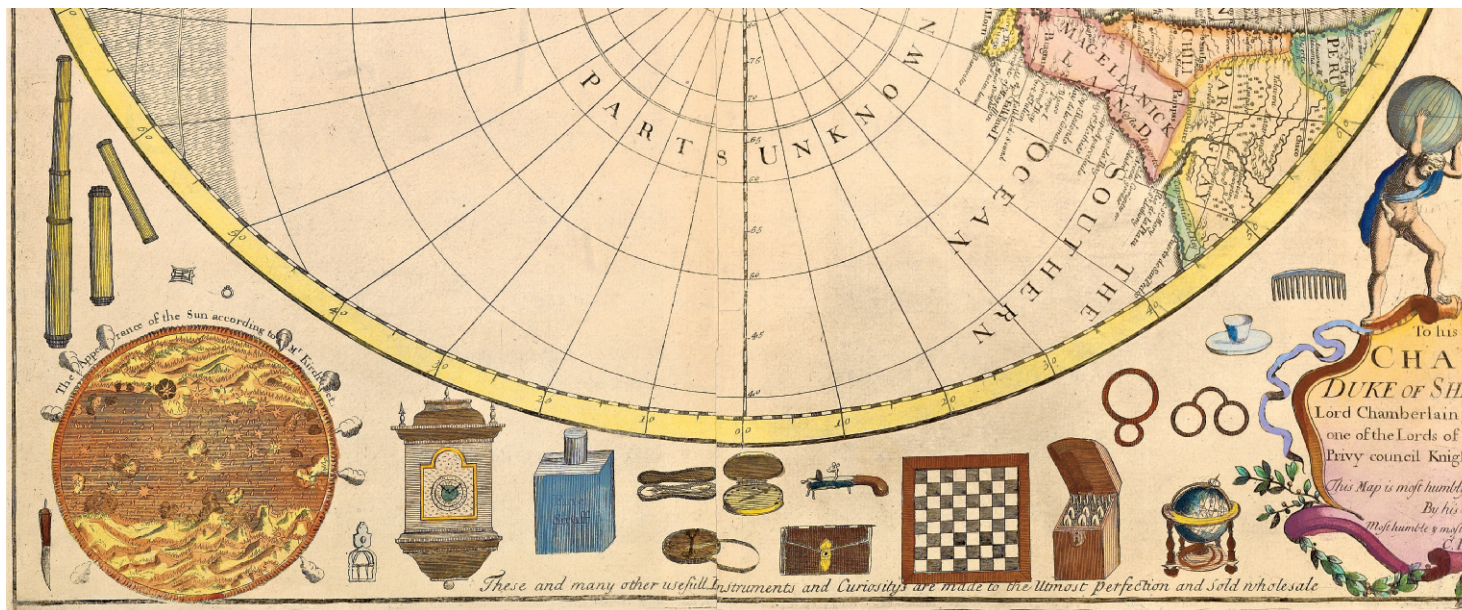


FIG. 458. DETAIL FROM A WORLD MAP SHOWING ICONS OF LUXURY COMMODITIES SOLD BY GEORGE WILDEY IN LONDON. Willdey had acquired the copperplates for a series of two-sheet maps, including this map, *A New and Correct Map of the World* (1714), from Charles Price, who had kept them as his share of his partnership with John Senex, which had ended in 1710. Willdey treated maps as just one more commodity and used them, as here, to advertise the various mathematical instruments and other

commodities—combs, spectacles, snuff boxes, firearms, gameboards—all “made to the utmost perfection and sold wholesale or retail” by Willdey at his “Great Toy Shop” near St. Paul’s Cathedral.

Size of the entire original: 62 × 99 cm; size of detail: ca. 20.5 × 99.0 cm. Image courtesy of the Osher Map Library and Smith Center for Cartographic Education at the University of Southern Maine, Portland (OS-1714-5).

control of military and hydrographic information. In the Iberian Peninsula (Spain and Portugal) and in Scandinavia (Sweden and Finland, Denmark and Norway), the old habit of viewing maps and charts as state secrets prevailed until the second half of the eighteenth century, keeping many cartographic documents in manuscript and inaccessible to both scholarly geographers and the wider public. Governments exerted control on the letterpress and copperplate print trade to varying degrees. In Russia, for example, all printing was done under government auspices until 1771, while in British America, no surveillance operated, though the region suffered from the lack of competent workers and capital.

Skilled copperplate engravers were vital for map production. In Great Britain, France, the Netherlands, and the German States, strong guild traditions of apprenticeship training of engravers helped the map trade to flourish. In other regions, including Portugal and British America, the dearth of capable engravers reduced the opportunity for map publication. In these regions, the book trade filled the gap by selling imported work. Toward the end of the century Spain, Russia, and some of the Baltic regions began to develop their own map production centers.

The final impediment to a flourishing trade was the lack of capital required for map engraving and printing. The costs of producing a manuscript map ready for engraving is difficult to ascertain from archival sources, but the high degree of plagiarism within the map trade suggests it was considerable. It is certain that the costs of engraving and printing, which are archivally more accessible, far outweighed the price of a single map. This led to a marked imbalance between the costs of production and potential revenue from sales.

**COSTS** Despite the steadily growing popularity of and interest in maps throughout our period, the map trade was a fragile and expensive business with no guarantee of success. Map production was costly both for the acquisition of content and the engraving of the copperplate. The time-consuming process of map compilation required mathematical, linguistic, and historical prowess for the necessary research and the ability to interpret field surveys and verbal descriptions. The work was rarely the result of one person’s labors, as the efforts of engineers, surveyors, topographers, travelers, and scientists often contributed material to a new map project, while trained designers and draftsmen were needed to



editor or publisher sought a copyright or privilege, registered with the government, for his work, but there were limitations in terms of a map's claim to originality. A basic question lay at the heart of any claim of infringement of cartographic privilege: can anyone own the idea of the geographic outline of the earth and its parts? The finding that the graphic interpretation of the earth and its contents was indeed an intellectual construction was difficult to prove without the cartographic memoir to explain the map's construction. Thus the ease and frequency with which one mapmaker could copy another continued to be an essential part of the map trade and the acquisition of stock.

After the production of a publishable manuscript map, engraving the copperplate accounted for a large portion of production costs. The plate itself was a significant acquisition, and paper, ink, and presswork took a further toll. Yet those costs paled in comparison to the labor-intensive engraving costs, which reflected the skill and time required to interpret and re-create the effect of the manuscript design, to handle the engraving burin, to control the etching acid, and to apply the drypoint for the desired relief effects of shading and hachuring. Lettering required precision and an aesthetic sense of space. The final cost of engraving could be as much as two hundred to two thousand times the price of one copy of the final printed map (Pedley 2005, 205–37; 2018, 102–4).

For some participants in the map trade, costs might be controlled by acquiring already engraved copperplates and, once again, adding a new imprint. The trade in copperplates seems generally to have been of older, worn copperplates, which could be retouched at a fraction of the cost of engraving a map from scratch. On occasion, bankrupt engravers would sell off their copperplates to pay off their debts or to raise new capital. Such practices emphasized the manner in which copperplates were intellectual properties, their value to be realized by the sale of impressions just like any other commodity (fig. 458).

Costs could also be controlled by employing inhouse engravers (Homann Heirs, the Artaria firm) or having the map compiler also do or supervise the engraving, as in the case of British map publishers such as Thomas Jefferys, William Faden, and Emanuel Bowen. In some regions, geographers learned to engrave. López was sent by the Spanish government to Paris to learn engraving with Guillaume Dheulland and geography with d'Anville. Geographer Samuel Mikoviny worked in his early years as an apprentice in the book and map publishing trade; his first engraved works were views of Nuremberg and Altdorf. In France, certain engravers, like Guillaume-Nicolas Delahaye, ran their own workshops of map engravers (Pedley 2005, 45). One of Rizzi Zannoni's achievements in Naples was to create

a veritable school of map engravers, exemplified in the work of Giuseppe Guerra and Aniello Cataneo on the *Atlante marittimo del Regno di Napoli* (1785–92) (see fig. 613), which was praised for rendering landscape as if it were the original manuscript: “the mountains are sketched out by etching and finished in drypoint with as much taste as the manuscript design being copied” (Bacler d'Albe 1803, 74).

Skimping on engraving meant publishers risked commercial failure, the quality of the map being only as good as its engraving. Contemporary critics remarked on the “look” of the map as much as on the content: Nicolas Lenglet du Fresnoy described a map by Gaspard Baillieul of the Electorat of Trèves as follows: “although good it is harshly and heavily engraved, which only spreads the confusion.” He compared the map of Tours by Delisle (“it is, like all the maps of this geographer, very confused and badly engraved”) to that of Jaillot (“clearer and more distinct and by consequence of better use”) (Lenglet du Fresnoy 1741–42, 3:492, 4:504).

The costs of design and engraving were rarely offset by sales alone; extra capital was required. Economic viability for the map trade was achieved in several ways. The infusion of needed capital through marriage or patronage could support the map producer (explored in the French context by Petto 2007, 2009). Marital support may be seen in the revival of fortune of the Homann firm when Anna Felicitas Franz, the widow of Jacob Heinrich Franz, and Barbara Dorothea Monath, daughter of Johann Georg Ebersberger, managed the company. Subscription offered another method of raising money in advance of production and ensured sales. Finally, a diversity of stock could secure business success by adding the sale of prints, views, globes, atlases comprising popular maps and less popular subjects, and other engraved materials such as trade cards, stationery, and standardized forms like bills of lading and certificates (fig. 459). Because maps were perceived as not only sources of geographical information but also as highly decorative objects, they were often advertised, like prints and views, as being suitable for framing and display.

Compared to the high cost of production, the price of a single map was low and relatively affordable when compared to living costs. In France and England, the average prices of a one-sheet folio-size map were one to two livres and one to two shillings, respectively. Such prices represented roughly a day's wage for a shop boy or a printer's apprentice. Finer paper, fabric, or the addition of coloring always raised the price. Atlases, especially well bound as folio-sized books, fell into the luxury zone, with prices as high as 120 livres or £20 to £30; in Sweden, the price of a French atlas at auction was as much as that of a horse. The format of maps also affected the price. They could be mounted for hang-



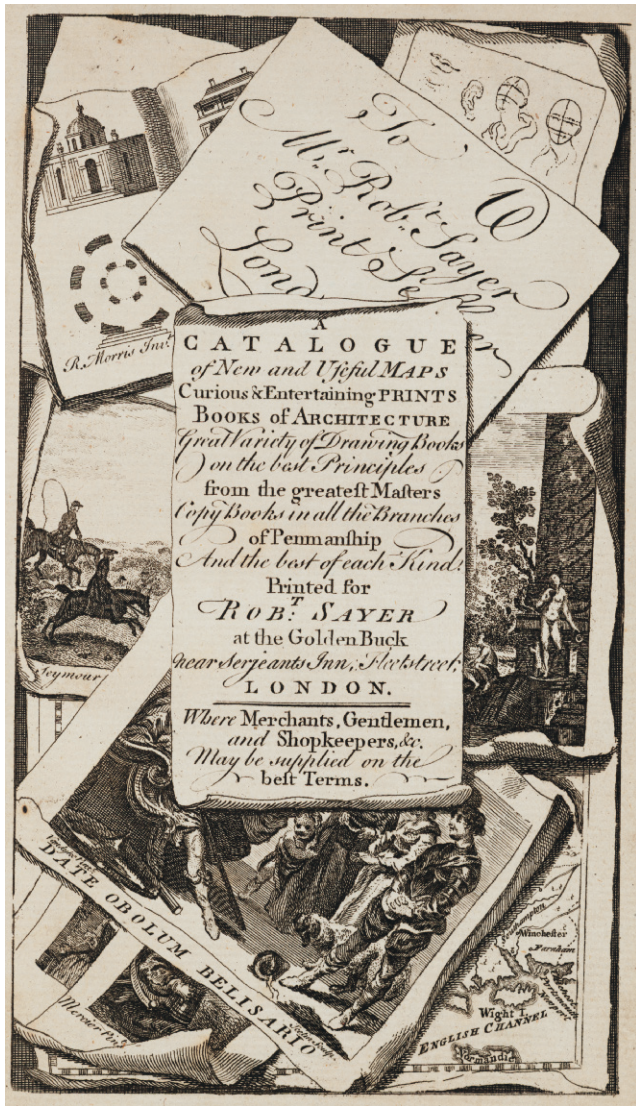


FIG. 459. FRONTISPIECE TO ROBERT SAYER'S NEW AND ENLARGED CATALOGUE FOR THE YEAR M.DCC. LXVI. OF NEW, USEFUL, AND CORRECT MAPS [1766]. With a similar title on a scroll surrounded by prints and maps, the frontispiece demonstrates both in word and image the variety of engraved material available at a successful map store in eighteenth-century London. Size of the original: ca. 18 × 10 cm. Image courtesy of the Lessing J. Rosenwald Collection, Library of Congress, Washington, D.C.

ing on the wall, glued to the frame of a screen, placed on rollers, framed, left in sheets in a cardboard folder, separated and glued onto a linen backing suitable for folding, and placed in a specially designed box or *étui* or rolled in a tube for ease of carrying, printed on other materials such as silk or linen, or pasted onto to wood or cardboard and cut in shapes as a jigsaw puzzle (see figs. 222 and 251).

**DISTRIBUTION** In general, the map trade disseminated its wares from the larger cities, with only one or two dominant in each region: Paris and Lyon; London; Rome and Venice; Amsterdam and Leiden; and Augsburg and Nuremberg. Maps were sold retail and wholesale from the address of the owner of the plates, whether the geographer or engraver or map editor (fig. 460). Resellers ranged from larger emporia in the main cities—in Paris, from at least 1752, Julien opened a map store from which he sold not only French maps but also those imported by his agents from Homann Heirs in Nuremberg, Gosse & Pinet in Amsterdam, Andrew Dury in London—to smaller outlets in the provinces (see fig. 472).

In the Baltic regions of Poland, Sweden-Finland, and Russia, government limitations on the book trade meant that very few active booksellers capitalized on the opportunities to import maps, and only a small market existed. A similar situation applied in the Mediterranean and the Iberian Peninsula, where the dearth of engraving talent meant that booksellers dominated the scant trade there, although distribution was geographically wide (see fig. 491). In Spain from the 1750s, the Real Academia de Bellas Artes de San Fernando in Madrid trained copperplate engravers and supported their further training in France and Italy in order to compete with foreign imports. Map consumption in regions where the local markets were weak operated through private channels: by networks of personal correspondence to booksell-

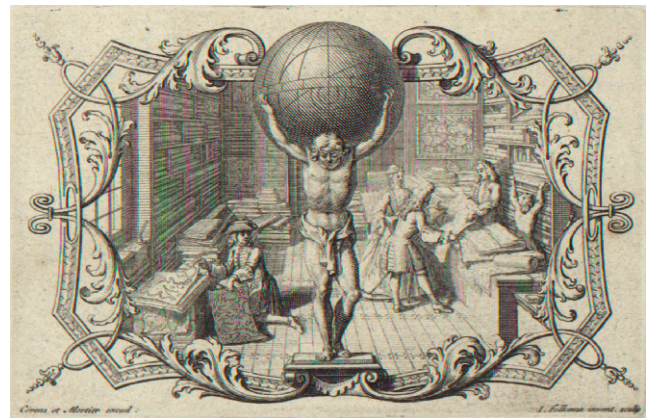


FIG. 460. INTERIOR OF THE COVENS & MORTIER MAP STORE, 1730. Detail from the title page of Guillaume Delisle, *Atlas nouveau, contenant toutes les parties du monde* (Amsterdam: Jean Covens & Corneille Mortier, 1730), a collection of maps copied from the work of Guillaume Delisle in Paris. The inset shows the interior of the map store as designed and engraved by Jacob Folkema. Size of the detail: 7.5 × 11.0 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (Atl 1730 L'Isle).

ers, mapsellers, engravers, and friends who supplied the desired map. Mapsellers' catalogs list agents in other European cities, and private correspondence reveals the thriving network of exchange across national borders, as witnessed by that of d'Anville with the diplomat Pierre Michel Hennin and Cardinal Domenico Silvio Passionei in Rome (Marcel 1904, 1908); Leonhard Euler in Berlin with Johann Kaspar Wettstein, the Swiss-born chaplain to the British royal family; and Huguenot writer Pierre Des Maizeaux with Dutch map publisher David Mortier (Van Egmond 2009, 197, 264).

The international distribution of maps aided the livelihood of many mapsellers, as may be discerned from the catalogs of Julien and of Covens & Mortier, the network of agents for the Homann firm, the subscription list for the Robert de Vaugondy *Atlas universel* (1757), and the letters to William Faden from European map dealers (Pedley 1979, 2000). The importation of maps into countries that did not have a robust book trade or the resources for local map production, such as British America, the Iberian Peninsula, or the Ottoman Empire, was the primary means of distributing geographic information to those remoter regions.

**DEMAND** The map trade was successful when the maps printed were sold quickly and widely (Van Egmond 2009, 189). In addition to general sheet maps, the trade stocked atlases, globes, travel maps and itineraries, school atlases, maps of latest discoveries, news maps, maps and atlases of theaters of war, fortification plans, urban maps, wall maps (continents, countries, cities), games on cards and boards, and textiles or pottery with maps printed on them: fans, handkerchiefs (silk, linen), teacups. Maps followed current events and the impact of war, never far removed from European soil during the century, meeting the demand for broadsheets of battles and theater of war atlases. Another growing market developed around atlases designed to accompany the written work of geographers. The influential geographical writing of Anton Friedrich Büsching (*Neue Erdbeschreibung*, 1754–92) attracted mapmakers like Daniel Friedrich Sotzmann (*Karte von Deutschland in XVI. Blatt*, 1789) and Franz Johann Joseph von Reilly (*Schauplatz der fünf Theile der Welt*, 1789–1806). The *Nouvel atlas portatif* (1762) of Didier Robert de Vaugondy competed with the *Atlas moderne* (Jean-Thomas Hérissant and Jean Lattré, 1762) comprising maps by Rigobert Bonne and others because they were both designed specifically to accompany the pedagogical work of the abbé Louis-Antoine Nicolle de Lacroix (*Géographie moderne*, 1752). The maps from these general atlases could also be sold separately, rebound into regional atlases or atlases designed specifically for schools, or reduced in format to a very small (octavo or sedecimo) size. Because

standard school curricula remained heavily oriented to the classics until well into the nineteenth century, maps of the ancient world formed a steady market stream for mapmakers and publishers.

Patterns of taste are also revealed through the guidance provided to consumers by reviews in learned journals (e.g., *Journal des Sçavans*, *Mémoires de Trévoux*), the periodical press (*Gentleman's Magazine*, *Journal de Paris*, *Monatliche Correpondenz*), and focused guides such as Lenglet du Fresnoy's *Méthode pour étudier la géographie* or Jacques Le Long's *Bibliothèque historique de la France* (new ed. 1768–78), which distinguished copies from original work. As Lenglet du Fresnoy pointed out regarding his list of maps of Great Britain: "these [maps] are not just for those who simply study geography, but also for those who would like to work on this science, who do not know where to get the original geographical maps of these kingdoms, of which the atlases are very exact copies" (Lenglet du Fresnoy 1741–42, vol. 1, pt. 2, 9). These sources and the map collecting habits of consumers also demonstrate an interest in antiquarian material as well as the most recent maps.

While the consumption of maps is covered elsewhere in this volume (see "Map Collecting"; "Consumption of Maps"; and "Public Sphere, Cartography and the"), some areas of potential research have not yet been fully explored. A thorough study of subscription lists to atlases and maps has the potential to create a nuanced picture of the location, social status, and affluence of map consumers, as well as information about the financing of an enterprise. Consumer information can also be gleaned from the published catalogs of mapsellers, sometimes in book or pamphlet form, often as a broadsheet tipped into an atlas or other publication. The inventories of possessions made upon the death of the owner provides a picture of private libraries (Delano-Smith 1995), as do contemporary auction catalogs of sales of private libraries and collections (Harley and Walters 1977, 1978; Bosse 2007). While these approaches have informed the history of the book and print trade, much work remains for the history of cartography.

Following the lead of the history of the book, studies of maps as material objects and analyses of their production would benefit map history. Understanding the costs and problems of acquisition of copper, paper, and ink and identifying the location of printers and their relationship to engravers would enhance and deepen our knowledge of the forces at work in the map trade. A dictionary of paper suppliers to the eighteenth-century map trade (Pacha and Mairan 1996, 61–76) provides a starting point for further studies.

Because the commercial printed map was reproduced in large quantities (a print run of 500 to 1,000 being common), it is the type of map most commonly avail-

able today both on the antiquarian market and in map libraries. Thus, the printed map's availability to the modern scholar means that its contemporary importance and impact are sometimes overestimated in terms of the information it contains. The context of a map's production, its contemporary reception, and its use are all factors that should temper the argument about the impact of a commercially printed map.

MARY SPONBERG PEDLEY

SEE ALSO: Atlas; Consumption of Maps; Geographical Mapping; Globe; Map Collecting; Modes of Cartographic Practice; Privilege and Copyright; Public Sphere, Cartography and the; Reproduction of Maps; Engraving and Printing

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**Map Trade in Denmark.** Because there was very little Danish map publication before 1800, due to expense and state limitations for reasons of secrecy, the Danish map trade has been little studied. This entry is based mainly on the general literature about the book trade and contemporary statements by the makers and publishers of maps and atlases. Overall, the economy of Denmark-Norway was weak after 1650, leaving the country open to external social and cultural influences, especially from Germany. By the late 1600s, German booksellers dominated the book trade in Copenhagen, whether as immigrants or as agents for larger German firms.

The earliest information about the map trade dates from the 1620s and the opening of the Dutch trading booth in the newly established market building (Børsen) in central Copenhagen, which remained the most important locus of the book trade until 1800. Both of the Dutch booksellers, Janssonius and Elzevier, traded there for some decades, but none of their catalogs survive. However, two catalogs from booksellers Joachim Moltke and Jørgen Holst from the early 1640s are still extant (Ilsøe 1992, 186–87). In 1661, the first book auction to take place sold the collections of Poul Resen, a brother of the topographical writer and map producer Peder Hansen Resen (Ilsøe 1978). From catalogs extant in the Kongelige Bibliotek, it is evident that the auctions probably prevented the establishment of antiquarian booksellers (H. Ilsøe 1991; I. Ilsøe 1992).

From the early 1700s, an emerging way of selling books and atlases began to dominate: the subscription. This became a very common way to sell or test the market for special publications. Among the titles produced by subscription was Erik Pontoppidan's *Den Danske*

*Atlas*, a multivolume topography with 17 maps, 74 town maps, and 187 other engravings (Cedergreen Bech 1969).

Early map publication mainly comprised a few sea charts made by the Kongelige Søkort-Arkiv. The first significant Danish printed map production started in 1762, with general surveying and production of topographical maps sponsored by the Kongelige Danske Videnskabernes Selskab on a scale of 1:120,000. The society's archives allow one to follow the sale and distribution of these maps through prices paid and numbers sold. The Vajsenhusets bookstore did both the printing and selling until 1779, when the sale of the maps was transferred to a bookstore at the Bourse. Later, Johan Georg Blankensteiner took over the business. In 1813–14 it was forbidden to sell maps because of the Napoleonic Wars. In total, the society sold a little more than 8,000 maps. Blankensteiner issued specialized map catalogs only in the last decade of the eighteenth century. His first catalog, from 1792, listed maps, atlases, and some instruments, as well as maps from Pontoppidan's atlas, Swedish maps from different sources, and maps from the Homann firm in Nuremberg, with further catalogs through 1805 (Blankensteiner 1792, 1805). In the nineteenth century, the map trade began to flourish with new maps and atlases created for schools, to which the subject of geography had been introduced.

HENRIK DUPONT

SEE ALSO: Denmark and Norway; Map Collecting: Denmark

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**Map Trade in France.** The French map trade during the Enlightenment was heavily centered in Paris, the economic heart of France, where the confluence of political power and academic scientific interest promoted the production and collection of maps. From the reign of Henri IV to the Revolution, royal privilege protected the printed work of commercial mapmakers from counter-

feiting, royal pensions supported some geographers and engravers, and royal censors exerted authority over particular contents. The support of Louis XIV and his first minister, Jean-Baptiste Colbert, for scientific activities created the conditions for Paris to become the economic and technical engine for map endeavors in France. Scientific institutions, such as the Académie des sciences, provided a forum in which geographers and astronomers like the Cassinis, the Delisles, Philippe Buache, and Jean-Baptiste Bourguignon d'Anville played an influential role. The availability of financial capital through patronage and subscriptions and the large pool of talented engravers and printers in Paris guaranteed high-quality cartographic products. Other French cities shared the benefits of Paris's predominance in the map trade, and book- and printsellers in the provinces also played a role in the dissemination and distribution of cartographic material (Pedley 1979). The growing cultural dominance of Paris increased the influence of French maps within the European market. No longer overshadowed by Dutch production, French maps were sought after and copied in the major map markets of Europe: London, Amsterdam, Nuremberg, and Augsburg.

The map trade in seventeenth-century France up to about 1670 is discussed thoroughly in volume 3 of *The History of Cartography* (Hofmann 2007), allowing the period under consideration here to span from roughly 1670 until 1789 on the eve of the Revolution, which disrupted patterns of production and distribution and also coincided with the death of many of the significant figures of the eighteenth century. From the seventeenth century, commercial French maps were almost always printed from engraved or etched copperplates. Engraved maps were essentially prints, part of a trade unrestricted by guild or corporate statutes but subject to a few regulations regarding content and material form (for example, a print could not include letterpress material of more than six lines nor any letterpress on the verso). Content of a political or insalubrious nature or of military sensitivity was supervised by the control of the book trade (the *librairie*) and the royal censor (Casselle 1976, 7–30, 174; Hofmann 2003). The print trade engaged a wide range of participants who energized commerce, a situation that continued into the eighteenth century (Hofmann 2007, 1580). The central role of the copperplate in the structure of the trade urges us to focus not merely on who was *making* maps but who *owned* the copperplates. The owner of the plate controlled a map's entry into the marketplace and reaped the profits from its sale, making the copperplate a source of capital.

Two main groups of map plate owners (i.e., publishers) may be discerned: academic geographers, who produced their own original works of compilation with

explanatory *mémoires*, and map editors, who assembled maps from material acquired in a variety of ways from others, including geographers. The latter group included geographical engineers, engravers, and printsellers. The skills and activities of the geographers and map editors overlapped: geographers could sell their work like printsellers or engravers; engravers and printsellers could work as map editors; geographical engineers not only surveyed but also engraved and published their own work and that of others. The relationships between all the participants in the map trade were fluid and complex. A complete prosopography of commercial geographers and mapmakers in eighteenth-century Paris based on the available rich archival sources with a thorough bibliography of their map and globe production remains to be written, though the dictionary of Paris map editors has provided a start (Pacha and Miran 1996) and builds on seminal work (Pastoureau 1984).

**CONTINUITY** The map trade in the early eighteenth century continued to be dominated by the heirs of the seventeenth-century firms of Sanson, Jaillot, de Fer, and Nolin. The stock-in-trade of the Sansons passed through friends to the geographers Gilles Robert Vaugondy and Didier Robert de Vaugondy, father and son, who expanded and corrected the Sanson oeuvre with their own work, published in the form of atlases, separate maps, and globes from their address on the quai de l'Horloge until Didier Robert de Vaugondy's death in 1786 (Pedley 1992). Their stock passed initially to globemaker Jean-Baptiste Fortin, and then to Charles-François Delamarche, who added the stock of Charles Dien the Elder. The firm passed to Félix Delamarche, son of Charles-François, who published maps well into the nineteenth century.

The stock of Alexis-Hubert Jaillot, engraver and map editor in partnership with Guillaume Sanson, remained in the Jaillot family until 1780. Jaillot's son Bernard-Jean-Hyacinthe, financially troubled, passed the firm to his son Bernard-Antoine, *ingénieur géographe*, who added new maps to the corpus until his death in 1749, when his sisters briefly but competently continued the business. One of them, Françoise Jaillot, married her cousin, Jean-Baptiste-Michel Renou de Chauvigné, grandson of Alexis-Hubert by his second marriage. Renou de Chauvigné took the name Jaillot and continued the lucrative contract for publication of the *Liste générale des postes de France* and the accompanying maps of post routes in France until 1771, when the postal administration took over publication of the *Liste*, though the maps continued to be edited by Jaillot and then by Louis-Charles Desnos (Pastoureau 1984, 233; Arbellot 1992, 28–29; Roland 1919; Fleury 1977, VIII–XV). Jail-



FIG. 461. TRADE CARD OF NICOLAS DE FER, 1705. The interior of the shop of de Fer, geographer and mapseller at the sign of La Sphère Royale, is represented as an elegant library, with the arms of the Bourbon King Felipe V of Spain and Louis, the Grand Dauphin, prominently displayed in the corners. Below the image is the catalog of de Fer's large works and maps in one sheet. Size of the original: 36.2 × 24.8 cm, folded to 36.2 × 21.7 cm. Image courtesy of University of Central England Digital Services. © The National Trust, Waddesdon Manor, Aylesbury (acc. no. 3686.1.17.28).

lot stock was acquired by Desnos and by Jean-Claude Dezauche, who added the plates and maps to his stock of Delisle and Buache work.

The stock of the engraver and map editor Nicolas de Fer (fig. 461) also remained in his family and in circulation after his death, though not improved or updated, by the marriage of his daughters to Rémi Richer and Jacques-François Bénard, both engravers, and Guillaume Danet, a paper merchant. Richer left the business, and Bénard and Danet had difficulty making a success of it. A final edition of de Fer's *Forces de l'Europe* appeared in 1746, published by his grandson Pierre-Jean Desbois, who sold the de Fer stock of plates to Des-

nos in 1760 (Pastoureau 1984, 169; Pacha and Miran 1996, 44).

Jean-Baptiste Nolin had entered the trade by engraving and promoting the maps and globes of Vincenzo Coronelli, which provided profitable stock for his engraving workshop and the title *géographe du roi* for himself (Pastoureau 1984, 357–63). Nolin's stock of theater of war atlases passed to his son Jean-Baptiste, who declared bankrupt in 1749.

**ACADEMIC GEOGRAPHERS** The first decades of the eighteenth century witnessed the increasing dominance in the map trade of the work of academic geographers who published their own maps, beginning with Guillaume Delisle. Supported by royal pension and the profits from their printed cartography, these geographers also published essays in serious periodicals (e.g., *Journal des Sçavans*) or *mémoires* of the Académies (Sciences and Belles-lettres). Except for the Robert de Vaugondys, they did not benefit from the acquisition of stock of previous cartographers. Delisle, his brother Joseph-Nicolas, his student and son-in-law Buache, and d'Anville created maps de novo, drawing upon a variety of sources both cartographic and literary, and justified their work and choices in detailed *mémoires*. They influenced the nature of geographical mapping throughout Europe, as witnessed by the copies and the imitations of their work published in other countries, giving impetus to the trade in which they participated fully. Guillaume Delisle sold his wide range of maps and globes from his address on the quai de l'Horloge in Paris and in partnership with Louis Renard in Amsterdam (Pedley 2005, 189). After Delisle's death in 1726, his widow, Marie Darbisse, continued the sales, aided by Buache, who succeeded his father-in-law as *premier géographe du roi*. After Darbisse's death in 1744, Buache continued to sell Delisle maps, though he focused his interests on aspects of thematic mapping and geographical theory. When Buache died in 1773, the Delisle-Buache stock passed to his nephew, Jean-Nicolas Buache, who sold it in 1780 to Dezauche, who combined it with his share of the Jaillot stock (fig. 462).

D'Anville sold his maps from his address in the Galeries du Louvre, the special apartments set aside in this royal building for artisans of the state, befitting his position as tutor and later secretary to Louis Philippe I, duc d'Orléans. Before his death, d'Anville sold his entire working map collection to the king, while his intellectual legacy was continued to some extent by his student Jean-Denis Barbié Du Bocage.

Jacques-Nicolas Bellin, *hydrographe du roi* in the Dépôt de la Marine, who also published *mémoires* concerning his methods of map and chart construction, was allowed by the Dépôt to sell marine charts from his ad-



FIG. 462. DELISLE/BUACHE/DEZAUCHE CARTOUCHE. The cartouche to Delisle's map of Germany shows the succession of the plate to Philippe Buache in 1745, then to Jean-Claude Dezauche in 1780, who reviewed and augmented the map. Detail from *L'Allemagne* (Paris: Dezauche, 1780). Size of the entire original: 50 × 62 cm; size of detail: ca. 18.0 × 18.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge D 11006).

dress in Paris. Like the other academic geographers, he also supplied maps to authors as illustrations.

Although academic geographers were prolific in the publication of separate maps, except for the Robert de Vaugondys they did not produce coherently designed atlases (Bellin's *Le Petit atlas maritime* [5 vols., 1764] was produced at the behest of Étienne-François, duc de Choiseul) nor did they produce maps in a variety of formats to meet popular demand.

**GÉOGRAPHES DU ROI** Each of the geographers described above and many others benefited from the title *géographe du roi*, granted by the king through the *maison du roi* (royal household) usually upon the presentation of a masterpiece map. The honorific entitled the holder to a certain annual pension, which varied in size (usually between 100 and 400 livres) and the right to append the title after the bearer's name on his cartographic work (Broc 1975, 482; Pedley 2005, 30). Such an imprimatur lent authority to the map as it reflected royal favor, not a hollow honor, since both Louis XV and Louis XVI were well trained in cartography, having been tutored by map-publishing geographers (Delisle, d'Anville, Jean de Beaurain, Buache), and they made maps themselves

(Mormiche 2010). Their active cartographic interest was clear in their support of the Cassini *Carte de France* and involvement in the preparation of maps for expeditions like that of Jean-François de Lapérouse. The particular title of *premier géographe du roi*, established for Guillaume Delisle, was worth more monetarily (1,200 livres) and also incurred the mapmaking obligations for various ministries (Dawson 2000, 82–93).

Similar titles were offered by other members of the titled aristocracy. Georges-Louis Le Rouge styled himself *ingénieur-géographe du Roy et A. S. Mgr le Comte de Clermont* along with his rank as a lieutenant in the regiment of Maurice de Saxe. Desnos held a brevet as *ingénieur géographe du roi de Danemarck*, a title that obliged him to provide maps and books to the king of Denmark in return for 500 livres per year.

Of more critical and competitive importance than royal appointment was membership in the Académie des sciences. Guillaume Delisle was an associate astronomer of the Académie (having been a student of Jean-Dominique Cassini [I]); his son-in-law Philippe Buache filled the newly created post of *adjoint géographe* from 1730 until his death in 1773, at which time d'Anville was elected followed by Jean-Nicolas Buache in 1782 (Heffernan 2014). Academic membership conferred a stamp of authority on maps produced, as the consumer was led to believe that a vetting process of presentation, discussion, and analysis had informed the map's production.

**MAP EDITORS: INGÉNIEURS GÉOGRAPHES** Despite the economic upheavals wrought by wars of the eighteenth century (the War of the Spanish Succession [1701–14], the War of the Austrian Succession [1740–48], and the Seven Years' War [1756–63]), new energy enlarged the map trade with the growing participation of *ingénieurs géographes* as engravers and publishers of both their own maps and those of others. Trained to survey, compile, engrave, and print maps during times of conflict, they turned to the commercial market to deploy their cartographic skills as map editors in peacetime. They were responsible for the diffusion of the theater of war atlas, which emerged as a genre in the late seventeenth-century, with the publication of plans and journals of campaigns and more comprehensive military histories that memorialized conflicts. Theater of war atlases reached a wide market, from military students and officers to the general public, hungry for information on current and past events.

One of the first to participate in this genre was Jean de Beaurain, a student of Pierre Moullart-Sanson, royal tutor of Louis XV, and *géographe du roi* (Antoine 1989, 101; Hofmann 2003, 178–79). He published battle plans and maps of fortifications and campaigns fought

during the reign of Louis XIV at the end of the seventeenth century as well as more recent conflicts from his address on the quai des Grands-Augustins (Hofmann 2003). His reputation was such that he was called upon to create an *atlas factice* in sixteen volumes for the French financier Marie-Joseph Savalette de Buchelay, now in Paris, Bibliothèque nationale de France. He was succeeded in 1771 by his son, Jean-Baptiste Jacques de Beaurain (Beaurain *filis*), also a *géographe du roi*, who continued publishing military atlases and maps, though not as successfully as his father, as attested by his bankruptcy in 1785. The plates of many Beaurain maps of Germany were acquired by the Dépôt de la Guerre in An VIII (1800) (Berthaut 1902, 1:233).

Roch-Joseph Julien, military engineer, *valet de chambre*, and later *intendant des bâtiments* to Charles de Rohan, prince de Soubise, opened a map store in 1752 in the Hôtel de Soubise at the corner of the rue du Chaume and the rue Paradis on the Right Bank in the Marais (Pacha and Miran 1996, 49–50). There a buyer could choose from French maps and other maps imported from the major mapsellers in London, Amsterdam, The Hague, Nuremberg, and Augsburg. Julien's *Nouveau catalogue des cartes géographiques et topographiques* (1763) gives prices and lists publishers, with occasional notes on the owners of plates and what stock has changed hands. His introduction ("Observations" [3–4]) outlines the difficulties he faced during the economic hardships of war, in spite of the heightened interest war provided for maps of the theaters of conflict. He describes his travels through Germany, Holland, and England to create a business of twenty years' standing, resulting in a catalog of nearly 130 pages describing the maps that constituted the stock available in his store. His correspondence with the London map firm of Jefferys & Faden (Pedley 2000) demonstrates the strong links maintained with a network of mapmakers and mapsellers throughout Europe. From his considerable stock, Julien was able to create composite atlases, such as *Le Theatre du monde* (1759), comprising over 200 maps by French, German, and Dutch geographers and engravers from the late seventeenth century to mid-eighteenth century; its table of contents was left blank for the buyer to fill with the titles chosen to make up the atlas.

As a map editor, Julien made his debut with Guillaume Dheulland, a geographic engraver and map designer (for Bellin, the Dépôt de la Marine, the *Carte de France*, and d'Après de Manneville); together they published the *Theatre de la guerre en Italie* in 1748 (2d ed., 1754). Dheulland also published the *Théâtre de la guerre dans les Pays-Bas* (with Nolin and Daumont, 1756) and the theaters of war in the German states during the 1750s. Dheulland and Julien developed the *carte-atlas*, a form of theater of war atlas created from a series of separate



FIG. 463. DETAIL FROM THE *TABLEAU TOPOGRAPHIQUE QUI COMPREND LA PARTIE SEPTENTRIONALE DU LANDGRAVIAT DE HESSE CASSEL ET DE LA PRINCIPAUTÉ DE WALDECK* (PARIS: ROCH-JOSEPH JULIEN, 1762), CA. 1:150,000. Julien experimented with two-color printing and offered two versions of this map “printed in a unique manner, that is: the woods & mountains in carmine red, & the other details in black,” for 4 livres 10 sous; and the same map “printed in the ordinary way,” i.e., in black, for 2 livres (Julien’s *Nouveau catalogue de cartes géographiques et topographiques* [Paris: R. J. Julien, 1763], quotes on 28). Size of the entire original: ca. 49 × 72 cm; size of detail: ca. 4.5 × 8.0 cm. Image courtesy of the Newberry Library, Chicago (map4F G6373.H42 1762 J8).

sheet maps drawn on the same scale with an overall map of the same dimension containing the title. The collection could be assembled in a single atlas volume or assembled as a wall map, with the *carte d’assemblage* as the cartouche (Hofmann 2003). Julien also published maps by Bellin and Giovanni Antonio Rizzi Zannoni and practiced innovations such as printing in two colors (fig. 463). After his death, two of his engravers, François Perrier and Ambroise Verrier, who also engraved maps for other geographers and publishers, continued his business for a brief period.

Le Rouge, *ingénieur géographe* who had served Louis, comte de Clermont, and as lieutenant in the regiment of Maurice de Saxe, during the War of the Polish Succession (1733–38), sold maps from his address in Paris on the quai des Grands-Augustins from 1741. He concentrated on military themes in his cartographic publications, which ran the gamut from theater of war atlases and battle and fortification maps to compilations of copies of English maps appropriate for understanding the Seven Years’ War and American Revolutionary War (*Atlas Américain septentrional*, 1778). Le Rouge’s enormous work on garden design (*Jardins anglo-chinois*) reflected his work and interests during his younger days as an engineer (Korzus 2004). His cartographic output was matched by his written work on military matters (e.g., *Le parfait aide de camp*, 1760) and geography (*In-*

*roduction à la géographie*, 1748). His reputation and connections in London led him to work with Benjamin Franklin on the French edition of Franklin’s map of the Gulf Stream (Cohn 2000).

In 1757 Desnos opened his shop for maps and globes on the rue Saint-Jacques, where he produced a prodigious number of atlases (the analysis of his stock noted plates for eighteen atlases) (Pacha and Miran 1996, 44–



FIG. 464. FRENCH EMPIRE AND COLONIES UNDER LOUIS XIV AND FRANCE UNDER LOUIS XV. From Giovanni Antonio Rizzi Zannoni, *Atlas historique et géographique de la France ancienne et moderne* (Paris: Sr. Desnos, 1764), pl. 32 and unnumbered pl. The striking repetitive format of using the same printed decorative frame for each map gave the atlas a coherent layout and a map ready for hanging on the wall if sold separately. Size of the originals: 26.2 × 31.5 cm. Images courtesy of the Stephen S. Clark Library, University of Michigan, Ann Arbor.



46). For many of them he employed a distinctive format of a repeated decorative frame within which each map fit (fig. 464). Although he styled himself as *ingénieur géographe*, Desnos had apprenticed as a master metal founder; he met and married Marie Charlotte Loye, the widow of Nicolas Hardy, who had been a globemaker on the quai de l'Horloge. The marriage gave Desnos access to the stock of globes (cardboard and papier-mâché shells on which gores could be pasted), spheres, copperplates, and tools of the trade from the Hardys (Nicolas and his father Jacques). Desnos sold globes, armillary spheres, and geographical maps using stock and plates purchased in 1760 from the de Fer descendants and from the plates acquired from the Jaillots in 1789 (Pacha and Miran 1996, 44; Pastoureau 1989; 1984, 233). Desnos's catalogs, printed as broadsheets, were often tipped into his atlases and provide an inventory of his productions from the 1760s until his death in 1805.

Academic geographers Delisle and Robert de Vaugondy and map editors Desnos and Jean Lattré (with Rigobert Bonne) joined scientific instrumentmakers Nicolas Bion, Jean-Baptiste Delure, and Jacques-Nicolas Baradelle to offer globes in a variety of sizes—three, six, nine, twelve, eighteen, and twenty-four inches. They relied on luxury craftsmen to produce innovative stands, ranging from plain wood with red edges to decoratively carved or lacquered stands to meet the fashionable tastes of the period, rococo or chinoiserie or neo-classical. The style of stand could demand a high price, as much as 1,000 livres for an eighteen-inch globe, “rich in ornaments, engraved with the arms of the subscriber” (*Journal des Sçavans*, April 1753, 255). Few engravers entered this specialized market, except when employed to engrave the globe gores.

**MAP EDITORS: ENGRAVERS** The integral role of engravers in map production cannot be overemphasized. Their skills in transferring the fine lines, legible lettering, and detailed topography of the manuscript map to the copperplate were crucial to the critical success of map sales. Some engravers who specialized in geographic engraving were inspired to become map editors and publishers.

Lattré and his wife, Marie-Françoise (née Vêrard), a talented engraver, exemplify the combination of engraving skill with entrepreneurial instincts. Lattré published individual maps and many urban plans, as shown in his various catalogs, often tipped into the back of his atlases, and through advertisements in Paris periodicals. Like Dheulland, Lattré engraved maps for the *Dépôt de la Marine* (*Hydrographie française*) and also saw the profitability of publishing his own urban plans and atlases. His *Atlas moderne* (1762) went through several editions with maps compiled chiefly by the geographers

Bonne, Rizzi Zannoni, and Jean Janvier. These same geographers also worked for Desnos, increasing competition within the map trade and leading to some fractious encounters (Pacha and Miran 1996, 46).

Janvier became a map editor and publisher in partnership with Sébastien-G. Longchamp, Voltaire's former valet and secretary. Longchamp had learned the fundamentals of map compilation and engraving from Desnos (Longchamp and Wagnière 1838, 2:337–44; Reitinger 2010). Other map engravers who published and sold maps were the Crépy family (Jean, sons Louis and Etienne-Louis, and grandson Jean-Baptiste), Louis-Joseph Mondhare, and his son-in-law Pierre Jean (Casselle 1976, 219–20). The printsellers Esnaults & Rapilly participated in the map trade in the third quarter of the century with maps of Paris, of France, and of significant places in North America, although maps were not a major part of their stock (Casselle 1976, 101, 225).

By the century's close, marked by the disruptions of the French Revolution, the academic geographers—Delisle, Buache, Robert de Vaugondy, d'Anville—had died, each without a successor, and their stock consolidated into the hands of Dezauche, Desnos, and Delamarche. Delamarche added the stock of Lattré to his Robert de Vaugondy material; when his son Félix consolidated business with the engraver Dien, they added plates from the stock of Le Rouge. The difficult financial climate of Revolutionary France and a shortage of ready money made new ventures nearly impossible, and the increased demand for maps was met by older material already on the market. Geographers like Edme Mentelle entered the market through teaching and producing school atlases to accompany new geographical curricula (Heffernan 2005).

**LOCATION OF THE TRADE** In Paris, the close connection between all participants in the map trade (geographers, map editors, and engravers) is manifest in the close proximity of their addresses on the Left Bank of the Seine, within the Latin Quarter, where the letterpress trade was located, restricted by guild provisions and the requirements of government supervision (Pedley 1981; 2005, 97–99). The geographers tended to cluster around the makers of scientific instruments on the quai de l'Horloge on the Île de la Cité and on the nearby quai des Grands-Augustins, whereas the engravers spread along the busy rue Saint-Jacques, home to booksellers and printers since the Renaissance, and the streets adjacent. Such propinquity made for ease of transport of copperplates from engraver to printer to editor. Two exceptions to these locations were d'Anville's residence in the Galeries du Louvre, where artisans in the employ of the monarchy were often housed, and Julien in the Hôtel de Soubise in the Marais on the Right Bank, far



FIG. 465. PLATE 1 FROM DIDIER ROBERT DE VAUGONDY, *TABLETTES PARISIENNES* (PARIS: L'AUTEUR, 1760). This plan, *Les Isles du Palais, S. Louis & Louviers, le Palais du Luxembourg, le Louvre, l'Opéra, l'Hôtel de Ville, la Comédie française, &c.*, has been annotated to show the areas in central Paris where the map trade was concentrated:

(1) Galeries du Louvre, (2) quai de l'Horloge on the Île de la Cité, (3) quai des Grands-Augustins at the south end of the Pont Neuf, and (4) rue Saint-Jacques.

Size of the original: 20 × 22 cm. Image courtesy of the Stephen S. Clark Library, University of Michigan, Ann Arbor.

from the print and book trade but deeply ensconced in a district of *hôtels particuliers* of wealthy clientele (fig. 465).

In Lyon, a similar phenomenon for the location of the print trade was apparent along the rue Mercière (the medieval *via Mercatoria*) and streets adjacent in the second *arrondissement* of central Lyon, the heart of the district of letterpress printers (Martin de Vesvrotte

et al. 2002, 7–9, 151–53). While the map trade in provincial centers of France has not been thoroughly studied, research on the Lyon print trade suggests that maps were sold locally by printsellers, such as Jean-Louis Daudet, who was succeeded by his widow, Étienne Leblond, and Louis Martin Roch Joubert. The widow Daudet and Joubert sold maps by de Fer, Jaillot, Crépy, Delisle, Bellin, and Le Rouge. Nicolas-Simon Duflos also

had Paris connections with Le Rouge, Desnos, and the cartographic engraver Petit (Martin de Vesvrotte et al. 2002, 65–66). Commercial map production in Lyon itself seems to have been limited to maps of the city, the best known being the plan of Lyon (1735) by Claude Séraucourt, geometer and engraver. Subsequent plans of the city and region were edited by Joubert beginning in 1767. In both cases the mapmakers received financial support from the city to create these urban plans (Bruyère, Chiron, and Dureau 1997, 51–59).

**ECONOMICS OF MAP PRODUCTION** No matter who owned the plates, the most difficult hurdle in bringing maps to market was acquiring the capital to undertake the considerable costs of compilation, copperplates, engraving, and printing. While the titles of *géographe du roi* and *premier géographe du roi* carried annual pensions, providing support for living expenses, they hardly provided the kind of sums required for map production. Other forms of patronage supported individual map projects (Petto 2007), and mapmakers might enjoy position and financial support in aristocratic households, as evidenced by d’Anville’s role as tutor and secretary to the duc d’Orléans, who financed many of d’Anville’s maps. Membership in scientific academies brought stature but little remuneration. Many geographers taught geography and mathematics; some were royal tutors (Delisle, Buache, Beaurain, d’Anville), others simply advertised their courses in the periodical press (e.g., Robert de Vaugondy in the *Journal de Paris*, 28 July 1780) or even on their maps as did Le Rouge: “He teaches mathematics, fortifications, military art, design, German, and English” (below the neat line of *Theatre de la guerre en Silesie* [1741], and, similarly, in the *Mémoires pour l’Histoire des Sciences & des Beaux Arts*, June 1741, 1141).

Another source of capital came through marriage: a wealthy wife could increase borrowing power as well as provide the necessary wherewithal for map publishing. Guillaume Delisle’s wife, Marie Darbisse, brought a dowry of 18,000 livres (Dawson, 2000, 259–62). Philippe Buache married the wealthy widow Elizabeth de Miremont in his second marriage, and d’Anville’s wife, Charlotte Testard, brought a dowry of roughly 400 livres per year (d’Anville website). Widows and daughters of men in the trade could bring their family business to a marriage, as in the cases of the daughters of de Fer and the wife of Desnos, noted above (Pastoureau 1984, 168; 1989; Pacha and Miran 1996, 44). Françoise Jailot brought geographical stock worth 25,000 livres and other goods and cash worth 12,000 livres to her marriage to Renou de Chauvigné (Fleury 1977, X). Friends, too, provided help: Gilles Robert Vaugondy was supported by his lawyer friend Jean Frémont in the early years of his cartographic career (Pedley 1992, 24–26). Some map

enterprises were accomplished as joint undertakings; the *Atlas universel* by Didier and Gilles Robert de Vaugondy was funded by the bookseller Antoine-Chrétien Boudet, though such an arrangement ran counter to guild regulations that protected the print (and therefore the map) trade from incursions by the letterpress community.

A common means of securing advance funding was through subscription, which offered a discounted price on maps or atlases prior to publication, thereby providing significant capital for the project if enough subscribers signed on. The most well-known examples of subscription funding were the Cassini *Carte de France* and the Robert de Vaugondy *Atlas universel* (Pedley 1979). Julien offered a cogent explanation of the need for advance capital in his appeal to subscribers to the *Theatre de la guerre en Italie* (2d ed., 1754) (Hofmann 2003, 180) and emphasized the number of subscribers required to recoup costs. The *Atlas universel* attracted just over 1,100 subscriptions from 650 subscribers; Julien asked for at least 800. These numbers provide expected print runs.

The French monetary units of the eighteenth century—livres, sous, and deniers (equivalent to pounds, shillings, and pence)—were the currency of costs. The price of a single sheet folio map was between 1 and 6 livres during the Enlightenment. By comparison, the *premier géographe du roi* received 1,200 livres in annual pension; a student needed 400–600 livres per year to live in Paris; an English diplomat requested 48,000 livres to live appropriately to his station. Although wages and prices were not fixed, fluctuating according to circumstances, and information gleaned from the archives must be analyzed in the context of the institution or individual source, some general patterns may be discerned. By consolidating the separate costs of copperplate, engraving, ink, paper, printing, and coloring, the cost of producing a single map could vary between 200 to 1,200 livres. An average of 600 livres for production meant that the price of a map at 1 livre represented only  $\frac{1}{600}$  the production costs, which did not include the time consumed by the editorial work of compilation and correction. To recoup the costs, a mapseller was obliged to sell at least 600 copies of every map title produced. This was especially difficult for more unusual titles and maps of obscure geographical areas. The mapseller often ran out of popular maps (world, continents, Europe, battles) and was left with excess stock of less popular areas and topics (ancient history, remote regions). The economic solution was a well-designed atlas, aesthetically pleasing and intellectually coherent, that offered a means of selling less popular maps bound with the more popular. Yet the price of an atlas like the Robert de Vaugondy *Atlas universel* was high: 150 livres for 107 folio maps on larger paper or 120 livres for the

same maps on smaller paper. Smaller-format atlases of course cost less: Lattré's *Atlas moderne* (1762) in large quarto was priced at 19 livres 10 sous bound in cardboard, 24 livres in leather, 25 livres 10 sous on high-quality paper and colored, and 30 livres on fine paper, colored and bound in leather. Lattré raised these prices in his subsequent catalog of 1771 and doubled them in his 1777 list. The increased prices bought more elegant bindings, finer paper, and coloring, but not refined map content, which remained untouched (Pedley 2005, 205–42; Hofmann 1999).

Other aspects of production besides costs also affected the trade. The availability and competition for competent and talented engravers, the detailed and demanding process of noting errors and correcting them carefully, the experimentation with new techniques of etching (such as *manière noire* or mezzotint and aquatint) were constant concerns. Color printing and innovative formats offered challenges, too. The limitations of engraving in the production of historical maps and atlases required the imaginative rendering of time as well as space (Hofmann 2000a).

**STOCK** The stock maintained by most participants in the map trade comprised separate maps of the world, the continents, countries, regions, and cities; maps covering historical themes, current events, or events of the recent past; and maps required for schools (blank maps, simplified geographical or thematic maps, and, by the end of the century, maps of physical geography). As the century progressed, map publishers designed maps specifically for an atlas format, using similar scales, styles, projections, and presentation to create a coherent, visually attractive volume. Robert de Vaugondy, Julien, Desnos, and Lattré were particularly adept at creating such atlases, offering various sizes and bindings and even soft covers allowing a collection to be rolled up for easy carrying. Geographers offered textbooks on geography and the use of globes to expand their sales.

The main forces driving market taste were education (both military and civilian), current events, and the practical use of maps by military officers, administrators, and travelers. The demand for maps, atlases, and globes in schools had been a constant from the early seventeenth century. The desire for maps to serve as vehicles for understanding history drove a strong market in historical maps and atlases in schools. The form and content of school atlases and maps changed with evolving pedagogical ideas, marked definitively first by the expulsion of the Jesuits from France in 1764, and the concomitant secularization of the history and geography curriculum, and later by the Revolution, with its new ideas about the accessibility and purpose of public education. The debate over the practicality and desirability of wall

maps over atlases and the creation of atlases to meet the changing norms of the curriculum marked cartographic developments for schools in the last quarter of the century (Pastoureau 1997; Heffernan 2005).

The wars that plagued Europe through the eighteenth century (in most of which France participated although no battles occurred on French soil) whetted public appetite for theater of war maps and atlases, whether of recent conflicts or retrospective maps describing famous military campaigns of earlier wars. The world map and the general atlas also attracted consumers by claiming to be up-to-date, showing recent discoveries, and being offered at affordable prices. Maps and atlases for way-finding, such as route maps, itinerary maps, guide books, and road lists with timetables, also found a steady market. The reforms of Anne Robert Jacques Turgot in 1776 to create a national system of public transportation by *diligence* (public stagecoach) provided a further impetus to the making of route maps (Arbellot 1992, 49).

**ADVERTISING AND CRITICISM** The range of maps available to the consumer was advertised in the catalogs of mapmakers, printed as broadsheets or small books, or tipped into atlases and other publications. The periodical press, such as the *Gazette de Paris*, *Les Affiches de Paris*, *Mercur de France*, and *Journal de Paris*, consistently reported the appearance of new maps, citing publishers, locations, and prices. Serious literary periodicals, such as the *Journal des Sçavans* and the *Journal de Trévoux* (*Mémoires pour l'Histoire des Sciences & des Beaux-Arts*), provided more detailed analyses of maps and atlases recently published and the opportunity for geographers to engage in description and debate concerning maps and map accuracy (Verdier 2015). These reviews and responses both educated and encouraged more discerning consumers.

Two other contemporary publications offered critical assessments of maps that informed choice. The *Méthode pour étudier la géographie* (1741–42) by abbé Nicolas Lenglet du Fresnoy offered short, sharp critiques of the maps listed in each of its seven volumes. At the end of volume 1, he included a “Catalogue des meilleures cartes.” Jacques Le Long's *Bibliothèque historique de la France* (1719), revised and corrected by Charles-Marie Fevret de Fontette (1768–78), opens the first of its five volumes with a chapter on the geography of France and lists of more than nine hundred geographical maps of France, its regions, and its neighboring districts. The sheer volume of cartography covered in this list, mostly of French production, impressively attests to the depth and range of the map trade from the late Renaissance to the eighteenth century.

These catalogs and periodicals describing maps reveal the far-flung consumers of French maps and the

long reach of the French map trade. The republication of French titles, whether through copying or selling the French maps directly, formed a significant portion of France's foreign map trade, especially in Great Britain, the Netherlands, and the German States. Other sources, such as correspondence and subscription lists, also describe a trans-European trade: the subscription list to the Robert de Vaugondy *Atlas universel* (1757) shows that nearly 300 of the 1,118 subscriptions left France for other regions (Pedley 1979, 69 [fig. 3], 71). Delisle's business correspondence with Renard attests to the strong demand for his maps in the Netherlands (Pedley 2005, 174–75, 189). The letters from French mapsellers (Julien, Lattré, Desnos) and geographers (Robert de Vaugondy, Rizzi Zannoni, d'Anville) to the firm of Jefferys & Faden reveal strong Anglo-French trade even in time of war (Pedley 2000). Volume was the volatile factor; since a map publisher was obliged to sell a large number of copies of a title to recoup its production costs, publishers hoped for, but rarely found, steady demand. The archived inventories after decease and bankruptcy filings illuminate the wide geographical range of a mapseller's creditors who pushed him toward the precipice of debt. Desnos renegotiated his debt in 1761 and again in 1784 in a bankruptcy filing, listing creditors in Paris and throughout France and as far afield as Cádiz, Turin, Majorca, Seville, and Amsterdam. Undeterred by these low points in the business cycle, he continued to offer maps in all formats, atlases, globes, and special paper and writing tools for sketching and mapmaking until the year before his death at age eighty (Pedley 1995, 107–8; Pacha and Miran 1996, 44–46).

By the end of the eighteenth century, France retained its position as a highly regarded center for commercial cartography. Through the consolidation of the stock of various mapselling firms into fewer hands and the expansion of the stock to include more than maps—prints, city plans, landscape views, books related to geography and mathematics, engraved stationery and forms—the map trade by the time of the Revolution was poised to become a more industrialized and centralized industry in the nineteenth century.

MARY SPONBERG PEDLEY

SEE ALSO: Anville, Jean-Baptiste Bourguignon d'; Atlas; Buache, Jean-Nicolas; Buache, Philippe; Delisle Family; France; Map Collecting; France; *Neptune du Cattéat et de la mer Baltique*; *Neptune françois* and *Hydrographie françoise*; Robert de Vaugondy Family; Sanson Family

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**Map Trade in the German States.** Map publishing in the German States from 1650 to 1800 owed its multifaceted nature to the strong territorial fragmentation and the concomitant multiplicity of political and cultural centers. Nonetheless, the publishing houses of Homann and Seutter, Lotter, and Probst dominated the market in

the eighteenth century until they were overtaken around 1780 by other large map publishing houses in Vienna, Weimar, and Berlin, as well as other cities. To a lesser degree, print and book publishers as well as independent copperplate engravers active in numerous cities also published maps.

The large cartographic publishing houses have been relatively well researched although important business records have not survived, except those in the archives of the Akademie der Wissenschaften in Berlin and the publishing archive of the Artaria house in Vienna. For this reason, only fragmentary material illuminates the financial aspects of mapmaking, which are often hard to compare due to the varying currencies and techniques of data measurement. Overall, these relationships have as yet been little researched.

**PUBLISHING CENTERS** The Thirty Years' War (1618–48), with its destruction and high loss of human life, almost completely disrupted the traditions of German cartography. Toward the end of the war, only a few publishing houses dealt with cartography, such as those of Paul Fürst in Nuremberg, Wolfgang Kilian in Augsburg, and Matthäus Merian in Frankfurt. Merian was known for lushly illustrated topographical and historical works from around 1623. The firm's main publications, the *Theatrum Europæum* and the *Topographie Germaniae* by Martin Zeiller, continued to be published by Merian's heirs after his death, who kept the large firm in business until 1727 or 1734, but it was better known for its prints and bird's-eye views than for its numerous maps.

The large Dutch publishing houses, which used the book fairs in Frankfurt and Leipzig to sell to German and international book- and printsellers, dominated the map market in the seventeenth century, a fact underscored by a contract of 17 March 1659 between Joan Blaeu and the German bookseller Alexander Harttung, in which the latter agreed to sell all of Blaeu's products (Stadsarchief Amsterdam, Not. Arch. 3014/197). The slimmer, cheaper atlas compilations marketed by the Dutch publishers De Wit, Visscher, Danckert, Valk, and Schenk, less encyclopedic than those of Blaeu and Janssonius, were important products; French maps by Nicolas Sanson and Italian maps by Vincenzo Coronelli seem to have been less influential. The German-language publishing houses initially copied Dutch products and then attempted to emulate the companies themselves, having presumably met their successful Dutch counterparts at the book fairs, and thereby learned their work methods. Yet German cartography from the graphic print centers of Nuremberg and Augsburg as well as the bookfair cities of Frankfurt and Leipzig succeeded only sporadically against Dutch competition in the seventeenth century, and no publishing houses specializing in cartography

were established. Some print and book publishers produced individual maps, usually for book projects or magazines, such as the Nuremberg publishing houses of Johann Hoffmann, active between 1658 and 1698, and Jacob von Sandrart, founder of the *Nürnberger Malerakademie* in 1662, who published maps from the 1690s, including folio maps for a world atlas with David Funck. While the number of copperplate engravers in Augsburg grew from six in 1661 to twenty-three in 1698, only Johann Stridbeck the Elder and Johann Georg Bodenehr were involved in cartography, publishing regional atlases and small-scale city and fortress maps (Ritter 2002c, 186). Around the turn of the century, larger individual projects appeared in Mainz, Leipzig, and Munich, such as Nicolaus Person's *Novæ archiepiscopatus Moguntini tabulæ* (1694), Christophorus Cellarius's *Notitia orbis antiqui* (1701–6), and Heinrich Scherer's seven-volume *Atlas novus* (1698–1710).

The eighteenth century saw a radically changed situation. In 1702, Johann Baptist Homann founded the first publishing house specializing in cartography in Nuremberg. He had collaborated on the works of Cellarius, Scherer, and Funck, and by ably exploiting the interests of buyers (especially in maps of the current participants in the War of the Spanish Succession), he was able to prevail over foreign map publishers in the German map market. Known as Homann Heirs from 1730, his publishing house largely copied Dutch map types and formats and became the leading enterprise in German commercial cartography until 1790. Also in Nuremberg, in the first quarter of the eighteenth century, the firm of Christoph Weigel the Elder and Johann Christoph Weigel (later Schneider und Weigel) published small-scale maps and atlases. A number of book and print publishers also operated in cartography, such as the Monath publishing house, which from 1713 published a few separate maps in addition to astronomic and mathematical books. Globes were manufactured in the first half of the eighteenth century by Johann Gabriel Doppelmayr, Johann Ludwig Andreae, and Johann Philipp Andreae as well as at the turn of the nineteenth century by the flourishing publishing houses of Klinger, Bauer, and Franz.

Inspired by Homann's success, Matthäus Seutter started his own cartographic publishing house in Augsburg around 1707. Since he was probably trained by Homann, his enterprise was markedly similar to Homann's, and the Seutter publishing house (succeeded by Tobias Conrad Lotter, then Johann Michael I Probst) was for a long time the only significant domestic competitor of Homann in number of titles and in sales. Other publishing houses in Augsburg offered cartographic products throughout the first half of the eighteenth century: Jeremias Wolff, Gabriel Bodenehr, Elias Baeck, and Johann Andreas Pfeffel. Toward the end of the century,



FIG. 466. DETAIL FROM PETRUS I SCHENK, *HERR JOHANN PETZSCHENS HOFF UND BALLEHAUßZ* (AMSTERDAM, CA. 1700). This engraving shows Schenk's activity during one of his visits to the Leipzig book fair. Size of the original: ca. 21 × 25 cm; size of detail: ca. 8 × 10 cm. Image courtesy of the Staatsbibliothek zu Berlin–Preußischer Kulturbesitz; Kartenabteilung (Kart. Y 28352).

other Augsburg publishers took advantage of increased demand caused by a broader spectrum of buyers and the weakness of the old market leaders. Johann Martin Will and his son-in-law Johannes Walch started a new map publishing house in 1789 from the auctioned estate of the Lotter family publishing house.

Besides the business of the international book fairs conducted within the sovereign borders of these two imperial cities, Leipzig and Frankfurt were also active in the map trade, Leipzig being of greater significance during the eighteenth century. The Dutch map and atlas publisher Petrus I Schenk attended the Leipzig fair regularly between 1701 and 1711 (fig. 466). His son Petrus II Schenk continued this tradition by publishing the *Atlas Saxonicus novus* (1752) and maintained a permanent address in Leipzig from around 1760. From 1720, Johann Georg Schreiber ran a small publishing house specializing in cartography whose primary work was the *Atlas Selectus von allen Königreichen und Ländern der Welt*, amply distributed in the German-speaking world, which grew from 27 maps in its first edition (around 1730) to 149 maps, keeping the firm in business into the nineteenth century. Many books with maps were published both in Leipzig and Frankfurt. Works dealing with contemporary wars were often illustrated with maps, and works on travel and exploration contained a surprising number of maps (e.g., *Allgemeine Historie der Reisen zu Wasser und zu Lande*, 1747–74, 21 vols. with over 300 maps). The broad orientation of the



FIG. 467. JOHANN WILHELM ABRAHAM JÄGER, *CARTE TOPOGRAPHIQUE DE LA WETTERAVIE ET DU CERCLE DU HAUT RHIN*. Sheet 40 of the *Grand Atlas d'Allemagne en LXXXI feuilles* (Frankfurt: Jäger, ca. 1789), copper engraving. This important atlas sold for 44 guilders.

Size of the original: ca. 49.5 × 62.5 cm. Image courtesy of the Staatsbibliothek zu Berlin-Preußischer Kulturbesitz; Kartenabteilung (2° Kart. L 550-40).

publishing business allowed some entrepreneurs to experiment, such as the attempts of Johann Gottlob Immanuel Breitkopf to typeset maps. From 1762 to 1789 in Frankfurt, the former military officer Johann Wilhelm Abraham Jäger prepared a map of the Holy Roman Empire at ca. 1:220,000 on eighty-one large sheets, resulting in the *Grand atlas d'Allemagne en LXXXI feuilles* (fig. 467).

Additional map production centers developed in a few of the cities with royal court residences. In Berlin, still a small city in Brandenburg-Prussia, the Akademie der Wissenschaften exploited the land mapping privi-

lege granted by Friedrich II by publishing separate maps as well as a maritime and a school atlas from the 1740s. The Schleuen firm likewise published maps and illustrations of Berlin and Brandenburg from 1740. Yet not until the end of the century did Berlin emerge as a center of cartographic publishing in the German-speaking world with maps by Carl Ludwig von Oesfeld (publishing from 1777), Daniel Friedrich Sotzmann (publishing from the 1780s), and the mapseller and publisher Simon Schropp (publishing from the 1790s). The most significant competition had shifted away from Augsburg and Nuremberg, especially after 1750, when the



Homann Heirs suffered a financial crisis that had delayed by twenty years further investment in more up-to-date maps, finally delivered by Franz Ludwig Gusesfeld. No unequivocal market leader, however, was apparent from the 1780s, as Berlin was joined by Vienna, which rapidly became a center for map publishing from 1786 onward with the Artaria firm and large atlas projects initiated by Franz Anton Schrämbel in 1787 and Franz Johann Joseph von Reilly in 1789. In Saxe-Weimar, Friedrich Justin Bertuch founded the Landes-Industrie-Comptoir in 1791. Bertuch's marketing successes with the school atlas by Adam Christian Gaspari (1792–93) and the magazine *Allgemeine geographische Ephemeriden* (from 1798) motivated him to found the Geographisches Institut in 1804. In Bavarian Munich, the travel atlas by Adrian von Riedel appeared between 1796 and 1805, though the Perthes publishing house in the small city of Gotha (Saxe-Gotha) did not publish its first maps until after the turn of the century. Thus new map production centers were definitively established in the economically and territorially turbulent years of the Napoleonic Wars, when the free imperial cities lost their independence.

Other maps, atlases, and books heavily illustrated with maps appeared as individual projects by authors who initiated them for ostensibly scientific or patriotic reasons but in fact intended to promote their careers in a royal court or the military. Given the desire for high-quality results, these projects almost always encountered major financial problems. For example, Johann Weichard von Valvasor invested the entirety of his assets in the publication of a superb topography, *Die Ehre des Herzogthums Crain* (1689). The large *Scenographie* of Vienna by Joseph Daniel von Huber (1778; see fig 889) was not a financial success. The superb globes produced by Johann Georg Franz in the early nineteenth century (after prototypes by Sotzmann) not only ruined him personally but forced his father to sell his half of the Homann firm in 1813 to cover his son's debts (Heinz 2002a, 45). These ambitious individual initiatives especially enriched cartography and geography, but they also demonstrated the very careful calculations and long-term planning required for cartographic publication projects.

Official or semiofficial map projects turned to cartographic publishing houses to handle the engraving and printing of the maps, such as the topographical survey of Bohemia, which was funded by the provincial governments for 24,000 guilders, surveyed by Johann Christoph Müller, and engraved on twenty-five plates by Michael Kauffer in Augsburg from 1720 until 1722 (Ritter 2010, 42–44). For its own topographical survey, the Silesian government contracted with Homann Heirs in

1735 for the engraving and printing, stipulating that the staff in Nuremberg were to be responsible not just for the graphic rendering of the original manuscript maps but also for the representation of territories beyond the Silesian borders and for decorative elements. After corrections, 2,500 copies were to be pulled from each plate for the initiators of the project (Heyer 1891, 89–90).

The professionalization of public administration and military demands in the second half of the century intensified the need for comprehensive large-scale maps. As these topographical surveys were made by the military, conflicts between military secrecy and administrative interests grew. For this reason, reduced copies of these maps were at times made and printed by civil draftsmen and copperplate engravers under the strict control of the military. These public commissions are beneficial for research since the study of archived correspondence and contracts could illuminate work methods and funding, including those of commercial firms.

**PUBLISHING HOUSES** The long activity and broad scope of the few large publishing houses that have been the subject of several studies (e.g., Ritter 2001, 2002a, 2002c; Stams and Stams 2004; Heinz 1997, 2002a) reveal patterns of production and structures and tendencies within the German map trade that contrast with the work of the many publishers who produced just one or only a handful of maps. The trends of the trade may be described in more detail through studying the large firms because they likely commanded over 50 percent of the market, giving them enormous importance.

Homann maps were almost synonymous with printed maps in Germany in the second half of the eighteenth century, when folio maps were explicitly referred to as the Homann format (*Homännisches Format*). During the Enlightenment, printing businesses were organized into one of three trades: book publishing, printselling, or antiquarian bookselling. Cartographic publication fell under the purview of printsellers, who were allowed to trade only in works printed from copperplate or substantially illustrated printed works. Printsellers in Nuremberg were members of the so-called free trades, less regulated but of lower social prestige than the controlled trade of the book publishers. Printsellers were obliged to contract the letterpress portions of their works to booksellers. Neither booksellers nor printsellers were allowed to trade in bound works, so as not to poach business from the antiquarian booksellers, who in turn were not allowed to sell unbound (i.e., new) works. These rigid boundaries, arising from guild regulations, seem to have relaxed gradually during the eighteenth century. For instance, while the early atlas title pages from the Homann firm (Homann sold bound

atlases from 1741 onward) always mentioned the book publisher who had prepared the title page and printed texts of the atlas, the later title pages were engraved and printed from copperplate, with the names of foreign publishers of the text portions removed.

In only a few years the largest map publishing houses such as Homann and Seutter developed into multifaceted enterprises that carried out most of their production in house or commissioned it to heavily dependent outside firms. The work of the publishing houses began with the development of a publishing program, the acquisition and elaboration of master maps, the printing process, and finally culminated with sales. This type of publishing house seems to have been modeled on the major Dutch companies.

These large firms were often founded by trained copperplate engravers, who initially ran small print publishing houses especially common in Augsburg and Nuremberg. Under favorable conditions and with the necessary personal initiative and penchant for risk taking, such enterprises expanded into larger cartographic publishing houses. Copperplate engraving was very costly, and founders of publishing houses could minimize this expense by doing much of the work themselves in the initial years. If cartographic engravers were unable to sell enough on their own, they could survive financially by working for other publishing houses while establishing their own business. The generation following the successful founders of publishing houses often did not continue as engravers but entered professions that were not craft oriented. Presumably, the founding of a publishing house was based on economic interests, even though the written statements to the government stressed the value of the planned enterprise to society. The decision to specialize in cartography may have stemmed from personal inclination or from envying someone like Matthäus Merian, whose assets were estimated at approximately 50,000 guilders in 1672 by virtue of an inheritance (Wüthrich 2007, 392).

The big firms like Homann served as attractive models for envious imitators in the eighteenth century, as seen in the acquisition of a prestigious building by Homann Heirs in 1734 for 6,500 guilders and Seutter's purchase of a two-floor residence for at least 1,600 guilders in 1723 (Sandler 1965, 6). It must be stressed, however, that success was achieved only through rigorous financial planning, as attested by the numerous personal bankruptcies of mapmakers in this period. Documents from the archives of the Akademie der Wissenschaften in Berlin show that the sale of all their maps in what was perhaps the unusually unfavorable decade of 1772–82, yielded a total profit of a risible 286.50 guilders.

Despite the complexity of the work, map-publishing

firms appear to have been relatively small. Johann Wilhelm Abraham Jäger employed about ten copperplate engravers to work on his *Grand atlas d'Allemagne* (1789). Homann Heirs, as one of the largest enterprises in Nuremberg, probably seldom engaged more than thirty family members and other employees, as well as about thirty external illuminators (*Briefmabler*) to color the maps, and a few extra copperplate engravers who were occasionally commissioned.

**PUBLISHING POLICIES** The successful German map-publishing houses tended to combine larger-scale separate maps of localities and regions and smaller-scale general maps as their core business stock, supplemented at times by atlases and, to a lesser extent, views, globes, and wall maps. The decision about which maps to publish required a proper knowledge of the market, acquired through contacts with printsellers, correspondence, and travel. The most important criterion was economic feasibility. Due to the relatively small circle of buyers, it took a long time for the relatively high investment in the physical production to pay off. The maps had to be of general interest in order to be sold for as long as possible (for example, in atlases). Current or newsworthy interest in a particular area shortened the period for making an initial profit. The Akademie der Wissenschaften in Berlin, for instance, sold only 58 copies of the postal route map of 1754 in its first year, but 541 in the war year of 1759 (Hanke and Degner 1934, 44). Under normal conditions, new map production did not pay for itself for several years. Publishers invested more in the quality of the master map only when pressured by competition or personal ambition. As for master maps, it was not until the late eighteenth century that the accurate location of places within the geographical grid really became relevant. Indeed, greater interest lay in the competent overall composition of the map image, the decorative elements, fine and clear engraving, and neat coloring, since maps at this time served more as general representations of regions. In this context, history played a very important role, and, despite superficial appearances, the up-to-dateness of maps was not a top priority. Even though some maps were updated repeatedly in order to include changed borders, towns relevant to warfare, or new portraits of rulers—as with seven versions of Lotter's map of Poland, and thirteen versions of Walch's map of Poland—publishers rarely hesitated to add such adjectives as *novissima* to a map's title itself, even when the map's contents lagged decades behind current geographical knowledge.

Only when map publishers entered the international market were they compelled to substantially improve

quality. In the 1740s, the Homann Heirs found that adopting these standards was financially risky. In general, the situation prompted publishers to constantly expand their offering to as many maps as possible. By the Napoleonic period, up-to-date information was required for all these maps, and the old publishing houses could not keep up.

**MASTER MAPS** The secondhand purchase of copperplates was the cheapest means of acquiring maps in the German-speaking world, as it had been for Dutch publishing houses of the seventeenth century. This practice seems to have been employed more by the Augsburg publishers (e.g., Joseph Carmine, who printed from a great number of plates from the defunct Amsterdam Ottens firm) than by those in Nuremberg. Copying maps that were already successful on the market saved the initial investment in cartographic compilation and was a nearly standard procedure in the start-up phase of a publishing house; it limited the costs to the acquisition of a selection of potential master maps for comparison and to a fixed sum for copying or redrawing the selected master. In addition, using another firm's maps (*Abkupfern*) was often unavoidable since one could not easily find a cartographer for every region to be represented.

Before about 1720, chiefly Dutch master maps were copied; after that date, French maps were used. Naturally, it was preferable to obtain master maps directly from the country to be represented. English maps were copied for just this purpose until the late eighteenth century; similarly, German maps of the Holy Roman Empire were copied abroad. At the same time, publishers were thoroughly aware that copying from other publishing houses was damaging and could adversely affect their firms, so they tried to protect themselves against copying by acquiring printing privileges (discussed below).

Purchasing newly created maps for publication was legally less dubious but considerably more costly. Even after a government agency or private author delivered a newly created map of a region, the publishers had to compile a master map that included portions of the neighboring lands along the region's boundaries, being attentive to avoid border disputes. This process might include creating an appropriate map projection and designing the *parerga* (embellishments), such as the title cartouches, scale data, and decoration. Even if the author of the map was paid very little, significant money was invested in subsequent preparation, sometimes involving the costly efforts of a highly qualified mathematician for new map projections, such as professor Johann Matthias Hase, hired by the Homann Heirs for Johann Wolfgang Wieland's *Atlas Silesiae* in the 1730s. New cartouche designs required the expense of an art-

ist. Compensation for original cartographic work was probably heavily contingent upon whether the author had approached the publishing house or vice versa. Unfortunately, sources on this topic are virtually unknown. Government agencies (and maybe even individual authors) often demanded a large number of the printed maps in recompense for their base map. For instance, in 1711 Homann included Johann Majer's map of Württemberg in his publication program after the duke of Württemberg had paid 1,400 guilders for both its printing and for 1,000 copies, thereby relieving Homann of heavy initial investment in this commercially attractive map (Heinz 2003, 23–24). Yet such offers or commissions from governmental agencies or knowledgeable cartographic authors only came to map publishers of certain renown. Government involvement could also do harm by confiscating map prints and copperplates when there was disagreement about the represented borders.

Expenses rose when publishing houses contracted a new design for a larger region or a continent based on an intellectual compilation process. It was difficult to find qualified geographers who could grapple with projections, assess written and cartographic sources in multiple languages, and draft a master map, since very few scientists dealt with cartography until the late eighteenth century. In this quest for talent, the location of a publishing house may have played a role. Nuremberg publishing houses enjoyed easier access to scientifically trained map authors than their competitors in Augsburg by virtue of Nuremberg's proximity to the University of Altdorf. A mapmaker was expected to master map projections, use written and cartographic sources in many different languages, and draw base maps. In 1753 Homann Heirs issued "Die Kosmographische Lotterie," a programmatic document that projected at least two years for each map compilation, but added the proviso that since each completed map could only be sold for the customary ten kreutzer, the cartographer would be paid for no more than one quarter of a year's labor (Kosmographische Gesellschaft 1753, X–XII).

Longer production periods for map designs are known from the correspondence with local persons invited to correct map designs. Solid information about the compensation for such projects is found only in the archives of the Akademie der Wissenschaften in Berlin, which from 1752 employed Johann Christoph Rhode as *Geograph der Akademie*, but until 1772 only paid him after completion of projects. In that year, Rhode demanded twenty-two thaler for drawing a planisphere for a school atlas and thirty-six thaler for the map of the ancient world (fig. 468). These rates corresponded to the sale value of 528 and 864 maps, respectively (Hanke and Degner 1934, 39). In 1773, Rhode delivered the final



FIG. 468. JOHANN CHRISTOPH RHODE, *ORBIS VETERIBUS NOTUS* (BERLIN: ACADEMIÆ REGIÆ SCIENTIARUM 1772). Copper engraving.

Size of the original: 31 × 36 cm. Image courtesy of the Staatsbibliothek zu Berlin—Preußischer Kulturbesitz; Kartenabteilung (Kart. U 2010).

drawing of a map of all the Prussian lands to the Akademie, which he had compiled from thirty-two different maps and map works and for which he charged 192 hours and 13 minutes (around 3 weeks, or 19 ten-hour workdays) and received forty-eight thaler (Hanke and Degner 1934, 59). These high costs meant that work on commission was very rare in German cartographic publishing. Probably the only highly qualified cartographer to be kept on a publisher's staff was Tobias Mayer, employed by the successful Homann Heirs, but only from 1745 to 1750, during the short period of their heyday.

**TECHNICAL PRODUCTION** The main work of map production resided in the preparation of the copperplates, the printing, and the hand coloring. Copperplate printing was exclusively employed, and the work conditions of copperplate engravers in the German-speaking world were probably the same as in other European countries. Yet the division of engraving labor that may be clearly observed in France for the different elements of line work—lettering, topographical elements, and decoration—was much less obvious in the German publishing houses. The Homann and Seutter publishing houses

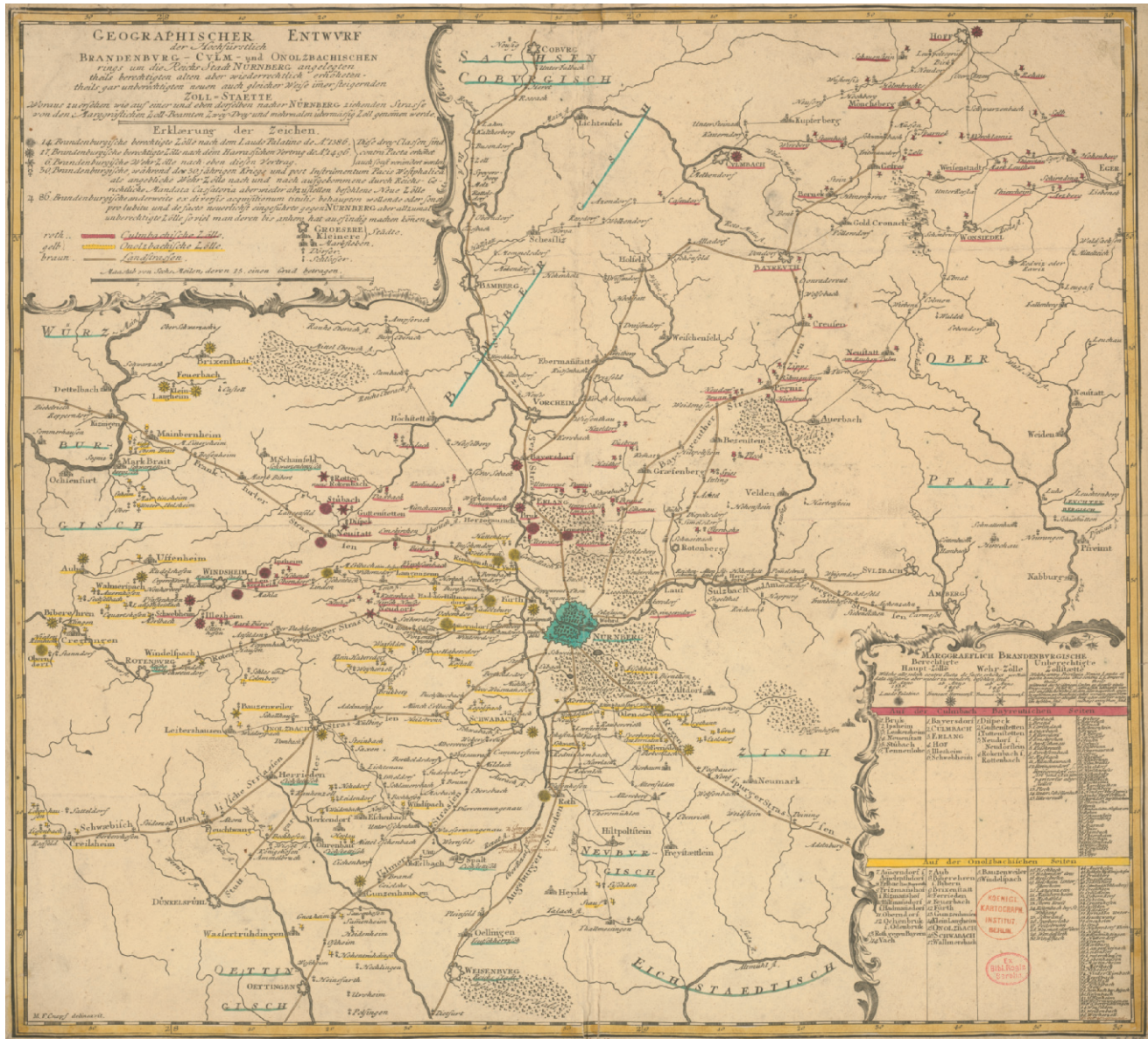


FIG. 469. MATTHÄUS FERDINAND CNOPE, *GEOGRAPHISCHER ENTWURF DER HOCHFÜRSTLICH BRANDENBURG-, CVLM- UND ONOLZBACHISCHEN RINGS UM DIE REICHS STADT NÜRNBERG ANGELEGTEN* (NUREMBERG, 1764). Copper engraving. The city

of Nuremberg had this map engraved by the Homann Heirs for 109 guilder and 30 kreuzer (see table 3). Size of the original: 54 × 59 cm. Image courtesy of the Staatsbibliothek zu Berlin–Preußischer Kulturbesitz; Kartenabteilung (Kart. M 7090).

hired engravers to work in-house but probably did not allow them to sign their work, a practice clearly indicated by the lack, with one exception, of any engraving signature of either Johann Baptist Homann or Matthäus Seutter on their own maps. Only about one-sixth of all the maps by the Homann Heirs publishing house bear any engraver signature at all, and those are presumably of outside contractors.

Although finding additional copperplate engravers

for maps in Augsburg or Nuremberg would not have been a problem, complaints about the lack of qualified copperplate engravers for map projects were common in other German regions. Thus ambitious map publications, such as Müller’s map of Bohemia, were executed only by expert engravers in these two imperial cities. Conversely, the rise of new map production centers in the late eighteenth century accompanied the improved training of copperplate engravers in Vienna and Berlin.

TABLE 3. Costs of engraving *Geographischer Entwurf der Hochfürstlich Brandenburg-, Cvlm- und Onolzbachischen rings*, 1764 (fig. 469). The total production cost was the equivalent of the price of 657 maps.

	Cost	Percentage of total costs
Untreated copperplate	13 guilders	12
Polishing the plate	1 guilder, 30 kreutzer	1
Engraving work	80 guilders	73
Designing and engraving two cartouches	15 guilders	14
<b>Total</b>	<b>109 guilders, 30 kreutzer</b>	<b>100</b>

Source: Staatsarchiv Nürnberg, Rst. Nürnberg, Stadtrechnungsbelege, Bündel 1564.

The costs of engraving an ordinary ten-kreutzer folio map are found in the invoice for the regional customs map of 1764 ordered by the city of Nuremberg from Homann Heirs (fig. 469 and table 3). The same invoice suggests that paper, printing, and illumination may be estimated at 2.5–5 kreutzer per map. Such external invoices included a profit margin for the publishers; the internal profit margin values assessed within the firm were probably lower.

Yet such extant invoices are few, making it difficult to calculate average costs in various locations or to discern a pattern of development over time and space. The conclusion, however, that hundreds of maps had to be sold in order to recover the costs of the engraving alone is substantiated by other sources. The records of the Akademie der Wissenschaften in Berlin show that engravers were paid differently according to the density of the lettering, a fact corroborated by Sotzmann's map of Germany (in sixteen sheets, 1793). The engraver received 200 thaler (the equivalent of 175 map sets) for plates with many place-names but only 70 thaler (the equivalent of 50 map sets) for a simple index map (Sotzmann 1793, XVII).

Carl Friedrich von Wiebeking calculated the following production costs for his map of the Duchy of Berg (four sheets, 1791): 990 thaler for initial survey and design of a master map and 1,250 thaler for printing and coloring 400 copies. He sought subscribers at 5 thaler (7.5 guilders) to cover his costs (1792, 16). His estimated costs per surface area were five times those of a Homann map. Data from the Homann firm show that the costs were recouped after 400 copies were sold, though this excluded the cost of the master map design. Based on the life of the printing plates, it took about five to eight years to sell 400 copies.

Similar financial considerations apply to printing. After a period of expansion over approximately ten years, the large publishing houses probably acquired their own printing presses. Smaller publishing houses contracted printing to local printers who owned the required presses and skilled workers. The availability of printing presses

able to accommodate large map formats was occasionally a problem. Research into the origins of the paper used has not yet been undertaken. Experienced printers were definitely important to the long-lived publishing houses, which depended on the longevity of the copperplates and the quality of the engraving. Many printing plates were reengraved three or four times (verifiable in the case of the Homann firm), but sometimes a new identical plate had to be engraved. A peculiarity of the Homann firm was its simultaneous preparation of up to three nearly identical printing plates for particularly important maps (e.g., the world, the continents, Germany, France, Poland, Scandinavia, Great Britain, Russia, Spain, Italy, southeastern Europe), which probably ensured their ability to stock these maps in case any one plate became damaged.

The number of prints pulled from a copperplate can only be estimated. Publishers who flourished long enough to have their plates reengraved multiple times before they became too faint from the repeated pressure of the rolling press could possibly pull a maximum of about 8,000 copies, a figure supported by documents in the archives of the Akademie der Wissenschaften in Berlin. In 1789, Sotzmann stated that he was ashamed of the printing quality of the maps in the school atlas since the plates had already been printed 8,000 times (Hanke and Degner 1934, 40–41). Homann printed an average of 3,000–5,000 copies from a plate, this would yield approximate annual sales of twenty to fifty-five copies of a map based on a life expectancy for most maps of approximately one hundred years. Presumably the publishers would print only as many copies as they could sell within the foreseeable future so as not to have too many outdated copies in stock in case changes were necessary. In 1671, the Merian firm had in stock a total of 6,600 prints from copperplate engravings for sixty works (including 150 rolls or bales [*Ballen*] of the *Theatrum Europæum*, 460 bales of topography, and 400 bales of other publications) in addition to letterpress texts (Wüthrich 2007, 392). An inventory prepared for an inheritance in 1788 itemized about one-third of

the warehouse stock of the Lotter publishing house in Augsburg, comprising 9,961 folio maps (7,165 colored and 2,796 uncolored) and 14,810 smaller maps (8,084 colored, 6,726 uncolored) (Stadtarchiv Augsburg, Kupferstecherakten 1723–1804, fol. 153). Assuming that the maps were printed from the 112 listed folio plates and available small plates, this constitutes an average of about ninety copies taken from each plate, roughly the number of prints that could be pulled from a printing plate in one day's work. Thus, Lotter maintained just more than one year's average sales volume by keeping a day's printing in stock, a sensible approach since plates had to be cleaned and prepared before and after printing. Also significant is that small-size maps were expected to yield 30 percent more sales than the folio maps.

These figures support the idea that 25 percent was added to the price for colored maps as opposed to uncolored maps. German maps were almost always illuminated with full color for the centrally depicted territories. The publishing houses prepared the master maps with templates for the colors that were later applied by hand. Around 1710, Johann Hübner described a systematic use of colors. His ideas were central to the Homann system, adopted in the following years, which used hues of a primary color consistently for the various provinces of a state, rather than contrasting colors as previously practiced. Several references confirm that this coloring work was usually done by women and children, often relatives of employees in the publishing house; coloring was also executed by the established guild of *Briefmahler* (illuminators) as well as other unaffiliated individuals. In 1735, 200 *Briefmahler* workshops were registered in Augsburg and probably as many as thirty external illuminators were active for the Homann firm around 1745 (Heinz 2002b, 1:148–49). The invoice between Homann Heirs and the city of Nuremberg in 1764 (see table 3) allows a calculation of 2.4 kreutzer per map for the coloring work, or roughly one quarter of the sales price. In 1793, Johann Georg Krünitz wrote that the illumination of land maps in Augsburg was carried out by children who were paid eighteen groschen or almost seven kreutzer for one hundred pieces completed in three days (Krünitz et al. 1773–1858, 60:150).

**MAP SALES** The structures for selling maps in the German-speaking world were even more complex than those for creating and printing them. A variety of measures promoted map sales or facilitated funding before publication, but there is little information about their efficacy. One approach involved the author or publisher presenting the master map to a high-ranking person to request permission to dedicate the work to him or her, but no research has as yet studied this process. Motivation for seeking dedication might have been for subsi-

dies of printing costs or other financial benefits such as printing privileges. The incorporation of a famous personality on the map was presumably a useful publicity measure.

The cartographer's or publisher's use of his title as an imperial geographer or comparable distinction, though evidently not linked to commissions or revenue, similarly could carry prestige. Homann had to pay 161 guilders and 30 kreutzer for the honor of becoming *Kaiserlicher Geograph* on 17 August 1715, along with a golden chain with a portrait medal of Charles VI. He immediately included the title on his maps. Around 1731 or 1732, his competitor Seutter also received the title, a date ascertained from his publications with the title after 1732. Similar titles, although less prestigious, were *kurfürstlich sächsischer und königlich polnischer Geograph* (Adam Friedrich Zürner, 1716) and *Fränkischer Kreisgeographus* (Johann Michael Franz, 1748, apparently given in lieu of support for his map publication plans).

Royal printing privileges were originally a public sign of having passed government censorship, as demonstrated by conflicts surrounding the *Atlas Saxonicus novus* (1752) by Petrus II Schenk. For the publisher, privilege promised protection against copying and reprinting, at least in the territory of the provincial sovereign who granted them, and also provided some publicity. Petrus II brazenly and publicly affirmed to the royal Saxon government that he had received its general privilege, though it was probably never granted. Nonetheless, he placed it on his publications, showing the importance of printing privileges to publishers. Homann Heirs held imperial printing privileges for ten years for all of their maps published between 1729 and 1750 as well as between 1762 and 1806. In 1729, the cost of the privilege was sixty guilders (equivalent to the cost of 240 to 360 maps). In 1741, the Seutter firm acquired a comparable printing privilege from the imperial vicar. The most effective way to invoke privilege was to file a complaint at the book fairs, where all the parties could be summoned before the imperial book commission. So far research has revealed only a few such proceedings in the cartographic industry.

Subscriptions and advance payments made it possible for buyers to invest in maps still in production. Such methods of financing were relatively rare in the German map trade until the late eighteenth century. Unfortunately lacking are the published lists of subscribers, which might provide information on the social and geographic distribution of buyers, as in the case of England and France. Larger publishing houses advertised directly to booksellers or printsellers and to potential buyers with printed lists or catalogs of their products distributed. The Homann list of publications was engraved on

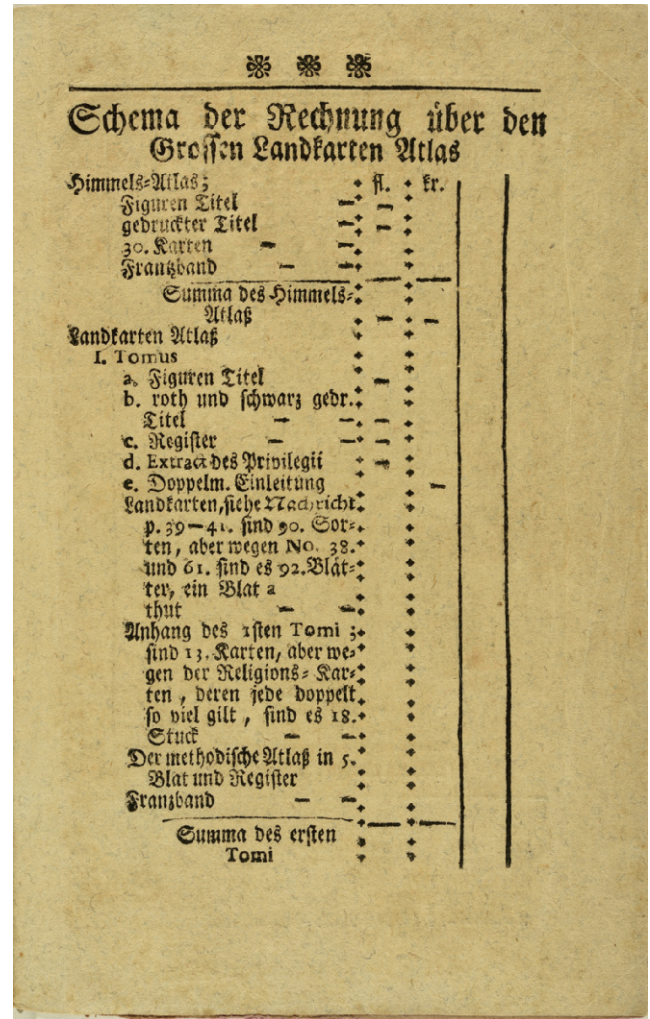
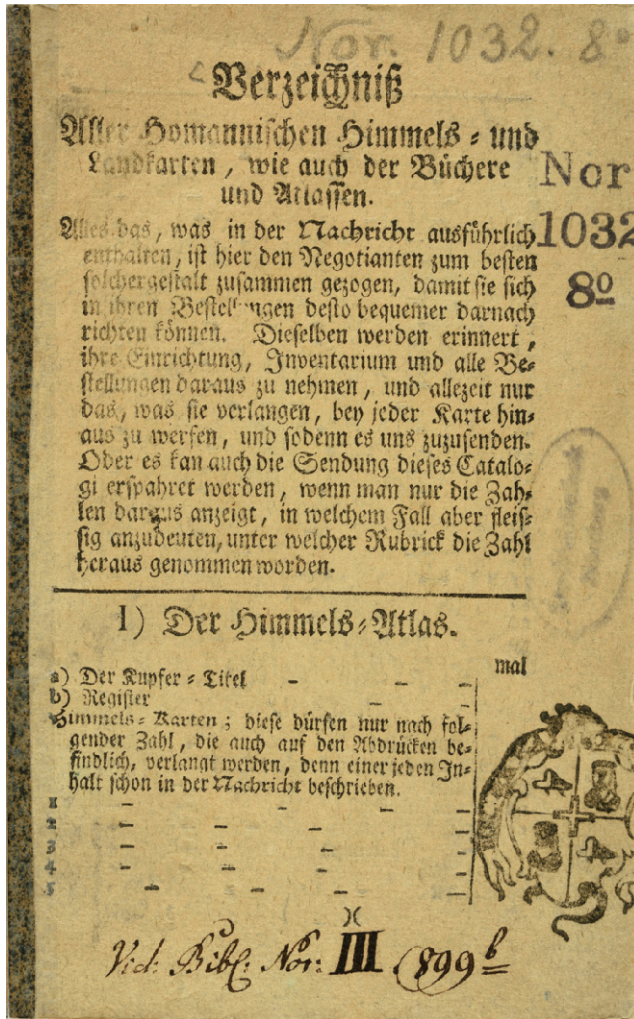


FIG. 470. TWO PAGES FROM HOMANN HEIRS, VERZEICHNIß ALLER HOMANNISCHEN HIMMELS- UND LANDKARTEN, WIE AUCH DER BÜCHERE UND ATLASSEN (NUREMBERG, 1741). In this sixteen-page order form, dealers or private customers could fill in the number of

copies of each map in the right margin of pages 1-14 (page 1 shown on left) and sum up the costs of a complete atlas on pages 15-16 (page 15 shown on right). Size of each original: ca. 16.5 × 10.0 cm. Images courtesy of the Stadtbibliothek Nürnberg (Nor. 8. 1032).

copperplate from 1714 onward so that it could always be expanded with new maps, a model followed by the Seutter firm. Homann Heirs switched to letterpress in 1741 and updated its catalog booklet at short intervals until 1824. The Homann order form of 1741 was an unusual, perhaps unique, feature (fig. 470). Individual booksellers or printsellers also occasionally published lists of the maps available at their shops.

Numerous books about cartography appeared in the first half of the century, which may have expanded the fame of map publishers and individual maps. The works usually served as guides for the purchase of other maps or atlases and indicated the best maps on the market by region, as exemplified by the work of Caspar Gottschling (1711), Johann Gottfried Gregorii (1713),

Eberhard David Hauber (1724), and Johann Hübner (1726). Until the late eighteenth century, map publishers only sporadically announced the appearance of new products in magazines, and map-related items were usually ignored in the catalogs of the book fairs. Nonetheless, Anton Friedrich Büsching's trade journal *Wöchentliche Nachrichten von neuen Landcharten* (1773-89) and Bertuch's *Allgemeine geographische Ephemeriden* (1798-1816; *Neue Allgemeine geographische Ephemeriden*, 1817-31) contained sometimes biased reviews. In 1800 the *Ephemeriden* (482-84) announced a plan to compile as completely as possible an international list of new publications, since individual announcements were usually so regional and publisher specific that they might not be seen by all interested parties even at the



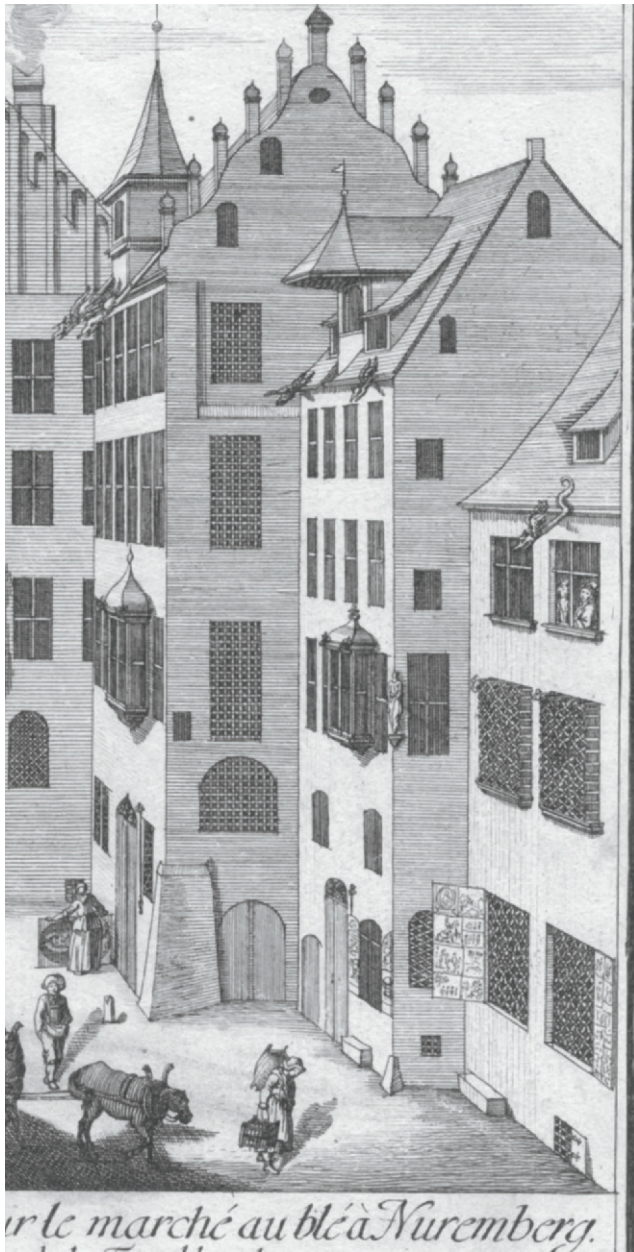


FIG. 471. DETAIL FROM JOHANN ADAM DELSENBACH, *DER PLATZ BEY DER ROSEN GENANT, AM KORNMARCKT IN NÜRNBERG*, 1715. The building furthest to the right (with large shutters) is the house of Christoph Weigel. To its immediate left, Homann's shop is recognizable by the pictures of globes on the smaller shutters. Size of the entire original: 21 × 31 cm; size of detail: ca. 16.5 × 8.5 cm. Image courtesy of Peter Bierl Antiquariat, Eurasburg.

place of publication. If this assessment was accurate for the entire period, then it must have been difficult for the consumer to locate available maps.

The publishers who owned or rented an entire building could maintain shops at street level, as did Homann

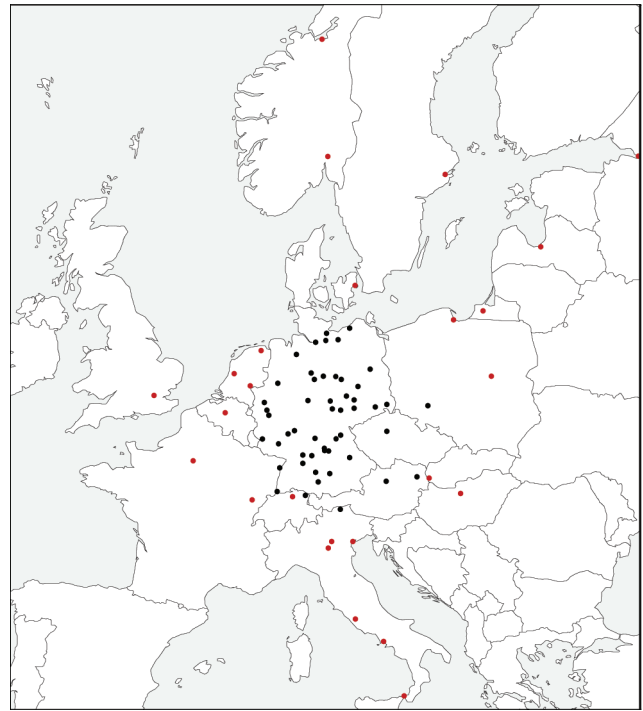


FIG. 472. NETWORK OF HOMANN DEALERS IN 1750. Map of the seventy-six cities where one could obtain the complete set of Homann Heirs maps in 1750. Cities outside the Holy Roman Empire are in red.

from 1712 at what is now Josefsplatz 2, recognizable by its casement windows decorated with globes (fig. 471). Neither in Nuremberg nor in Augsburg was there a spatial concentration of publishing houses or printers within a city, as in Paris and London. Walk-in customers were certainly few in number, and most maps were sold and sent to individuals or more often to book- and printers in other cities. The Akademie der Wissenschaften shipped a box containing 13 school atlases, 6 sea atlases, and 237 individual maps from its own publishing house to 3 people in West Prussia for 247 thaler and 16 groschen in 1773 (Archiv der Berlin-Brandenburgischen Akademie der Wissenschaften, A.I.VII. Nr. 47). The dominant market position of the Homann house from about 1715 peaked in the 1740s with a network of distributors throughout Europe. The firm's publishing list from 1750 included one hundred sellers in seventy-six cities; fifty-two were located within the Holy Roman Empire; the remainder spread west to Paris, London, and Amsterdam; north and east to Scandinavia, Russia, and Eastern Europe; and as far south as Sicily (fig. 472). The complexity of this market may be seen in the collaborative efforts with Roch-Joseph Julien in Paris and John Rocque in London to share the map market throughout Europe. It is unlikely that this



FIG. 473. PETER REINICKE, FIGURINE OF STREET VENDOR SELLING CARTOGRAPHIC MATERIAL, MEISSEN, CA. 1750–60. Designed by Reinicke 1744. Street vendors sold maps all over Europe in large quantities. Height of the original: 17.5 cm. Image courtesy of the Victoria and Albert Museum, London (C.924-1919).

distribution network survived in toto after the publishing house's crisis in 1750. A comparably broad sales network for the Merian publishing house in 1672 may be ascertained in their accounts receivable from Amsterdam, Rotterdam, London, Zürich, Lucern, Geneva, Venice, Copenhagen, Salzburg, Rostock, Kaliningrad, Stettin (Szczecin), and many other cities. Thousands of maps were also sold via traveling salesmen, who plied their limited assortment—usually individual maps—in

places as far-flung as Istanbul (fig. 473) (Gatterer 1790, 299).

Besides the large map publishing houses, which also sold maps of other firms, only one specialized map merchant is known to have existed in the eighteenth century; the school principal Johann Hübner in Hamburg established his *Museum geographicum* in 1711, which probably existed until midcentury. Hübner collected maps worldwide as a basis for his work on geographical schoolbooks and developed his method of coloring and designed dozens of atlas collections, which he published as the *Museum geographicum* (1726). The specially colored maps and atlases enjoyed success, as substantiated by some surviving volumes. Toward the end of the century, other specialists, like Simon Schropp based in Berlin and, from the 1770s, C. F. Bremer in Braunschweig, traded in foreign maps otherwise difficult to obtain. Yet by the 1780s, Bremer, too, mostly offered Homann maps.

The book fairs in Frankfurt and Leipzig, which at the time took place twice per year, were significant central shipping points for maps, including those of Dutch map publishers. However, there is no reliable information about the transportation of the merchandise. The extent to which wars or import limitations motivated by mercantilism affected the map trade has not yet been researched.

The prices of maps and atlases are based on isolated data, often difficult to compare due to the multiple currencies in use. The price of a map depended on its size (with greater expenses for especially difficult copperplate engraving), on paper types (printing on cloth cost from 25 percent to over 100 percent more), on costly coloring (up to double the price), and also on the ability of the producer to calculate compensatory prices. Large publishing houses were able to spread the expense of cost-intensive maps over all of their products, while individual mapmakers could not do so. Homann evidently was able to achieve success by maintaining very low prices for his maps. His price (ten kreutzer per folio map, verified from 1753) guaranteed a relatively wide distribution, yet it also hampered innovative map projects, which could not support the low price. Johann Wilhelm Abraham Jäger's 1789 *Grand atlas d'Allemagne* (eighty-one folio sheets) cost forty-four guilders (or forty-eight kreutzer per map sheet) competed with Homann's *Atlas Germaniae* of 143 recognizably older maps at seven guilders, though the Jäger atlas seems to have been successful (see fig. 467). A smaller-scale school atlas of the Akademie der Wissenschaften in Berlin (1753, forty-one maps) initially cost five guilders, twenty-five kreutzer but was reduced to four guilders, thirty kreutzer in 1769, to compete with the Homann school atlas (fifty maps), offered for three guilders, forty-four kreutzer. In

the second half of the eighteenth century, Homann maps were offered by independent sellers at fifteen kreutzer, a 50 percent trade markup.

While individual maps were a luxury for the majority of the population, atlases were completely unattainable. Eckhard Jäger found that a Homann map corresponded to two plates of food at an inn, or one-half week of a cook's salary in Leipzig, but only cost 5 percent of a carpenter's assistant salary. Yet a Homann atlas of 150 maps was equal to a full month's salary of a town clerk in Frankfurt (Jäger 1978, 72–74). The Danish poet Ludvig Holberg relied on the presence of maps in the household of a manual laborer for his satirical play *Den politiske Kandestøber* (1722). In the introduction to his textbook *Atlas Homannianus illustratus* (1753), Johann Jakob Schatz alluded to the affordability of maps, explaining that his text covered the maps from Homann Heirs, since their price was so low that even the poorer children at the gymnasium could buy them; their French and Dutch counterparts, in contrast, cost twice as much or were completely unattainable. An assessment of who could afford even a slender atlas and who could not is difficult since, on the one hand, multiple school atlases could be kept on the market and, on the other, the school atlas of the Berlin Akademie der Wissenschaften could be sold only at a reduced price since most of the schools in Brandenburg did not even have geography classes, as A. A. Rhode reported in 1768 (Hanke and Degner 1934, 34).

If the customer wished to compile an atlas, an extra 20 percent was added to the cost of the maps for the bookbinder, a sum that included gluing maps to guards as well as the binding. An important feature of atlases in the German-speaking world was the additional guards bound into atlases to allow for more maps to be glued in later. Since the back of the maps included no text or other written material that imposed a special sequence of maps, atlases could be gathered ad libitum by the customer from maps by various publishers as long as the format was uniform. These two conditions resulted in numerous compilation atlases (*atlas factices*) in the German-speaking world that survive to the present, whose creation was often complex.

Little research has looked into the expectation of buyers. Most maps served the interest of users seeking general information (e.g., newspaper maps like Lotter's map of the Balkans, *Kriegs Schauplatz zu leichter Erklärung der Zeitungsblätter*, 1788) and were valued for their competent and accurate draftsmanship, clear engraving, neat coloring, and especially their low price, as described as late as around 1800 (*Verzeichniss von Land-Charten*, 1804, 8). From the mid-eighteenth century, demand grew. Around 1785, the prominent geographer Büsching asserted that if maps were to be useful

then the placement of regions, their size, and the distances between places should be determined by careful astronomic calculations and accurate surveying, with precise map projection and manner of representation (Büsching 1785, 23–24). Büsching still expected historical data on the maps, which explains why maps—despite repeated emphasis on their currency—could still be sold with only minor changes in content or style over many decades. Not until the Napoleonic period, when traditional principalities and sovereignties disappeared from maps in great numbers, did buyers urgently expect actual up-to-date borders.

The unsystematic structure of the map trade resulted in ambivalence regarding originality of maps. Since foreign originals were often unavailable or expensive, German publishing houses were praised for copying them, though the readers were aware of the damaging effect of this practice on business.

In the economically tumultuous period after the Thirty Years' War, small cartographic publishing houses developed gradually in the printing centers of Augsburg and Nuremberg based on Dutch models, and perhaps in emulation of the Merian publishing house. The Homann and Seutter publishing houses brought international fame to these centers in the eighteenth century and gave authors and states favorable opportunities to publish, as long as funding was available and no money was to be spent on a master map. This private commercial cartography dominated public access to maps completely and was reflected in almost every aspect of map production. While the requirements for maps gradually began to change from the mid-eighteenth century, the centers of map production did not shift until late in the century (ca. 1780–90) when newer cartographic publishing houses piggybacked onto the businesses of Homann and Seutter. By the early nineteenth century, the political, economic, administrative, and technical parameters changed substantially: the imperial freedom of Augsburg, Nuremberg, and Frankfurt ended, the official topographic bureaus expanded, and the technique of lithography came into use. The public demanded more astronomically correct positioning, more relevance to current affairs, and more everyday practicality.

MARKUS HEINZ

SEE ALSO: German States; Homann Family; Reproduction of Maps: (1) Engraving and Printing, (2) Typographic Printing; Seutter, Probst, and Lotter Families; Wiebeking, Carl Friedrich von

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**Map Trade in Great Britain.** The map trade in London was dominated throughout the Enlightenment by the copperplate engravers, printers, and printsellers who made and brought the raw material of cartography to the marketplace. The training and general social organization of the trade was largely rooted in the tradition of craft guilds, or livery companies (so-called from the adoption by their senior members of a distinctive livery or style of dress), to which London mapmakers and

mapsellers generally belonged. The function of these companies was originally to control entry to the trade; to regulate wages, prices, and working conditions; to oversee training and standards; and to provide charitable relief for members and their families. In return for these activities, the guilds and their members were usually granted some form of monopoly over the practice of their trade. There were three usual routes to admission to a company: by “service,” the completion of an apprenticeship of usually, but not invariably, seven years to an existing freeman; by “patrimony,” the right of birth in being born to an existing freeman; and by “redemption,” which usually involved the payment of a substantial fee.

An obvious home for the map trade was within the Worshipful Company of Stationers, formally incorporated in 1557. Its members were granted a near monopoly of printing in England and Wales and were called upon to police the output of the press as well as to regulate matters of copyright. Although many mapmakers were affiliated to the Stationers, the production of intaglio images (including maps) on a rolling press developed separately from letterpress printing and, largely by historical accident, London mapmakers also joined many other companies. A significant early group were the chartmakers of the so-called Thames School who were affiliated to the Drapers’ Company—a group including William Hack, John Thornton, and Joel Gascoyne (Campbell 1973; Smith 1978)—while another influential and interconnected group in the Weavers’ Company in the late seventeenth century included Joseph Moxon, Robert Morden, William Berry, Philip Lea, and Sutton Nicholls.

Affiliation could run across several generations, as found in the master-apprentice line in the Merchant Taylors’ Company that descended from John Seller and included Charles Price, Emanuel Bowen, Thomas Kitchin, Thomas Jefferys, and their own numerous apprentices. The globemaker George Adams and his sons were members of the Grocers’ Company in a direct master-apprentice line from Augustine Ryther in the sixteenth century. A natural affinity with the engraving of decoration on gold and silver plate explains membership of map engravers in the Worshipful Company of Goldsmiths, including John Sturt, Francis Dewing (who migrated to Boston), John Pine, John Tinney, William Palmer, John Cary, and John Luffman. Other company affiliations included the Joiners (John Bowles, Thomas Bowles, and Carington Bowles), the Clothworkers (William Faden, William Darton, James Wyld, John Betts), the Tinsplate Workers (Garnet Terry, Ebenezer Bourne, Thomas Foot), and the Cooks (Samuel John Neele, Sidney Hall, and Edward Mogg). Wyld exemplifies the nineteenth-century end of a direct master-apprentice line

threading through various different companies back to William Rogers in the sixteenth century (Worms and Baynton-Williams 2011, xi–xx).

As London expanded beyond its historical boundaries, the power and influence of the livery companies grew steadily less, particularly after the Great Fire in 1666. We have no evidence for the companies influencing prices or overseeing workmanship, at least as far as maps are concerned (although there was still regulation concerning letterpress printing and binding), but the formal apprenticeship system remained intact. Foreign members of the map trade, like Herman Moll and John Rocque, operating outside the formal boundaries of the City of London, appear never to have felt the need to affiliate to a company, but they were exceptions. Throughout the eighteenth century, most mapmakers still belonged to one or other of the companies. The advantages of mutual support, social cohesion, possibilities of collaboration, and even simple family sentiment ensured that this remained the case.

The later seventeenth century was a time of considerable enterprise, innovation, and ambition in the British map trade, seeing, for example, the publication of the first British road atlas, the first wholly British maritime atlases, and the first large-scale and accurate maps of London. It was also a period of hesitation, projects and promises left unfulfilled, and frequent financial failure—a period of reliance on cost-paring miniature atlases, the endless refurbishing of old printing plates, and the continual recycling of outdated sources (Wallis 1978; Worms 2002).

The fundamental problem was one of chronic undercapitalization or, as the mapmaker Morden himself succinctly put it on one occasion, “irresistible Poverty” (Morden 1693, dedication). Costs of production were high, financial reward modest and uncertain, and the expense of a fresh terrestrial or marine survey was generally well beyond the means of the map trade. It was only with official aid from the state that a publication such as Greenville Collins’s *Great Britain’s Coasting-Pilot*—a maritime atlas of forty-eight folio charts, engraved in London and based on original surveys conducted by Collins between 1681 and 1688—could be brought into being (see fig. 515). Yet such official aid was seldom forthcoming.

A further problem for the map trade, still at this date almost wholly confined to London, was simply that of size. Biographical dictionaries (Tyacke 1978, 107–48; Worms and Baynton-Williams 2011) indicate that in 1693, the year the *Coasting-Pilot* was published, only a dozen individuals were actively engaged in producing maps commercially. This in itself was a form of vulnerability. Of the most significant names of the period, John Ogilby, William Morgan, Robert Greene, Joseph Moxon,

William Fisher, and Robert Walton were already dead, while Moses Pitt was incarcerated for debt. With the deaths of John Seller in 1697, Philip Lea in 1700, Robert Morden in 1703, Joel Gascoyne and Richard Blome in 1705, and John Thornton in 1708, the map trade was all but wiped out. The majority of these men left no long-term successors. The Fisher business was successfully continued by Richard Mount (who published the *Coasting-Pilot*), Walton's premises near St. Paul's passed in turn to Christopher Browne and George Willdey, and Lea's business continued in a modest way under his widow, Anne, but a second generation of sons represented by James Moxon, Jeremiah Seller, and Samuel Thornton was short-lived and made no great impact (Tyacke 1973; Worms 2002).

These were men not easily replaced. Ogilby's drive and entrepreneurship in completing his road atlas and the great map of London produced with his kinsman Morgan were of a very rare order (Van Eerde 1976). Joseph Moxon had brought a seldom matched intellectual edge to the map- and globemaking of his time. John Seller's historically poor reputation has been much modified in recent years; he is now seen as a crucial figure in the development of the trade, not just for the breadth and interest of his output but as the founder of a master-apprentice line in the Merchant Taylors' Company, which was to form the nucleus of the map trade over several generations, giving a critically important bulwark of continuity in experience and training (Worms and Baynton-Williams 2011, xii, xvii, 595–98). Philip Lea's death at the age of forty cut short a highly promising career, while his former master, Morden, is remembered not only for producing what became the standard set of maps of the English counties for upward of fifty years but also for such things as his magnificent wall map, *This New Map of y<sup>e</sup> Earth and Water, According to Wright's alias Mercator's Projection* (1699). Gascoyne, who migrated from Thames School chartmaker to land surveyor, produced the first multi-sheet county survey on a scale of one inch to one mile (1:63,360), *A Map of the County of Cornwall* (1699), establishing a standard for larger-scale mapping of the future (Ravenhill 1991; Ravenhill and Johnson 1995). Gascoyne's method of publishing by subscription also offered a potential way of financing such ventures—one that, for want of an alternative, was much adopted over the ensuing century, despite its inherent drawbacks in requiring immense patience and perseverance with often difficult subscribers and much tiresome administration, advertising, and correspondence. Thornton, Gascoyne's former master, uniquely combined his skills as a manuscript chartmaker with the publication of maritime charts and atlases. He oversaw the transition from manuscript to print in this area and made a significant

personal contribution to the charting of the wider world (Cook 1985).

The eighteenth century was a time of rapid growth in trade and overseas expansion that brought fresh challenges to the map trade. Industry and manufacturing grew apace, and the need for better maps to carry the infrastructure forward was increasingly understood. What is discernable from the 1730s onward is not a uniform and undifferentiated map trade, but a division between those who saw maps as part of a wider stock issued primarily for decorative purposes, who were content for the most part to endlessly reprint existing maps, and those of altogether higher ambition who were capable of conducting a survey if funds allowed (Hodson 2009).

Initially, the duty of 30 percent on imported maps, enacted in 1712, served to consolidate the London map trade (Howgego 1978, 17). In this period, almost by default, Herman Moll came to prominence. Moll had been employed as a highly skilled engraver in London since at least 1678, working for many of those named above, but his major works and his occupation of prominent retail premises only occurred after their demise. He enjoyed for a time a position of almost unparalleled dominance in the map trade, his work omnipresent in the publications of the time, becoming, in the words of his biographer, "Great Britain's most celebrated geographer and mapmaker of the first half of the eighteenth century" (Reinhartz 1997, 1).

Apart from Moll and (insofar as charts were concerned) Mount and his new partner Thomas Page (Adams 1993), the only other figures of real consequence were the various members of the printselling dynasties of the Bowles and Overton families: the elder and younger Thomas Bowles, later joined by John Bowles, John Overton, and Overton's sons Henry and Philip, at their various retail establishments in prime locations across London (Worms 2000). Their maps enjoy no great reputation; they were primarily print sellers and wholesalers of all kinds of engraved material, although they capitalized on what was evidently a new market in pocket maps—portable maps for working purposes with the word "pocket" conspicuously in their title, a development attested by the spate of pocket road atlases appearing from 1718 onward. The first was a reduction of Ogilby's *Britannia* by Thomas Gardner, rapidly followed by a similar work by John Senex and, in 1720, by *Britannia Depicta or Ogilby Improv'd* engraved by the young Emanuel Bowen and published by Thomas Bowles. Such road books were to join the conventional county atlas as a staple of the trade throughout the period, although few were as successful as *Britannia Depicta*, which ran to multiple editions over the years (D. Hodson 1984–97, 1:78–95; Y. Hodson 2009, 769–75).

Printsellers like Bowles also began to produce local



FIG. 474. CHARLES PRICE AND JOHN SENEX, *A NEW & CORRECT GLOBE WITH YE TRADE WINDS &C.* (LONDON: JOHN BOWLES, CA. 1740). A later issue of a pocket globe originally published by Senex and Price in about 1710,

it is contained in a wooden case bearing representations of the celestial hemispheres on its inner faces. Diameter of the original: 7 cm. © The British Library Board, London (Cartographic Items Maps C.4.a.4.[11.]).

maps of London based on a regular cycle of annual revision, marking an interesting development in terms of organization and marketing, but Moll's only serious rivals as specialist mapmakers (and much resented as such) were Price, a former apprentice of John Seller, and his protégé Senex (Worms 2004a, 6–7). Senex had been apprenticed in the Stationers to the bookseller Robert Clavell in 1695 and was made a freeman in 1706 and a liveryman in 1721, by which time he had turned map- and globemaker. Working in partnership, Price and Senex produced a number of globes (fig. 474) and a series of maps of all parts of the world between 1707 and 1711; the maps were published on two sheets of imperial paper, the particular format favored by Moll. Their partnership came to end, but Senex went on to produce a number of interesting maps and atlases, including *A New General Atlas* (1721) and *A New Map of the County of Surrey* (1729), the latter based on his own surveys, eight years in the making, and intended “as a Specimen of the rest of the Counties of England, to be performed after a new Method” (*Post Boy* [15–18 April 1721]). Senex was also involved in the publication of William Williams's one-inch map of Denbighshire and Flintshire in about 1720 and Henry Beighton's survey of Warwickshire (1728), an exceptional map (see fig. 834), far in advance of its contemporaries (Harvey and Thorpe 1959, 22–27). Senex became the leading British

globemaker of his time with an international reputation (see fig. 332), and, as a bookseller, he was the champion of the new empirical science, publishing Isaac Newton and all his protégés and disciples. Elected a fellow of the Royal Society in 1728, it is probably fair to see him as the first modern British mapmaker (Worms 2004a, 6; Woodfield 2009, 475–76).

Price had little share in Senex's success. After successive partnerships with Willdey, whose own quirky maps adorn many collections, and the instrument- and globemaker Benjamin Scott, he drifted into a period of obscurity, practicing for a time as a land surveyor before ending his career offering new sea charts at reduced prices from the Fleet Prison, where he had been confined for debt. Whether impractical, quarrelsome, or simply unlucky, his influence on the future of the map trade was nonetheless major, providing a link from John Seller to the next generation. His influence on Senex was crucial, while Scott, who later emigrated to Russia, founded a line of important globemakers, which continued through Thomas Heath to Tycho Wing and the great Adams family—the two Georges and Dudley. Price's apprentice Richard Cushee assisted Senex on the survey of Surrey and became an important globemaker in his own right (see fig. 338), followed by his widow Elizabeth, her brother William Wyeth, her son Leonard, and Cushee's own apprentice, Nathaniel Hill.





Bowen, apprenticed to Price in 1709, also founded a distinguished line of mapmakers. Already mentioned as the engraver of *Britannia Depicta*, Bowen published a fine wall map of his native South Wales in 1729, which ranks alongside the county maps of Gascoyne, Williams, Beighton, and Senex in adhering to new standards of accuracy and detail. Bowen also engraved James Corbridge's new survey of Norfolk (1730) and William Gordon's map of Huntingdonshire (at two inches to one mile, 1731). Samuel Fearon and John Eyes's *A Description of the Sea Coast of England and Wales, from Black-Comb in Cumberland to the Point of Linus in Angelsea* (1738), a survey that had crucial financial backing from a group of Liverpool merchants, was also engraved by Bowen, as were the surveys of the Orkneys by Murdoch Mackenzie the Elder, the first hydrographical charts based on triangulation, published as *Orcades: Or a Geographic and Hydrographic Survey of the Orkney and Lewis Islands* (1750) (see figs. 80 and 759).

Bowen's business was never secure and he is seen most often engraving smaller maps for magazines and travel books, but he nonetheless compiled and engraved the maps (with his own former apprentice Kitchin) for *The Large English Atlas*, published serially between 1749 and 1760. It was very far from perfect, but it incorporated material from such new surveys as there were and was undoubtedly the best county atlas produced since the days of Christopher Saxton and John Speed (fig. 475). Significantly, the project could be brought to completion only with financial help (once the hard work was done) from the big printsellers—the Bowles family and Robert Sayer, successor to the Overtons. In the end, it was a very successful publication for the printsellers, but no great profit to Bowen, who died in poverty in 1767 (Hodson 1984–97, 2:97–147).

The map trade remained small, and the business of producing better maps received welcome reinforcement from the activities of Rocque, probably originally from France via Switzerland, who was living in England by 1728. His career began by making plans of the estates and gardens of royalty and nobility, then town plans, and eventually county surveys. Examples of all three

genres are a plan of Richmond Palace (1734); plans of Bristol (1743), Exeter (1744), Shrewsbury (1746) (fig. 476), York (1750), and the two great maps of London (both dated 1746 [see fig. 878], although the map of the built-up area was not published until 1747); and maps of Shropshire (1752), Middlesex (1754), Dublin (1756), Berkshire (1761), and, posthumously, Surrey (1768). It was work that was never particularly financially rewarding but was continued by some of his assistants and colleagues in the London Huguenot community—Pierre André (Peter Andrews), James Dorret, Bernard Scalé, and, in particular, Andrew (André) Dury, who himself produced fine maps of Hertfordshire (1766), Louth (1766), Kent (1769), and Wiltshire (1773), often in partnership with John Andrews.

Dury also produced plans of New York, Boston, and Philadelphia (all 1776), as well as some of the surveys of Bengal by James Rennell, as British engagement with the wider world had become a key component in dictating the output of the map trade. Maps compiled from primary and secondary sources demonstrated the spread of the principles of mathematical cosmography within the trade. Henry Popple's *A Map of the British Empire in America* (1733) (see fig. 212), engraved by William Henry Toms and incorporating a note of approval from the astronomer Edmond Halley himself, was a highlight of the earlier part of the century, while John Mitchell's *A Map of the British and French Dominions in North America* (1755) (see fig. 282), engraved by Kitchin, would be used to guide negotiations for the 1783 Treaty of Paris and as such became the founding map of the infant United States.

Kitchin, Bowen's son-in-law, was the first of his apprentices to come to prominence, producing the first pocket atlas of Scotland, *Geographia Scotiae* (1748–49), working on *The Large English Atlas* with Bowen, as well as a smaller version published as *The Royal English Atlas* in about 1764, producing his own road book, *Kitchin's Post-Chaise Companion* (1767), and engraving Peter Perez Burdett's survey of Derbyshire (1767; see fig. 903) and Andrew Armstrong's survey of Northumberland (1769), as well as Bernard Ratzer's elegant plans

(facing page)

FIG. 475. EMANUEL BOWEN, AN ACCURATE MAP OF BUCKINGHAM SHIRE DIVIDED INTO ITS HUNDREDS: DRAWN FROM THE BEST AUTHORITIES, [1756]. The map is at two miles to an inch (1:126,720); from Bowen's serially published *The Large English Atlas* (London: For J. Tinney and R. Sayer; T. Bowles; J. Bowles and Sons, 1749–60), pl. 6. The character of this map as a compilation of various sources is evident in its display of a range of cultural and antiquarian information, from the sites of horse races to the seats of the nobility; overtly practical information included

the days when each market was held and the measured mile-ages between the market towns. Bowen's atlas of one-sheet county maps constituted the last traditional effort in county mapping before the widespread undertaking of detailed, large-scale county surveys; the survey of Buckinghamshire sponsored by Thomas Jefferys would appear in four sheets, at one inch to the mile (1:63,360), in 1770.

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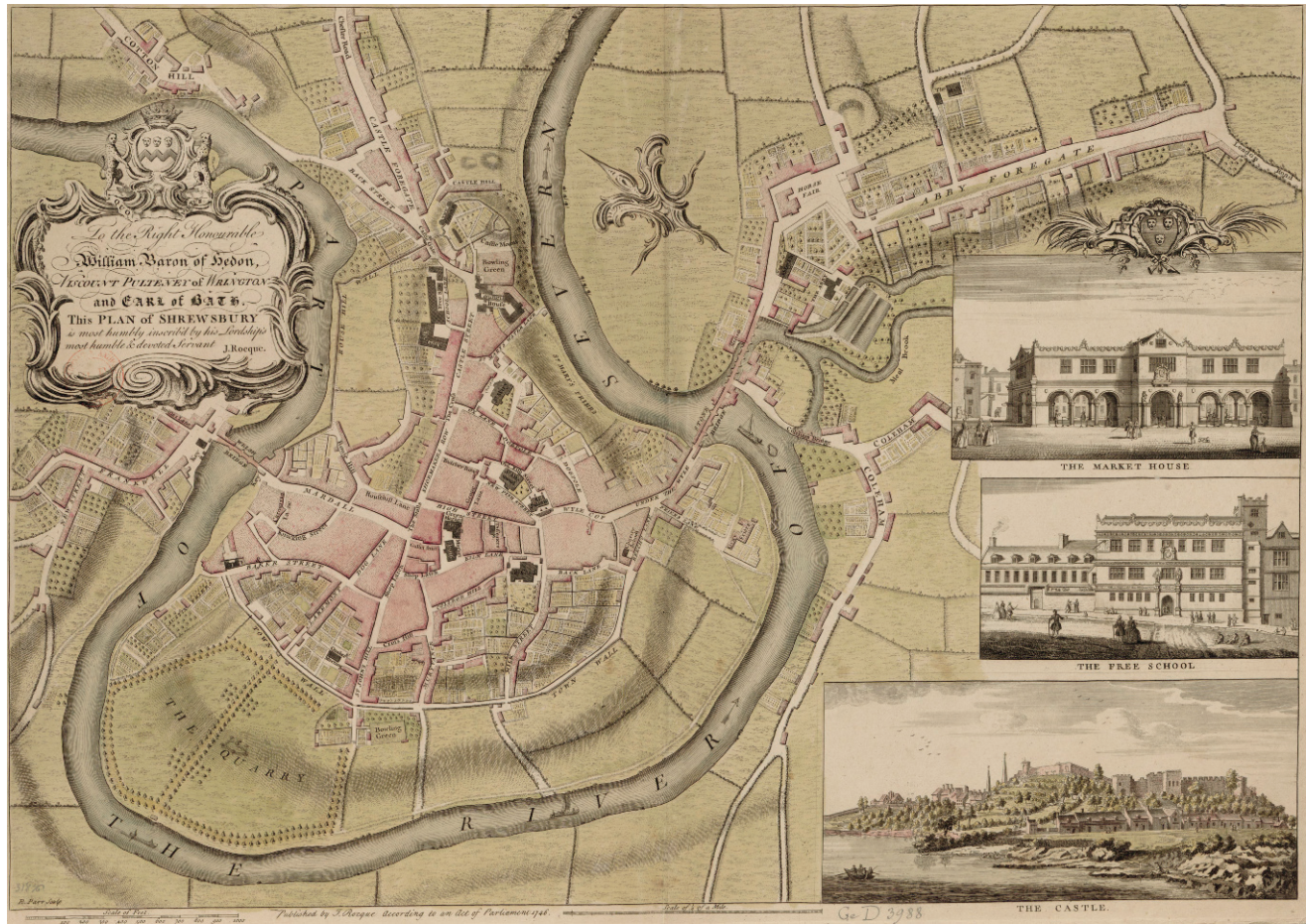


FIG. 476. JOHN ROCQUE, *THIS PLAN OF SHREWSBURY* (LONDON: J. ROCQUE, 1746). Rocque's map of Shrewsbury, engraved by Richard Parr, with inset images of the Market House, the Free School, and the Castle. Copper engraving on paper, scale ca. 1:3,250.

Size of the original: 45 × 63 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge D 3988).

of New York (1769–70); Ratzler's works exemplified how military engineers turned to the London trade to meet popular interest in important North American sites of conflict. Another new market opening up for map-makers and engravers, especially from the midcentury onward, was furnishing maps for increasingly popular periodicals and guidebooks. The 170 maps Kitchin produced for the *London Magazine* alone between 1747 and 1783 offer in themselves a comprehensive summary of the preoccupations of the period (Hodson 1984–97, 2:147–59; Worms 1993; Jolly 1990–91, 1:89–143).

While maps and plans of London were a staple of the map trade (Howgego 1978), plans of prosperous and fast-growing towns throughout Great Britain also appeared in increasing numbers (Kain and Oliver 2015, 78–88). Another of Bowen's apprentices, Jefferys, produced a sequence of town plans of the industrial midlands, including Noble and Butlin's plan of Northamp-

ton (1747), Samuel Bradford's plans of Coventry (1750) and Birmingham (1751; see fig. 424), and Isaac Taylor of Ross's Wolverhampton (1751). Jefferys became a major figure in the mapping of North America, publishing, inter alia, Joshua Fry and Peter Jefferson's *A Map of the Most Inhabited Part of Virginia* (1753), *A Chart of North and South America* (1753) by John Green (i.e., Bradock Mead) (see fig. 342), William Gerard De Brahm's map of South Carolina (1757; see fig. 194), Joseph Blanchard and Samuel Langdon's *An Accurate Map of His Majesty's Province of New-Hampshire* (1761), the first published of that colony, and several others, as well as numerous charts—not least Captain James Cook's *A New Chart of the River St. Laurence* (1760), the first major chart by Cook to be published (Worms 2004b, 22).

Jefferys, who received the formal title by royal warrant of geographer to the king in 1760, made a major

contribution to county mapping. He surveyed, engraved, and published maps of Bedfordshire (1767); Huntingdonshire (1768); Oxfordshire (1769); Buckinghamshire (1770); Westmoreland (1770); and Yorkshire with inset town plans of Kingston upon Hull, Leeds, Ripon, Scarborough, Sheffield, and York (1771–72). These works appeared despite his bankruptcy in 1766, almost certainly occasioned by the sheer cost of undertaking the surveys (Harley 1966).

Much has been made of the decision in 1759 by the Society of Arts to offer a prize of £100 for any fresh original county survey at one inch to the mile, but how much influence this actually had in prompting new work is debatable (Harley 1965, 60–62). Certainly there was a significant increase in this kind of activity over the next forty years—some sixty or so maps of this kind were produced—but the awards were seldom and somewhat arbitrarily made, and compared with the actual costs of a survey of the requisite standard, they can only have had a marginal impact; Benjamin Donn's map of Devon (1765), engraved by Jefferys and winner of the inaugural prize, was stated to have cost some £2,000 (Williamson and Macnair 2010, 43n36). Their importance was perhaps mainly in defining a minimum modern standard for such mapping. Both Jefferys and Dury were probably more influenced by a desire to continue the work of Rocque, who had died in 1762. Above all, the quality of surveying equipment improved sharply from the mid-century on, and the new mapmakers made better maps simply because they now could.

Jefferys also explored a quite different new market in producing map-based games and puzzles—a market further developed by his apprentice John Spilsbury, who made the first commercially produced English jigsaw puzzles. As the Industrial Revolution took hold, another new demand on the map trade was the production of plans to accompany proposals and reports—plans for canals, improvements to river navigation, and new docks and harbors—a genre in which both Kitchin and Jefferys were prominent.

Jefferys died in debt in 1771, and there is a momentary sense of the map trade once again stalling. Bowen, Rocque, and Jefferys were dead, while Dury was by now in difficulties of his own and not long to live. Kitchin was still working, engraving Armstrong's map of the Lothians (1773), for example, but he was perhaps too cautious to commit to launching surveys on his own account. He had, after all, seen what had happened to Bowen and Jefferys and was now in any case in quasi-retirement in St. Alban's. Even the Bowles family was finally beginning to run out of steam as far as maps were concerned. The best part of the trade was now in the hands of one man, the printseller Robert Sayer (see fig. 459).

Sayer, who had joined the Stationers through redemption in 1748, had acquired the stock, premises, and, just as importantly, the national and international wholesaling network of Philip Overton and was well placed to exploit a fast-growing market in topographical, sporting, humorous, and fine-art prints (Clayton 1997, 220–21). He published Thomas Martyn's important new map of Cornwall in 1748, shared in the publication of *The Small British Atlas* with Rocque in 1753, and became a partner with the Bowles family in Bowen and Kitchin's *Large English Atlas*. An early interest in sea charts was evidenced by his republication of Cyprian Southack's *The New England Coasting Pilot* in partnership with William Herbert in 1757 and of *A Chart of the British Channel* with Jefferys in 1759. He was astute enough to publish, in partnership with Carington Bowles, Joseph Ellis's *The New English Atlas* (1765), more convenient in size than the comparable Bowen and Kitchin atlases and a great commercial success, running through multiple editions into the nineteenth century (Hodson 1984–97, 3:26–51). His financial strength enabled him not only to assist Jefferys at the time of his bankruptcy, sharing with Jefferys in the publication of *A General Topography of North America and the West Indies* (1768), but also to acquire a substantial portion of Jefferys's stock. In partnership with John Bennett in the 1770s, he published a fine sequence of American atlases based on Jefferys's work, including *The American Atlas* and *The North American Pilot* (both 1775). Within a few years, Sayer became the leading British chart publisher, eclipsing the now arthritic firm established long ago by Mount and Page and assuming an ascendancy over such other practitioners as the idiosyncratic John Hamilton Moore, despite losing a legal case over copyright to Moore in 1785, and David Steel (who himself lost a similar case against Moore in 1789) (Fisher 2001, 23–25).

Maps remained a relatively small part of Sayer's stock. A rough estimate of the material in the Sayer and Bennett catalog of 1775 would suggest that maps made up less than 20 percent of it, but this was still a large number of maps, including old maps by Moll, John Seller's Kent (almost a hundred years old), Senex's Surrey, and Bowen's South Wales, but also much more recent material—the best part of the stock of Jefferys and Rocque, including Rocque's maps of London and three of Jefferys's county surveys, although it is noticeable that Sayer had only bothered to acquire the three most popular. Sayer was sage in his understanding of what would and would not sell, becoming, in marked contrast to most of the rest of the map trade, a very wealthy man.

No one in the map trade could rival Sayer until the appearance on the scene of the young William Faden. Born just across the road from Sayer's shop in 1749, Faden

was the son of a printer and trained as an engraver. He presumably had some earlier experience working with Jefferys, and by 1772 the nominally defunct business at the corner of St. Martin's Lane had been revived under a new name, a partnership styled "Jefferys & Faden" or "Faden & Jefferys," between Faden and Jefferys's teenage son, Thomas Jefferys the Younger, born in 1755 and apprenticed to his father in 1769. Both were novices, but before long the partners were making fresh maps of their own and were in correspondence with many of the leading European mapmakers to import what were the best available maps being produced abroad (Pedley 2000, 10–12). By January 1774 their *A Catalogue of Modern and Correct Maps, Plans, and Charts* was ready to be published.

The younger Jefferys soon dropped out, but with the assistance of Jefferys's old employees and associates—John Ainslie, apprenticed to Jefferys in 1762, Joseph Hodkinson and Thomas Donald, both of whom had carried out surveys for Jefferys, as well as Dury, a useful point of contact with the French trade—Faden was soon making a mark. In 1776, at the age of twenty-six, he became an active member of the Society of Civil Engineers (the Smeatonian Society), the circle that surrounded John Smeaton, the leading civil engineer of the day, comprising almost all the leading engineers of the Industrial Revolution, which is to say the men who were changing the face of Britain. Faden almost always engraved and printed their requisite maps and plans.

The outbreak of the American Revolution gave Faden opportunity for a rapid outflow of war-related maps: plans of the latest battles and campaigns engraved, printed, and on sale within days of the dispatches arriving in London. He was importing the best and most recent maps produced overseas, and his own material was starting to travel in the opposite direction: many of his charts were bought on behalf of the French *Dépôt des cartes et plans de la Marine* and in many cases formed the primary source for the *Dépôt's* official French marine charts of North America (Pedley 2005, 145–55).

Faden was appointed "to the place and quality of Geographer in Ordinary to his Majesty" in 1783 (Kew, *The National Archives of the U.K.* [TNA], LC3/67, p. 154) and from unpromising beginnings was rapidly building up by far the best and largest stock of large-scale maps to be had in the British Isles, systematically acquiring, revising, and updating the plates of the best available county surveys. He bought back from Sayer, at some stage, Jefferys's map of Yorkshire, as well as acquiring the best of the county surveys of Rocque, Taylor, and Dury. He added Burdett's Cheshire (1777); William Yates's Lancashire (1786), one of the best maps of the period, made from carefully measured baselines and properly executed triangulations; and Yates's Staffordshire (1775)—buying the plates in 1789 for £95 (a

small figure given what the survey must have cost to produce and one that provides its own commentary on the fraught economics of publishing this type of map) (Pedley 2005, 226)—and dozens more: the best of modern work, all from surveys made in his own lifetime and all at a one-inch scale or larger.

Not only did Faden acquire existing maps, he commissioned and published numerous new maps on his own account, including Thomas Eyre's map of Northamptonshire (1779), the first large-scale map of that county; the first large-scale map of Jersey (1783); Joseph Hodkinson's Suffolk (1783); Thomas Milne's Hampshire (1791), advertised in the cartouche as "executed and Published at the private expence of the Proprietor W. Faden" (and for which he was rewarded by the Society of Arts); Donald and Milne's Norfolk (1797), yet again the first map of the county at one inch to the mile—the costs for the survey of which had already reached the sum of £2,000 in 1794 (for a map sold at the modest price of two guineas)—and many more, and this is to say nothing of his impressive array of town plans and maps of the wider world. Faden did not compromise. If there was no satisfactory map of a given area, then he did not stock one at all. And never once, in a career spanning over fifty years, did he fall back on the old standby of the county atlas. He was entirely a maker of serious maps for serious purposes.

No less serious, in their different ways, were Faden's contemporaries John Cary and Aaron Arrowsmith. Cary was trained as an engraver by William Palmer, a mapmaker and engraver who had worked with Dury, Ellis, Alexander Dalrymple, Faden, Sayer, and the globe-maker John Newton, as well as training an impressive list of specialist map engravers. Cary's delicate and distinctive engraving style gave a fresh and modern look to all his output, to the extent that some commentators have taken it to be more modern than perhaps it was. The first of his many road books, *Cary's Actual Survey of the Great Post Roads between London and Falmouth*, was published in 1784, the roads in fact surveyed by Arrowsmith (Fordham 1925, 17–18; Smith 1988). Cary was subsequently officially employed by the Post Office to make measurement of the mail roads, giving his road maps a valuable stamp of authority and approval. *Cary's New and Correct English Atlas*, first published in 1787–88, made ample use of recent new surveys, completely superseding all earlier compilations to become the best-selling county atlas of the period (Hodson 1984–97, 3:172–98). Unlike its predecessors, it underwent a program of ongoing revision, to the extent that wholly new printing plates were required by 1809. *Cary's New Map of England and Wales, with Part of Scotland* (1794), published in atlas format to cover the whole country at a scale of five miles to the inch, was another pioneering and enduringly popular map. Cary

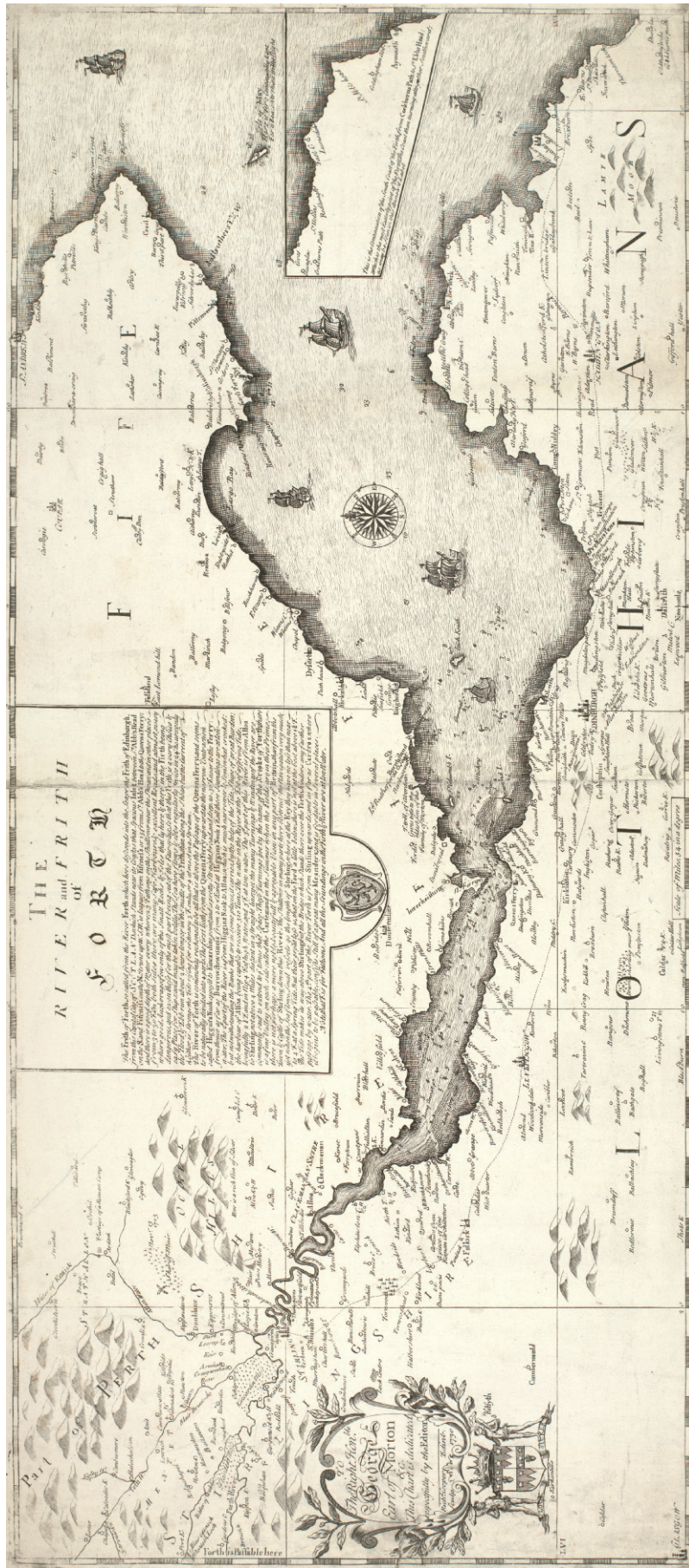


FIG. 477. [JOHN ADAIR], THE RIVER AND FRITH OF FORTH (EDINBURGH: RICHARD COOPER, 1730). Engraving on paper, scale statement reads "Scale of Miles, 54 in a degree." Cooper engraved and published several of Adair's manuscript maps after 1725 without, as here, necessarily crediting Adair as the author. Size of the original: 30.1 × 70.7 cm. Image courtesy of the National Library of Scotland, Edinburgh (EMS.s.738[4]).

was also a successful globemaker, working in tandem with his brother William.

Arrowsmith's background is a little obscure, but his presence as a signatory of Dury's will in 1777 strongly suggests with whom he may have learned his trade. Though he practiced as a surveyor in the 1780s, a world map in 1790 made his reputation. His *A Map Exhibiting All the New Discoveries in the Interior Parts of North America* (1795) was the best of the continent since the Mitchell map published forty years earlier. His maps were characterized by the rigorous exclusion of all dubious or unsupported information, the inclusion of the very latest material, and prompt revision in the light of fresh survey. They were often accompanied by memoirs detailing Arrowsmith's sources. He soon gained an international reputation and his large maps were in much demand by official bodies (Tooley 1979).

Outside London, the publication of maps remained somewhat sparse throughout the century, but in Dublin, George Grierson was publishing his own versions of the Moll atlases and other material from 1730 onward. Rocque based himself in Dublin, with Dury, for some years during the 1750s, producing some of his finest work. He gave employment to local engravers, and from then Dublin was home to reasonably continuous activity, mainly in producing local maps but some of greater ambition. Wales saw little more than the impressive maps of North Wales and Shropshire produced by Robert Baugh of Llanymynech late in the period. The unusual and enterprising surveyor Isaac Taylor of Ross (Smith 2006) on the Welsh borders produced some attractive maps including town plans of Oxford and Wolverhampton (both 1751) and large-scale county surveys of Herefordshire (1754), Hampshire (1759), Dorset (1765), Worcestershire (1772), and Gloucestershire (1777). In Oxford, the elder Benjamin Cole was producing maps even before 1700. By the late eighteenth century, most of the larger towns were producing local maps. In Liverpool, Thomas Billinge engraved some of the county surveys by Yates and Burdett. Liverpool was to go on to become an important center, with John Jones having a navigation warehouse there stocking charts by William Heather and others in about 1800.

In Scotland, cartographic publishing began rather ear-

lier. John Adair was given a license (and financial aid in 1686 through a levy on Scottish shipping) to survey the entire country and its coasts and to produce maps and charts. Some of his work was engraved by James Moxon and published in Edinburgh at the time, while further charts engraved by James Clark (who had earlier worked for Seller) appeared as *The Description of the Sea-Coast and Islands of Scotland, with Large and Exact Maps, for the Use of Seamen* (1703), but most of Adair's work remained in manuscript. It was the arrival of the English engraver Richard Cooper in 1725 that established a permanent school of engravers in Edinburgh, with Cooper himself finally putting much of Adair's work into print (fig. 477) (Worms and Baynton-Williams 2011, 1–3; Moore 2000, 48). The Scottish surveyor John Laurie published *A New and Correct Map of Midlothian* (1763), an early published map showing spot heights. Cooper's apprentice Andrew Bell also produced some fine maps and, interestingly, was one of the original proprietors of the *Encyclopædia Britannica*, first published in Edinburgh between 1768 and 1771. Edinburgh of the Scottish Enlightenment (the Edinburgh of Adam Smith and David Hume) became a center of academic publishing. The return of Ainslie to his native Scotland gave further momentum to the map trade. Trained under Jefferys, Ainslie accomplished in Scotland what Faden had in England; their maps were often copublished. He was the first to make Edinburgh a genuine force in the map trade and laid the basis for the Edinburgh publishers of the nineteenth century, such as William Johnston and Alexander Keith Johnston, and in particular George Bartholomew and his son John (trained as engravers in a direct master-apprentice line from Cooper and Bell) to become leading international cartographic publishers.

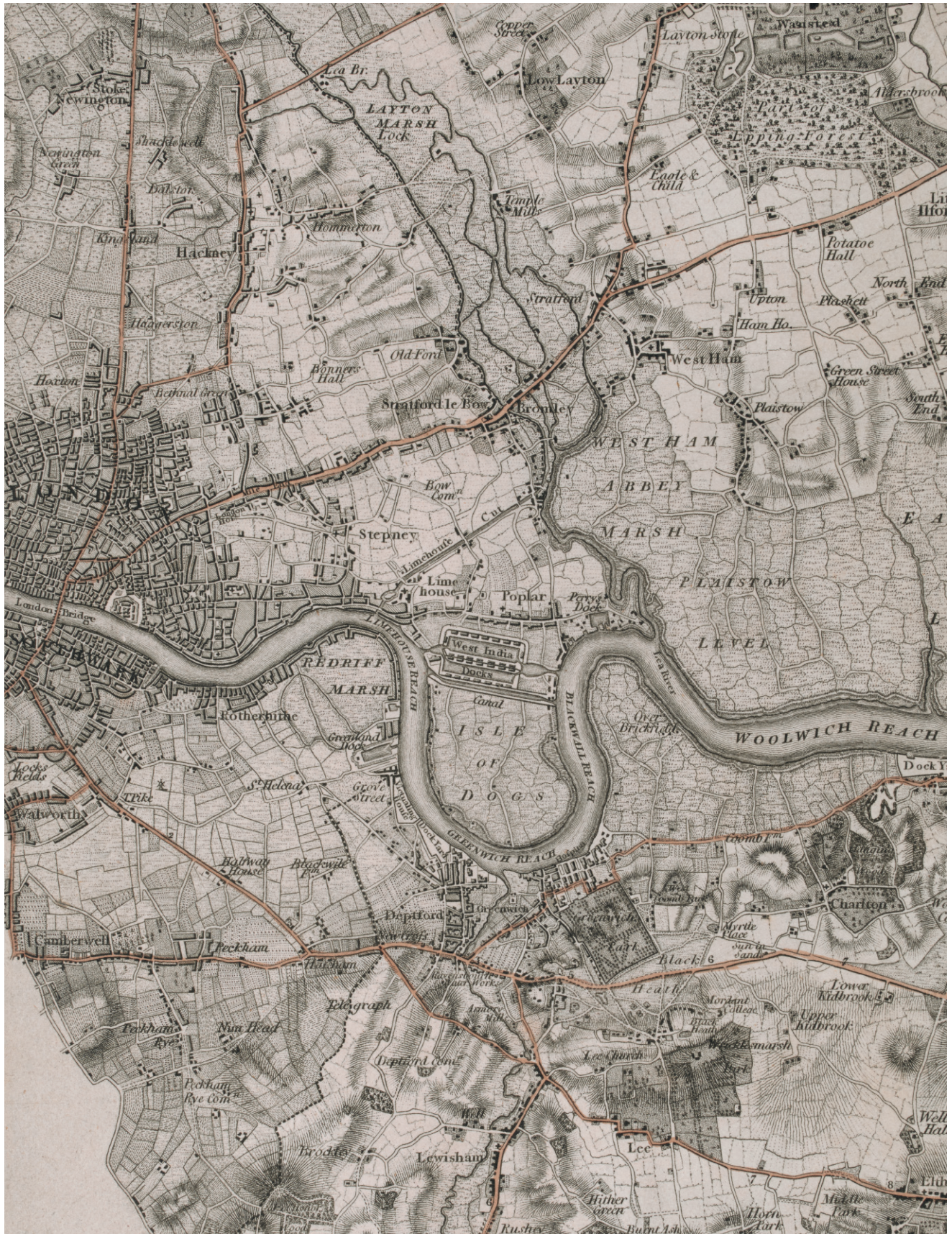
Mapmakers, or at least some of them, had become more prosperous by the very end of the eighteenth century, but the old problem of financing original surveys had not gone away. When the Board of Ordnance finally began to pursue a detailed survey of the country, or at least initially those areas under threat from French invasion, Faden drew on his connections with the Board to turn the military surveyors' work into commercial products. The cross-connections were apparent; many of those concerned were fellow Smeatonians, including the

(facing page)

FIG. 478. DETAIL OF EASTERN LONDON, 1801. This detail shows the full range of engraving techniques employed to represent land use, elevation, built-up areas, and lettering styles for hierarchies of place-names in the Board of Ordnance's map of Kent, one inch to the mile, published by William Faden. The map's title indicates its status as the first product of the future Ordnance Survey: *General Survey of England and Wales: An Entirely New & Accurate Survey of the County of Kent* (Lon-

don: William Faden, 1801), in four sheets; the detail is from sheet 1. Note that the Board's surveys of Kent would be later reduced and reengraved on smaller printing plates as the first six sheets of the countrywide map series.

Size of each sheet: 90 × 62 cm; size of detail: ca. 65 × 50 cm. © The British Library Board, London (Cartographic Items Maps 8.c.38).



instrumentmaker Jesse Ramsden and William Mudge, superintendent of the Board's survey activities from 1798. Triangulation data from the Board of Ordnance surveys was used for the topographical map of Sussex, surveyed by William Gardner and Thomas Yeakell (see fig. 835), completed by Thomas Gream, and published in 1795 by Faden, who then reduced the new military survey of Kent to the one-inch scale, publishing it on 1 January 1801 as the first product of what would become the Ordnance Survey (fig. 478). Thereafter, the Board of Ordnance became its own publisher, and former Faden employees, the engravers Foot and Benjamin Baker, went to work at the Tower of London, where the Board was based. Baker became the overseer of printing and engraving in 1804, while Faden continued to act as the agent for retail distribution (Oliver 2014, 60, 66–75).

The establishment of the Ordnance Survey has sometimes been seen as a kind of watershed, representing a more responsible and authoritative means of publishing maps, divorced from the uncoordinated and what might seem to be haphazard practices of the traditional map trade. In fact, the traditional British map trade was, through a variety of personal, business, and family connections, more cohesive and continuous than previously supposed. The life of the Ordnance engraver Benjamin Baker illustrates this, both in his training and in his family connections (Worms and Baynton-Williams 2011, 37–38). He followed John Cary as an apprentice (in 1782) to Palmer, whose own master was John Pine, one of the finest engravers of the eighteenth century, and the engraver of Rocque's large map of central London (1746). Pine had died halfway through Palmer's apprenticeship, leaving Palmer to serve the remainder of his time under the map engraver Richard William Seale, creating a double line of map trade tradition and training. The Seale apprenticeship line takes us directly back to Senex. Thus, Baker was steeped in the best of the map trade traditions. These were compounded by ties of family and kinship. Baker's father and grandfather, both Edward Bakers, were instrumentmakers. His grandmother belonged to the Cole family of engravers, instrumentmakers, and globemakers. Baker's sister, Mary, married John Newton of the globemaking family, who was for a time in partnership with Palmer. Baker's first wife was Sophia Mary Ellis, daughter of the map engraver Joseph Ellis, granddaughter of Seale, and niece of Palmer. Joseph Ellis and Palmer of course worked together on *The New English Atlas* (1765). In the life of Benjamin Baker, the Ordnance Survey is perhaps better interpreted as a culmination of existing practice than as its antithesis (fig. 479).

By the end of the eighteenth century, the trade in marine charts had also come into the province of publicly funded mapping. The Admiralty had long given occa-



FIG. 479. TRADE CARD OF BENJAMIN BAKER OF ISLINGTON, CA. 1795. Engraving on paper. Baker's trade card incorporates a map of Islington: to the right of the cartouche, a pointing finger picks out Baker's own premises on the High Street. Size of the original: ca. 11.5 × 7.5 cm. © The Trustees of the British Museum, London (Banks, 59.7).

sional assistance in the preparation and publication of charts, as in the case of J. F. W. Des Barres and *The Atlantic Neptune* published by the Admiralty (though not without a lengthy dispute over money) between 1775 and 1781 (Hornsby 2011). Such intermittent and ad hoc arrangements were unsatisfactory, and the Hydrographical Office of the Admiralty was established in 1795 under Dalrymple, hydrographer for the East India Company from 1779. The Hydrographical Office was created partly to improve on existing practice but also specifically to collect and publish charts. The first Admiralty chart was published in 1800, but by 1807 still no standard set of charts for use by the navy was available. A committee of experienced officers was appointed



to examine every obtainable existing chart, both public and private. Of the two hundred they selected for official use, half came from the private map trade (and half of those from Faden, who had frequently published the exceptional charts of Louis Stanislas d'Arcy De la Rochette). Admiralty charts were not sold to the public until 1823, and the familiar "blueback" charts (so called from their protective backing of blue sugar paper) of the private practitioners such as Robert Blachford, James Imray, Sayer's successor Robert Laurie, William Heather, John Norie, and Charles Wilson remained a familiar sight throughout the nineteenth century (Day 1967; Fisher 2001).

As it stood, at the close of the eighteenth century, the combination of public and private was close knit and in harmony, a full flowering of a well-worked tradition. Under the leadership of the triumvirate of Faden, Cary, and Arrowsmith, alongside the globemaking Adams family and the new state-funded agencies, British cartography was poised to be considered among the best in the world.

LAURENCE WORMS

SEE ALSO: Adair, John; Games, Cartographic; Great Britain; Jefferys, Thomas; Map Collecting: Great Britain; Marine Charting: Great Britain; Ogilby, John; Urban Mapping: Great Britain

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**Map Trade in British America.** The history of the map trade in British America was one of persistent dependence on the importation of maps from Britain and of steady expansion in conjunction with the general book trade. The colonial American trade was distinguished from the European trades by a lack of regulation: no trade guilds, church officials, or government entities regulated or prescribed the activities of British American map vendors.

The printing of maps and charts made by British Americans, whether engraved and printed locally or in Britain, was only a sporadic, if notable, segment of the colonial map trade (Wheat and Brun 1978). A variety of Americans, including merchants, artists, engravers, schoolmasters, and clergymen, made maps, although few of their efforts enjoyed financial success or achieved more than a local or regional audience (Bosse 2007, 3). These momentary mapmakers typically issued a single title and always marketed their own publication, frequently relying on sales by subscription. Often the map itself states its availability from its maker, as in the case of a 1756 chart of Delaware Bay by Philadelphia merchant Joshua Fisher, which also lists the subscribers (fig. 480).

Only after 1790, and the creation of the United States of America, did publisher Mathew Carey of Philadelphia first infuse capital and stability into what had previously been a precariously funded ad hoc enterprise (Harley 1977). In 1790, Boston auctioneer and merchant Matthew Clark became the first American to publish a set of sea charts, aided by Osgood Carleton, mapmaker and philomath, and engraver John Norman. Although entirely based on English charts, Clark's untitled atlas established Boston as a center of chart production for the ensuing decade (fig. 481). Norman and his son William later issued the *American Pilot* and other titles that became staples of the chart trade (Bosse 1999, 49–52). Yet

even as American mapmakers increased production and began to publish atlases and globes, and as war taxes raised the price of British printed goods (Raven 2000, 195–96), most American retailers continued to import and sell British cartographic products.

The North American colonies steadily developed into a principal market for British book and map publishers (Raven 2000), and for much of the seventeenth and eighteenth centuries the map trade in British America largely consisted of American colonists purchasing more-or-less contemporary British products. French, Dutch, and German maps and atlases, as well as antiquarian works of various origins, were also sold, but these accounted for a minor portion of the trade. With imported maps dominating the market, American merchants and booksellers relied on trading partners for securing cartographic products. In some cases, American retailers dealt directly with cartographic publishers, but more often they placed orders with their British counterparts. For example, during the time that he operated a printing office and bookshop in Philadelphia, Benjamin Franklin ordered atlases, maps, and globes from bookseller William Strahan in London, although these amounted to only a fraction of their trade together (Franklin 1959–, 3:21; 4:323, 353). American retailers also provided one another with cartographic products. Thus, beginning in 1771, the daybook of printer, engraver, publisher, and mapseller Robert Aitken of Philadelphia records sales of British and American maps, atlases, and globes, often to American merchants and booksellers (Bosse 2007, 6).

The composition of the American map trade only superficially resembled that of Britain. In London, vendors of maps, charts, and globes were largely drawn from the ranks of the print trades, particularly print- and booksellers, engravers, stationers, and printers. Until the 1670s, the colonial economies supported few specialized booksellers and printers. In their absence, general merchants retailed both books and maps, and some occasionally carried maps and atlases. Even as specialized retailers developed in the major ports—such as the Boston bookseller Michael Perry, who served as a source of cartographic products from an early date, as evidenced by an inventory of his store taken at the time of his death (Ford 1917, 163–82)—general merchants in outer areas and other specialized merchants in the ports continued to find opportunities to sell cartographic products. A variety of tradesmen took advantage of the unrestricted nature of the trade to temporarily sell maps and atlases. Notices in newspapers show that individuals as diverse as hatmakers, apothecaries, grocers, carpenters, tavern keepers, upholsterers, and bakers occasionally sold maps in the American colonies and early republic. The close connection between applied mathematics and cartography led the makers of mathematical instruments

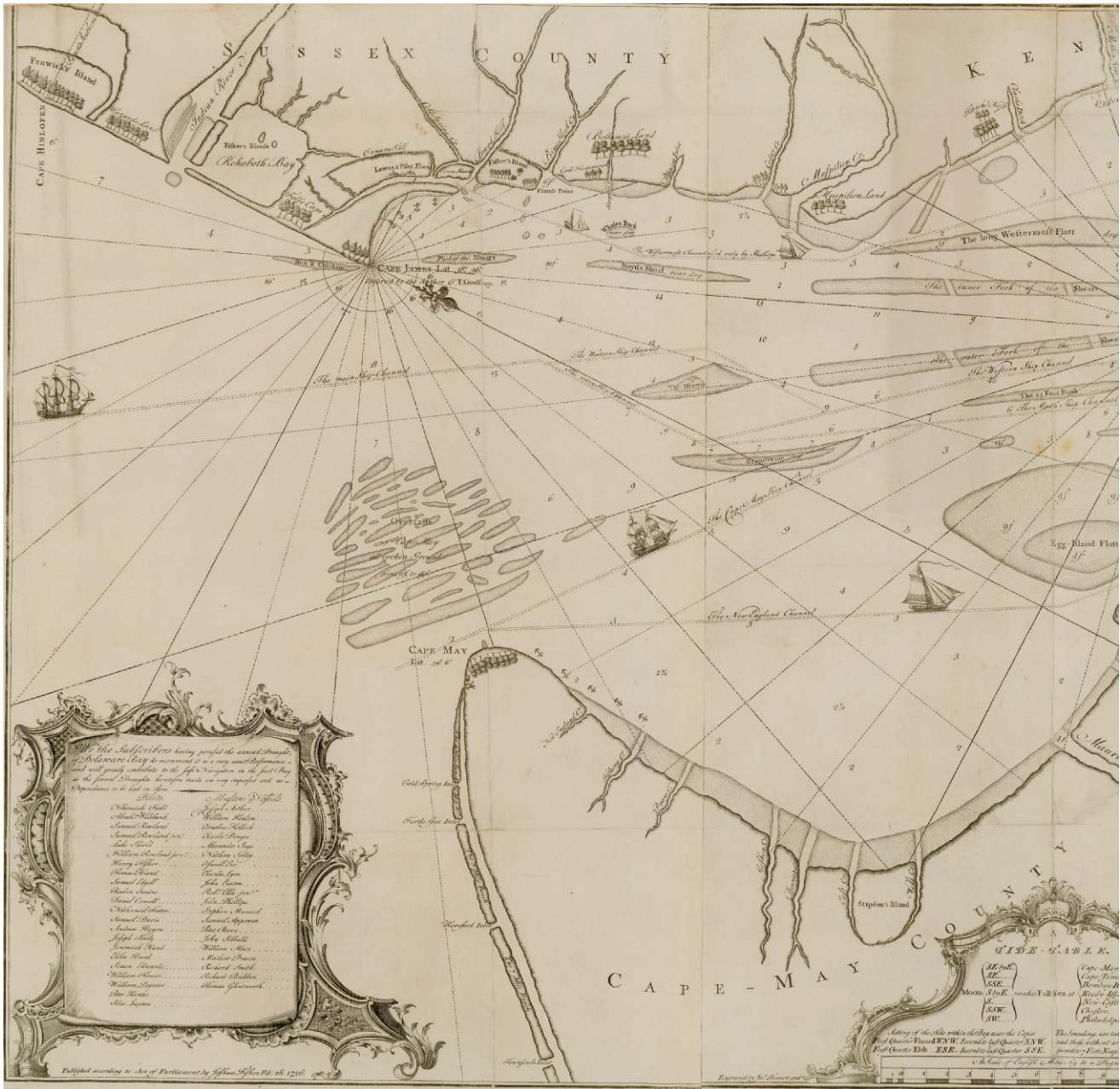


FIG. 480. DETAIL FROM JOSHUA FISHER, CHART OF DELAWARE BAY FROM THE SEA-COAST TO REEDY-ISLAND (PHILADELPHIA, 1756). Engraved by James Turner, Fisher underwrote production of the map by raising subscriptions and further listed it as being “sold by the author in Front-Street Philadelphia.” The subscribers were all pilots and ships masters who certified the quality of the chart.

Size of the entire original: 60 × 115 cm; size of detail: ca. 60.0 × 61.5 cm. Image courtesy of the John Carter Brown Library at Brown University, Providence (Cabinet/cc756/1/Oversize).

such as compasses and quadrants to trade frequently in maps and charts. Ship chandlers stocked all manner of maritime stores and commonly sold charts and maps. Maps were also featured in auctions organized by merchants and booksellers, whether in their own merchan-

dise or in the libraries and household goods consigned by nonspecialists (Bosse 2007, 10–14). Many of the booksellers, printers, bookbinders, engravers, and stationers who constituted the American print trades also engaged in selling cartographic prod-



of practical need for cartographic and geographical information meant that their market for maps was amply served by works produced abroad, primarily in France and Holland. The geographical maps produced in Rome and Venice were the only ones that managed to find a market outside Italy during the course of both the seventeenth century (when the European market was dominated by French and Dutch atlases) and the eighteenth century (when additional competition from the German cities of Nuremberg and Augsburg asserted itself). However, one should note a clear difference here from the situation during the Renaissance, when the copperplate prints produced in Rome and Venice were linked; not only were engraved plates and prints exchanged between the two centers but printers and publishers were active in both cities. In subsequent centuries, this link was broken; the cultural dialog was no longer between Rome and Venice but between each city and its market beyond the boundaries of Italy. The relationship with French and Dutch cartography was now a direct one, and Rome and Venice no longer exchanged cartographic information. Thus, Giacomo Cantelli da Vignola in Rome and Vincenzo Coronelli in Venice might have been contemporaries, but they were far from being competitors. One might say that they ignored each other.

As for other Italian cities, historical reasons account for their lack of workers with the technical skills and abilities required to produce cartographic engravings. Florence and Turin, for example, had a developed market for prints and books, but its engravers never acquired the necessary skills to produce cartographic engravings, with the notable exception of Sir Robert Dudley's *Arcano del Mare* (1646–47, 1661), engraved by Antonio Francesco Lucini (Woodward 2007, 793–94). While the illustrations of architectural monuments, views, and city maps within the *Theatrum statuum regiae celsitudinis Sabaudiae ducis* (known as the *Theatrum Sabaudiae*) were entirely the fruit of surveys and drawings by local artists and technicians (including Giovanni Tomasso Borgonio and Giovenale Boetto), the plates themselves had been engraved and published in Amsterdam, by Joan Blaeu in 1682 (Sereno 2007, 847–53). In general, only in the last quarter of the eighteenth century were the first atlases produced by local engravers and printers in Florence and Tuscany (Valerio 1993, 185–87).

Other key factors in the development of independent production of cartographic works and the establishment of new centers of printing and publishing were the reform in education and the nascent interest in geography noticeable from the second half of the eighteenth century onward. Clearly inspired by cultural attitudes rooted in the European Enlightenment and expressed in Denis Diderot and Jean Le Rond d'Alembert's *Encyclopédie*, which focused on systematic thought and ra-

tional knowledge, educational reform developed from a greater diffusion of cultural ideas and produced a lively interest in the organization of education. With the introduction of new syllabi and teaching methods, public schools increased the number of both teachers and students. One consequence of this augmentation of potential consumers was that publishers, geographers, and printers competed to conquer this expanding market. Indeed, at times the courts themselves had to rule on cases regarding infringements of privileges, plagiarism, and the issuing of illegal copies (as often happened, for example, with Remondini printers of Bassano).

The success of the *Encyclopédie* within Italy is clear from the editions produced in Livorno and Padua; Remondini, in fact, also planned to produce a translation of the entire work into Italian, but nothing came of the project. A revised and extended version of the second French edition, the Padua *Encyclopédie méthodique*, included the *Atlas encyclopédique* (2 vols., 140 pls.) by Rigobert Bonne, with plates newly engraved by Pietro Scattaglia. In his "Discours sur la géographie" in the *Encyclopédie méthodique*, Nicolas Masson de Morvilliers stressed "the space of indifference we have had until now for this science in our institutions of learning" and the need to separate geography and history (1785, xiv).

The Veneto in particular saw the publication of numerous atlases intended for school use; between 1777 and 1796, Giacomo Storti published various editions of a *Nuovo atlante portatile* (312 text pages, 24 pls.), while the publisher Antonio Zatta in the last decade of the century published four school editions of his *Nuovo atlante* (20 text pages, 24 pls.). Other Venetian publishers also ventured into this expanding sector of the market. Giammaria Bassaglia published the *Nuovo atlante portatile ovvero metodo facile per apprendere in breve la geografia* (1777, 328 text pages, 24 pls.; 2d ed. 1785); Paolo Santini published the *Atlas portatif à l'usage des colleges* (1788, 63 pls.), copying the French work of the same title by l'Abbé Grénet (Paris, 1779–82) and adding new maps; and even the Remondini print works entered the school textbook market with their small *Atlas géographique . . . à l'usage des écoles, & de toute la jeunesse des deux sexes* (1801, 60 pls.), which borrowed the frontispiece of Giovanni Antonio Rizzi Zannoni's *Atlas géographique contenant la mappemonde et les quatre parties* (1762) and added new maps (from 27 to 60) while maintaining French titles and texts.

Another factor contributing to the growing interest in geography and maps during the second half of the eighteenth century was the European discoveries of islands and lands in and around the Pacific Ocean, resulting from circumnavigations of the globe. The South Seas exerted a powerful fascination over the Western imagination of the day; no atlas or geographical text produced

in Italy after James Cook's voyages in the Pacific failed to refer to them. Sometimes the authors boasted that they were the first to offer maps showing the new frontiers of geographical knowledge, as Zatta did in the introduction to his *Atlante novissimo* (1775), commenting on his map of the South Seas and New Zealand, based on Cook: "I have done nothing except simply copy it out, my sole boast being that I am the first to make an interesting map available in Italy" (Zatta 1775, 49).

The American Revolutionary War, the French Revolution, and the success of Napoleon's armies in Europe all further stimulated an interest in geography. The production of individual sheet maps or atlases made it possible to follow the unfolding of history and gain some insight into future developments. In short, at the end of the eighteenth century the image of the world was changing as a result both of emerging geographical knowledge of the Americas, Africa, and Oceania and of the political and social transformations taking place in Europe and its colonial possessions. Under these circumstances, cartography became a means to give a timely and appropriate account of such changes.

In Venice in 1758, the publisher Pietro Bassaglia issued an *Atlante geografico* of only seven plates (engraved by Francesco Grisellini) entirely dedicated to the Seven Years' War. The atlas was probably meant to accompany Bassaglia's *Storia delle operazioni militari* (6 vols. 1758–63). In the same city in 1781, Vincenzo Formaleoni published the *Teatro della guerra marittima e terrestre* with two views and forty-one maps covering the various sites associated with the American Revolutionary War, largely based on the work of Jacques-Nicolas Bellin. Interest in the British colonies in America had already led the publisher Marco Coltellini in Livorno to issue a *Gazzettiere Americano* in 1763, translated from English works, which was reissued in 1777 at the height of the war by the publisher Giovanni Tommaso Masi with the all-encompassing title *Atlante dell'America*. In fact, from the last quarter of the eighteenth century onward, Livorno became an interesting center of editorial and cartographic activity; its vast network of maritime commerce linking the city with all of Europe was managed largely by foreign residents, who were extremely interested in political and military events that might affect the flow of trade.

A similarly important commercial port was Genoa, which maintained its political independence until 1797. There, Yves Gravier, an enterprising bookdealer of French origin, sold the main works of French hydrographers. Active from the last quarter of the eighteenth century to the middle of the nineteenth, Gravier's bookshop maintained its original address ("derrière la Loge de Banchi") and reproduced maps and nautical atlases by French authors that were published with his own imprint; for

example, Joseph Roux's famous *Recueil des principaux plans des portes et rades de la Mer Méditerranée* (1764) in a Genoa edition in 1779 and 1804 (both with 123 pls.), in 1804 (163 pls.), and 1814 (179 pls.). Similarly, Gravier sold an *Atlas maritime* of maps by Bellin taken from *Le Neptune françois* and *Hydrographie française*, issuing two different editions of this work: in 1798 (32 pls.) and 1802 (37 pls.). In addition to selling his own editions, his shop also handled a large number of nautical maps from all over the world, again primarily from France. A bookshop catalog of 1818 shows that in that year the business was still selling Bellin's *Le Petit atlas maritime* (1764, 5 vols., 580 maps) and Jean-Baptiste-Nicolas-Denis d'Après de Manneville's *Le Neptune orientale* (2 vols., 1745–75) (Valerio 1993, 184).

Thanks to the large market provided by religious pilgrims and those interested in visiting sites of classical antiquity, Rome's copperplate printers tended to specialize in the genres of *vedutismo* and topography. Located at the sign "alla Pace," the De Rossi print works first ventured into cartography during the time of Giovanni Giacomo De Rossi, who reproduced the four mural maps of the continents by Blaeu in 1666 (Woodward 2007, 777–79). In 1669, the workshop began engraving the plates for the *Mercurio geografico*, a project that continued until nearly the end of the century (the first frontispiece is dated 1692), ultimately comprising 127 plates. One of the most sizeable atlases published in Italy, the *Mercurio geografico* was edited by Giacomo Cantelli da Vignola, who signed most of his maps as "geographer to the duke of Modena," a title he received from Francesco II d'Este, duke of Modena and Reggio, in 1685 (fig. 482). The production of the *Mercurio*, supported and financed by De Rossi, involved the best engravers working in Rome: Antonio Barbey, the Dutchman Jan L'Huillier, Giorgio Widman, Vincenzo Mariotti (a painter of architectural scenes), and Giovanni Battista Falda, who also produced a twelve-sheet mural map of Rome. The success of the work is proven by its presence in all the major libraries of Italy and by the fact that numerous editions, produced by Domenico Freddiani De Rossi, son of Giovanni Giacomo, were published until 1738, when the Camera Apostolica acquired all the engraved plates from Filippo De Rossi to form the core collection of what became the Calcografia Camerale.

The cartographic work of Giovan Battista Nicolosi promoted the universal nature of the Roman Church. Having moved to Rome from Paternò, Sicily, Nicolosi quickly gained favor with the city's most powerful families and in 1652 was appointed to produce a geographical work for use by the Sacred Congregation for the Propagation of the Faith (or Sacra congregatio de propaganda fide). After twelve years of study and research, he published the *Dell'Hercole e studio geografico*, in two



FIG. 482. GIACOMO CANTELLI DA VIGNOLA, *BASSA LOMBARDIA E ALTRE APPENDICI*, 1681. From Giovanni Giacomo De Rossi, *Mercurio geografico ovvero guida geografica in tutte le parti del mondo* (Rome: Alla Pace all'Insegna di Parigi, [1685?]), no. 10. De Rossi, copperplate engraving,

ca. 1:875,000. This map was one of the 127 plates of the *Mercurio geografico*.

Size of the original: 42 × 59 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (Atl 1685 Ro).

volumes with twenty-two newly devised maps. Nicolosi proposed a new projection for the construction of the world map in two hemispheres, known today as the Nicolosi projection, in which the parallels and meridians are arcs of the circle and equidistant along the equator and central meridian (fig. 483).

The last work of cartography produced in Rome toward the end of the eighteenth century came from the Calcografia Camerale itself: Giovanni Maria Cassini's *Nuovo atlante geografico universale* (1792–1801), one of the most prestigious of Italian atlases, in three volumes with 182 maps (see fig. 137). The author's introduction evoked the renewed interest in geography that blossomed in Italy during the last quarter of the century: “In the midst of this ardor for geography, which within recent years has become particularly widespread in Italy, I—spurred on by a true desire to be of use to my fellow

countrymen— . . . determined to undertake a new geographical atlas” (Cassini 1792, 20–21).

In Venice, the cartographic scene from around 1690 to the end of the first decade of the eighteenth century was dominated by the extraordinary polymath Coronelli, who flooded the market for cartographic and historical-geographical works with an extraordinary range of products; in part these were distributed via the Accademia Cosmografica degli Argonauti, a geographical society *avant la lettre* that Coronelli had set up to promote acquisition of his works. After his death there was a long period of stasis in the production of cartography within Venice, in part due to the serious stagnation of the city's economy that ended only toward the middle of the century. The first sign of recovery in the output of cartographic works was the substantial atlas published by Giovanni Battista Albrizzi, the *Atlante novissimo, che*



FIG. 483. GIOVAN BATTISTA NICOLOSI, *CONTINENTEM DVDVM NOTAM COMPONEBAT IOA BAPTISTA NICOLOSIVS S.T.D.*, 1660. From *Dell'Hercole e studio geografico di Gio. Battista Nicolosi* (Rome: Nella Stamperia di Vitale Mascardi, 1660), no. 1. Copperplate engraving, ca. 1:50,000,000.

Size of the original: 53 × 42 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (Atl 1660 Ni).



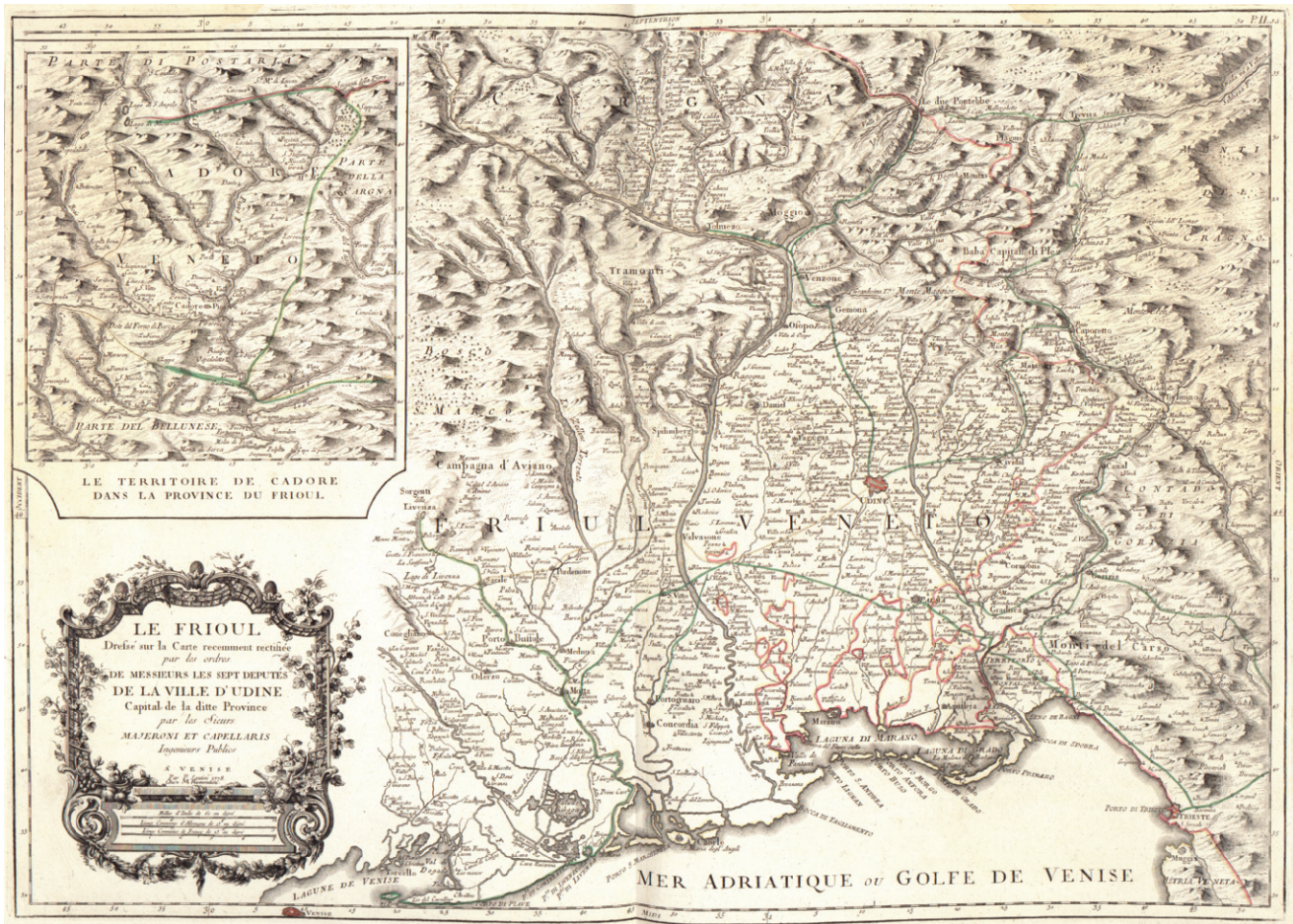


FIG. 484. LE FRIUL DRESSÉ SUR LA CARTE RECEMENT RECTIFIÉE . . . PAR LES SIEURS MAJERONI ET CAPELLARIS, INGENIEURS PUBLICS, 1778. From Santini, *Atlas universel dressé sur les meilleures cartes modernes* (Venice: Remondini, 1784), vol. 2, no. 15. Copperplate engraving, ca. 1:225,000. Santini's atlas combined maps copied from foreign sources with other maps based on original surveys

in the Italian region, like that depicted here. This map of the Friuli was based on observations by two topographical engineers, Majeroni and Capellaris.

Size of the original: 50 × 67 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (Atl 1784 Sa).

*contiene tutte le parti del mondo* (2 vols., 1740–50). In these same years, Albrizzi also published the first Italian edition of the works of Thomas Salmon, *Lo stato presente di tutti i paesi, e popoli del mondo naturale, politico, e morale* (24 vols. 1738–62), which incorporated many of the maps engraved for the *Atlante novissimo*. The decoration of the *mappamundi* in this work was by Giovanni Battista Piazzetta, a far from rare case of an important Venetian artist being involved in the production of a work of cartography within the city. Albrizzi's atlas was followed by important works by Francesco Santini and Paolo Santini, who produced an *Atlas universel* (maps dated between 1775 and 1780), and Zatta, whose *Atlante novissimo* was published in four volumes between 1779 and 1785 (having received a privilege

from the authorizing body the Riformatori dello Studio di Padova for fifteen years in June 1773). Except for the area of the Veneto, for which the Santinis reproduced locally surveyed plans (fig. 484), most of the maps in the Santini *Atlas* were copied from French sources (Jean Janvier, Jean-Baptiste Bourguignon d'Anville, Didier Robert de Vaugondy, Guillaume Delisle). Zatta similarly relied on European sources, all described in detail in the introductory "Saggi preliminari"; he reworked the maps on what he called a "nuova proiezione," although this was nothing more than a stereographic projection, as he himself made clear (Zatta 1775, 45). Zatta's *Atlante* also included a list of subscribers that gives some indication of the range of consumers of his work.

Further stimulus to the production of maps in the last

quarter of the eighteenth century came from the establishment of national institutions responsible for the survey, preparation, and publication of geographical and topographical maps. The bodies established for this purpose included the Turin Ufficio Topografico, the Naples Officina Geografica, and the Osservatorio Astronomico di Brera in Milan. The Naples Officina in particular generated a veritable school of cartographic engraving that trained a large number of artists in the difficult task of engraving maps. The result was that from 1780 and onward throughout the whole of the next century, the output of regional maps and geographical atlases in Naples was one of the richest and most noteworthy of any center in Italy.

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SEE ALSO: Calcografia Camerale (Copperplate Printing Administration; Rome); Cassini, Giovanni Maria; Coronelli, Vincenzo; Italian States; Rizzi Zannoni, Giovanni Antonio

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**Map Trade in the Netherlands.** During the Renaissance, the Low Countries (present-day Netherlands, Belgium, and Luxembourg) had become an economic world power. After the fall of Antwerp in 1585 and the founding of the Republic of the Seven United Provinces (the northernmost provinces, here understood as the Netherlands) in 1588, economic preeminence shifted to Am-

sterdam, while the arts and sciences in the Republic expanded and flourished.

The Netherlands also made its mark in cartography. In the seventeenth century, Amsterdam hosted a worldwide trade in maps, atlases, and globes, owing to the myriad trade and exploratory voyages initiated from this city. In addition, so-called news maps of military actions were in great demand. The large-scale domestic geographical changes—impoldering, urban expansion, and new infrastructural projects—likewise stimulated map production. The most significant stimulus, however, was the exodus of Protestants from the Southern Netherlands resulting from the Spanish conquest of its economic centers; highly trained Protestant engravers, publishers, and printers chose Amsterdam as the new center for their trade (Van der Krogt 1994; Schilder 1989).

Dutch commercial cartography made a decisive mark in Europe both qualitatively and quantitatively. In the late Renaissance, renowned publishers such as Cornelis Claesz., Jodocus Hondius and his sons Jodocus Jr. and Henricus, Willem Jansz. Blaeu and his son Joan, Claes Jansz. Visscher, and Johannes Janssonius devoted themselves to map- and printmaking (Koeman et al. 2007). In close collaboration with the best engravers, they produced a highly varied offering of maps, atlases, and globes in diverse sizes and forms. Enormous rivalry defined these seventeenth-century map publishers as competitive pressure pushed them to outdo one another, resulting in the manufacture of gigantic globes that were a few meters in diameter and of the massive nine- to twelve-volume *Atlas maior* by Joan Blaeu in the third quarter of the seventeenth century.

This highly productive trade bequeathed a rich cartographic heritage to late seventeenth- and early eighteenth-century Dutch map producers. Studying the cast of mapmakers and the transitions in their business management between 1650 and 1800 reveals how the Dutch map trade maintained a premier economic position in Europe and managed the competition with rivals from other nations.

**AMSTERDAM** The second half of the seventeenth century and the first decades of the eighteenth century saw far-reaching changes in the Dutch book industry in general and the map trade in particular. From 1660 onward, as economic growth stagnated in the Republic, a long series of wars with neighboring countries hampered the import of paper as well as the foreign sales of books and cartographic products. Prominent publishing houses such as those of Blaeu and Elzevier ceased their activities, sometimes by necessity. This forced Dutch commercial cartography to adjust and reorient itself by making inroads into new markets both domestically and abroad



FIG. 485. GERARD VALK, TERRESTRIAL AND CELESTIAL GLOBES, AMSTERDAM, 1700. Valk's globe pair was a completely new work, incorporating the geographic findings of the French academy on the terrestrial globe and the observations of Johannes Hevelius on the celestial globe.



Diameter of the originals: 31 cm. Image courtesy of the Globenmuseum, Österreichische Nationalbibliothek, Vienna (inv. no. gl 038 and 039).

and by introducing other production and distribution techniques. The scarcity of paper resulting from export restrictions on French paper was overcome by the development of a domestic paper industry in North Holland (Zaan district) and Gelderland (Veluwe). A new generation of book- and mapsellers profited from this, including numerous French Protestant entrepreneurs who sought safe refuge in the Republic after the persecutions of the Huguenots by Louis XIV. The Netherlands took advantage of this available talent, as it had done a century before.

This revamped cartographic stage hosted several protagonists in Amsterdam, headed by the Visscher family: Nicolaas I Visscher and Nicolaas II Visscher, the son and grandson of Claes Jansz. Their firm was one of the few rooted in the early seventeenth century, and they chiefly focused on the manufacture of atlas maps. Nicolaas II also made a name for himself as a compiler and publisher of military news maps. After the death of his widow Elizabeth Verseyll in 1726, the copperplates came into the hands of Petrus II Schenk,

who used them to reprint the Visscher maps (Koeman 1967–85, 3:150–58).

Other prominent cartographic families were the Danckertses and the Allards. Justus Danckerts and his two sons Theodorus and Cornelis worked as engravers and mapsellers in Amsterdam (Koeman 1967–85, 2:88–97). They mainly owed their fame to a few monumental wall maps and urban views. The Allard family was also established in Amsterdam. After the death of founder Hugo (Huych) Allard in 1691, the business passed to Carel Allard, who compiled a few atlases of a rather homogeneous content, including the *Atlas minor* (1697) with 100–260 maps and the *Atlas major* (1705) with more than 500 maps (Koeman 1967–85, 1:31–48).

Petrus I Schenk and Gerard Valk worked together in Amsterdam from around 1680 (Koeman 1967–85, 3:107–10, 136). They initially published mostly portraits and topographical prints, venturing into cartography in 1694, when they brought out a new edition of Janssonius's *Novus atlas*. Together with his son Leonard, Valk manufactured new globes in the course of the eighteenth

century (fig. 485). Schenk, meanwhile, chiefly focused on mapmaking. After his death, he was succeeded by his son Petrus II and grandson Petrus Schenk Jr.

One of the most active Amsterdam mapsellers of the second half of the seventeenth century was Frederick de Wit, who may himself have worked regularly as an engraver, wielding a burin, and who specialized in atlases, wall maps, and prints (Carhart 2016; Werner 1994, 13). Last but not least, Pieter Mortier established himself in Amsterdam in 1685, after previously learning the book-selling trade in Paris. From 1690, he published maps and atlases as well as books, a worthwhile venture that soon prospered and from which Mortier's successors would reap the fruits in the eighteenth century (Van Egmond 2009, 59).

By the turn of the century, the arena of Dutch commercial cartography still offered plenty of room for industrious publishers, who were concentrated in Amsterdam around the Dam, the economic heart of the city. Cartographic specialization was very common by reasonably independent players.

Leiden was one of the few cities other than Amsterdam to host cartographic enterprises. There the large firm of Pieter van der Aa published maps and atlases in addition to a particularly active trade in the sciences and the classics (Van der Krogt and Braat 2012; Hoftijzer 1999). Cautiously active in cartographic publishing in the 1690s, Van der Aa expanded his stock during the eighteenth century by acquiring stock from the estates of Carel Allard and De Wit. Van der Aa's most famous publication is *La galerie agréable du monde* (1729), a huge work of sixty-six parts in twenty volumes with around three thousand maps, prints, and portraits.

While several large publishers filled the frame of the map trade at the end of the seventeenth century, the picture thinned during the eighteenth. Only a few Amsterdam publishing houses dominated Dutch commercial cartography for several decades: Covens & Mortier, Van Keulen, and to a lesser degree Ottens and later Tirion. Cornelis Mortier, along with his brother-in-law Johannes Covens, expanded the list of publications of his father Pieter Mortier. These two chiefly concentrated on publishing maps, atlases, and prints and avidly added to their stock from the auctions of the contents of other publishing houses. Their firm stayed active until 1866. Joachim Ottens founded a publishing house that reached its peak under the management of his sons Reinier and Josua Ottens (Koeman 1967–85, 3:85–87). They produced a few hundred maps and a multivolume *Atlas maior*, for which they used material from other publishers. Besides Covens & Mortier and Ottens, Jan de Lat of Deventer and Hendrik de Leth of Amsterdam were among a number of smaller eighteenth-century

booksellers who listed a few cartographic editions in their catalogs. Isaak Tirion published his *Nieuwe en beknopte hand-atlas* in 1744, a work he repeatedly expanded with maps compiled from a variety of sources; it was the first new Dutch world atlas since Joan Blaeu's *Atlas maior*.

In the specialized market for marine charts, the publishing house founded by Johannes I van Keulen dominated Dutch maritime cartography for two centuries



FIG. 486. JOHANNES VAN KEULEN, FRONTISPIECE OF *DE NIEUWE GROOTE LIGHTENDE ZEE-FAKKE*, 1684, VOL. 4. Engraved by Jan Luyken. Spelling of “lichtende” varies, sometimes appearing on frontispieces as “lichtende,” as seen here.

Size of the original: 51 × 31 cm. Image courtesy of the Universiteitsbibliotheek Leiden (COLLBN Atlas 11-1).

(De Vries 2005). Its signature publication, *De nieuwe groote lichtende zee-fakkel*, rolled off the presses from 1681 to 1684, becoming five folio volumes of 135 accurate sea charts, and was considered the *atlas maior* of Dutch marine charting (fig. 486). The *Zee-fakkel* was revised and expanded by Johannes's son, Gerard van Keulen, and later by Gerard's grandson, Gerard Hulst van Keulen. From 1743, the family was the official chartmaker for the Verenigde Oost-Indische Compagnie (VOC), a position that affirmed its preeminence among chartmakers and gave its members access to valuable manuscript material on Asia. The firm continued to exist until 1885.

By the end of the eighteenth century, no major cartographic publishers remained active with the exception of the firms of Covens & Mortier and Van Keulen. Maps, atlases, and globes continued to be manufactured mostly in Amsterdam, which remained the center of the map trade in the Netherlands, though most of the map-producing publishers now were located outside the economic heart of the city. Only in the mid-nineteenth century did the production of Dutch maps and atlases cease to be the exclusive domain of Amsterdam publishers (Van Egmond 2009, 49–50, 2001).

**ORIGINALS VERSUS COPIES** The realignments in the Dutch map trade manifested in significant changes to the kinds of maps that were published. In the seventeenth-century, Dutch commercial cartographers had compiled maps from knowledge first gathered in Amsterdam, the crossroads of world trade at the time and a port from which many exploratory voyages began. Map publishers such as Hondius, Blaeu, and Janssonius adapted their maps and globes very quickly to newly acquired geographic information and even undertook initiatives to create the most up-to-date maps. For instance, Joan Blaeu wrote to various municipal authorities requesting the most recent town plans be sent to him to create new town plans in a standard format for his *Toonneel der steden*, giving rise to many prototypes and their derivatives, widely imitated in other European countries (Koeman et al. 2007, 1335–36). But the crowded field of publishers led to intense rivalry, fierce competition, and rampant copying.

As Amsterdam lost its map trade monopoly over the course of the second half of the seventeenth century, changes occurred in how cartographic copy was acquired. Publishers such as De Wit, Visscher, and Allard were much further removed from source material than the previous generation of mapmakers and were forced to reprint maps from copperplates acquired elsewhere or to engrave copies of existing maps of Dutch territories. These maps were at times completely or partially

modified or replaced with new ones after better, usually foreign, base maps appeared. Amsterdam publishers became dependent on French cartography for the newest information about non-Dutch regions, as cartography based on astronomical observations under the aegis of the Académie des sciences began to flourish in France in the late seventeenth century.

Pieter Mortier, who had learned the book trade in Paris from 1681 until about 1685, was quick to grasp the superiority of French maps. After returning to Amsterdam in 1685, Mortier began to sell copies of French maps from 1690, beginning with Sanson's maps from the *Atlas nouveau* (Van Egmond 2009, 107, 190, 194). He did not fear French claims of plagiarism against him, since privilege had no legal status across national borders. Mortier even requested and received a privilege granted by the States of Holland and West Friesland for exclusive rights to copy French maps. Copying foreign works was both common and often an economic necessity, due to the stiff competition in the book industry (fig. 487).

Mortier's great success selling copied French maps led other Dutch publishers, such as Gerard Valk and Petrus I Schenk, to imitate the practice. Mortier claimed their copied maps were an infringement of his privilege, a conflict eventually resolved to their mutual satisfaction. Reprinting up-to-date foreign maps became a favorite activity of Dutch mapmakers throughout the eighteenth century. The work of French geographer Guillaume Delisle was especially popular (see fig. 459), to the point that sometimes Mortier replaced the name of the original author with that of Delisle on the copied map (Van Egmond 2009, 194–97).

Besides reprinting foreign maps, Dutch publishers acquired stock by reprinting older copperplates by seventeenth-century Dutch cartographers that were obtained along with large numbers of printed maps from the estate auctions of defunct publishers. They then engraved a new imprint on the plates or added the new publisher's name in manuscript to the printed maps acquired from the auctions, breathing new life into the maps of Blaeu and Janssonius in the eighteenth century. Other publishers reprinted De Wit's maps, which were so popular a half century after his death that his name was added to maps he never made. The Ottens firm even offered "De Wit" maps printed from old, poorly engraved, and unreliable copperplates by Danckerts, whose name had been replaced. This remarkable commercial *modus operandi* was remarked upon by Covens & Mortier in one of their catalogs, where they noted that their De Wit atlas was genuine, because it was printed from De Wit's original copperplates (Van Egmond 2009, 196, appendix IX).



FIG. 487. *ATLAS NOUVEAU*, THREE VOLUMES, AND *LE NEPTUNE FRANÇOIS*, TWO VOLUMES, TOGETHER IN UNIFORM BINDINGS, FROM 1692/1693, PUBLISHED BY PIETER MORTIER. These cartographic works, copied after French originals, were the largest format atlases ever published in the Netherlands.

Bijzondere Collecties, Universiteitsbibliotheek Amsterdam (HB-KZL I 3 A 14-16 and HB-KZL V 9 X 10 [1-2]). Photograph courtesy of Jan Werner.

All in all, the practice of copying and reprinting old plates was rife among eighteenth-century Dutch commercial cartographers, who produced very little original work. They did occasionally compile material from existing maps, such as Pieter Mortier's theater of war series (from 1695), multisheet productions mostly based on French material depicting contemporary war regions of Europe (fig. 488). The theater of war map was very popular in the first half of the eighteenth century during the many wars of succession that affected the Low Countries in particular. Original work also appeared in a few regional maps, created from commissions by government officials and large landholders to publishers. Yet the results of new surveys and cartographic initia-

tives outside the borders of the Netherlands were rarely included in commercial Dutch cartography.

**QUALITY VERSUS QUANTITY** Not surprisingly, eighteenth-century Dutch publishers achieved tremendous production levels with their program of copying and reprinting maps. Publishers' stocklists and sales catalogs of the period at times contained a few thousand cartographic items. From a single publishing house, a customer could often choose from multiple maps of a certain region created by different authors. The map trade concentrated on the production and sale of as many maps as possible in atlas (folio) format, which allowed customers to compile their own composite atlases.



FIG. 488. THEATER OF WAR MAP, FLANDERS AND BRABANT, 1702, PUBLISHED BY PIETER MORTIER. Second state of the map *Téâtre de la guerre*, 1696, in four sheets.

Size of the original: 96 × 120 cm. Image courtesy of the Collection Niewodniczanski, Bitburg.

The Amsterdam traders also stocked maps of all the continents, various countries, regions, and cities. However, their quality left something to be desired. Originality was lacking, made worse by skimping on the precision of the map image. Van der Aa, for instance, reduced the distances between parallels in order to fit two maps on one page, ludicrously distorting the map. Authors of scientific reference books and periodicals from abroad therefore accused the Dutch cartographers of making poor copies (Van Egmond 2009, 281–82), and the French geographer Jean-Baptiste Bourguignon d’Anville leveled a critique of Dutch engraving techniques (d’Anville 1738, 1091–93).

Reprinting from old Dutch copperplates also led to

the diffusion of outdated geographic images. So-called corrections were often limited to merely altering the imprint or providing a new title. Nonetheless, Dutch publishers were not entirely uncritical of the topographical reliability of more local maps, leading to substantial improvement of the maps of the Dutch territory. Yet when small-scale (and usually copied) maps of the world and its continents were improved on the basis of recent geographic information, it was usually based on foreign sources from the second half of the seventeenth century. Consequently Dutch commercial cartography trailed its French and, later, English and German counterparts in terms of revealing the results of explorations and in adjusting geographical shapes and distances.

What remained at a high level in the Netherlands was the art of engraving. Indeed, there was no shortage of good Dutch engravers in the eighteenth century, who had inherited a rich seventeenth-century tradition. Such skillful engravers as Romeyn de Hooghe, Jan Stemmers, Jan van Jagen, Johannes Condet, Leonard Schenk Jansz., and Cornelis van Baarsel beautifully engraved or etched maps whose scientific content was largely inferior to foreign editions. While there was no continuity of monumental seventeenth-century typography, the exceptional navigational works of the Van Keulen family competed globally, both for their appearance and their hydrographic contents. Tirion's maps for his *Hand-Atlas* also excelled by virtue of their modern-looking style and homogeneous character.

**DISSEMINATION** At the height of Dutch commercial cartography in the seventeenth century, Amsterdam was *the* center of an enormous export market. Despite the relative stagnation of the Amsterdam staples market at the end of the seventeenth century, the map trade in the city maintained its international role as the most important distribution center, largely thanks to the efficient organization of the Dutch book business. A tight network of printed communication, from thin pamphlets to heavy atlases, developed within the Republic, maintained by numerous vendors, booksellers, printers, and publishers. By virtue of relatively high political tolerance, a favorable geographic situation, and the Dutch commercial spirit, the Republic offered a pleasant "island of tempered freedom" (Bots, Posthumus Meyjes, and Wieringa 1985, 68) within Europe from which authors could disseminate their thoughts to the world. The Republic was the central depot for international book distribution, offering low book prices, thus cutting out foreign competition. Thanks to exiled Huguenots who established themselves in the Republic after the Revocation of the Edict of Nantes (1685), Dutch booksellers accessed an extensive information circuit, allowing them quickly and cheaply to reprint successful editions that had appeared in France or elsewhere. The map trade, primarily driven by booksellers, profited from this situation, which persisted until approximately 1750, allowing Dutch map material to enjoy ample international distribution through this trade network. Maps published by Pieter Mortier, for instance, were sold in London by his brother, David Mortier. In Nuremberg the Homann firm traded material from Ottens, Covens & Mortier, Schenk, Valk, and Visscher as well as maps from France and England. Homann's maps, in turn, were attainable from Covens & Mortier. This guaranteed a foreign sales market to publishers and gave them easy access to maps of regions with which they were less familiar.

The distribution of map material may also have oc-

curred through barter, although little about this practice can be gleaned from the literature (Van Egmond 2009, 257–58). Booksellers avoided payment in cash as much as possible in their trade with fellow booksellers. Bills of exchange and bonds were used, as was the acceptance of books as payment for the supply of books, and map material may also have changed hands in this way. A barter system may help to explain the hybrid character of many eighteenth-century collectors', or composite, atlases.

In the second half of the eighteenth century, international distribution of Dutch maps stagnated, in part because of foreign protectionist measures that had repercussions on commercial cartography. While Dutch commercial maps previously had Latin or French legends, they now bore Dutch texts, sometimes supplemented by equivalent French titles. The few publishing houses that were still active in cartography only produced maps and atlases for domestic use. French domination of the Netherlands, as of 1795, enhanced this inward, national orientation, which the Dutch map trade did not overcome until the nineteenth century.

**CONSUMPTION AND TASTE** The changing character of the Dutch map trade was further reflected in patterns of consumption. At the time of the Republic, most maps, atlases, and globes were purchased by well-to-do citizens who wanted to show off their interest in the sciences and geography. Hardly interested in whether an atlas was based on the latest geographic knowledge or whether a wall map was up to date, consumers focused on the superficial appearance of the map: decorative value in a library or salon mattered more than scientific content. The seventeenth century was an era of wealthy collectors who individually compiled each unique *atlas major* by supplementing an unbound version with hundreds of maps and topographical prints and then binding it. Such a composite, or collector's, atlas (*atlas factice*) often comprised multiple volumes. Famous examples of this sort of atlas are the forty-six-volume Atlas Blaeu–Van der Hem, compiled between 1660 and 1678 by the Amsterdam patrician Laurens van der Hem (Van der Krogt and De Groot 1996–2011) (fig. 489), and the four-volume Atlas Bus or Atlas Van der Hagen, compiled in 1702 or 1710 by Jan Bus or Dirk van der Hagen (De Groot 2006, 292). Part of the seventeenth- and eighteenth-century elite pursued an ideal of refinement and genteel recreation through these collectors' atlases.

The Dutch map trade heartily responded to this chiefly quantitative demand by delivering title pages and tables of contents for the *atlas factices* of domestic and foreign collectors as well as printed geographical introductions. In general, the collectors' atlases formed two types: the





FIG. 489. ATLAS BLAEU-VAN DER HEM *ATLAS FACTICE*. Image courtesy of the Kartensammlung, Österreichische Nationalbibliothek, Vienna.

*atlas major*, with many hundreds of maps, and the *atlas contractus* or *atlas minor*, with around one hundred maps. The latter contained a relatively homogeneous collection of maps, although the maps were produced by various publishers.

A wider audience was interested in the above-mentioned theater of war maps because they allowed readers to follow scenes of battles and trace various military march routes. Another popular cartographic product was the pocket atlas for travelers, which met the growing market for tourism, spurred by students, Grand Tourists, and other travelers. For these trips an *atlas du voyageur*, consisting of small-format maps of certain countries, served as handy and functional aids. As the map trade became increasingly oriented to the national market by the end of the eighteenth and into the nineteenth century, travel guides appeared mostly of Dutch regions. The nineteenth-century audience became even less interested in merely decorative maps and atlases, preferring functional maps first and foremost, meaning that the market for commercial cartography shrank even more.

In this way the Dutch map trade from 1650 to 1800 shifted from forcefully driving the international market to merely responding to the domestic market. The international reputation of the Dutch map trade at the time

of the Hondius and Blaeu families and the astounding productivity of publishers such as De Wit, Visscher, and Covens & Mortier became a thing of the past by the nineteenth century.

Dutch commercial cartography during the Enlightenment was primarily characterized by numerous transitions, which influenced the total production process. At the end of the seventeenth century, plenty of economic room still existed for major commercial cartographic enterprises in the Republic, but by around 1800 only a few publishers were actively engaged in publishing maps, atlases, and globes. The map trade remained concentrated in Amsterdam, which did not yield its position as the most prominent cartographic center in the Netherlands until the mid-nineteenth century. Amsterdam mapmakers chiefly acquired their copy by reprinting foreign maps and old Dutch copperplates; there was hardly any originality. Cartographic production achieved an all-time quantitative high in the first half of eighteenth century, but the content of the manufactured material was overshadowed by what was produced in France, and later in England and Germany. Yet the artistic quality of the maps was competitive due to the skill of Dutch engravers. Thanks to the efficient organization of the book business, Dutch map material enjoyed ample international distribution until the mid-eighteenth

century. After about 1750, map publishers found themselves compelled more and more to orient their sales to the domestic market.

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SEE ALSO: Art and Design of Maps; Covens & Mortier (Netherlands); Map Collecting: Netherlands; Marine Charting: Netherlands; Netherlands, Republic of the United

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**Map Trade in Poland.** The first published catalog of a Polish bookseller was printed in Gdańsk in 1672, but no copy has survived. The earliest extant catalogs date from 1679 and were published by Gillis Janssonius van

Waesberge (or van Waesbergen), the grandson of Amsterdam map publisher Johannes Janssonius, in Gdańsk. In Warsaw, the first book catalog appeared in 1730, but only French and German titles were listed. Later, book catalogs started to appear in other cities of the Polish-Lithuanian Commonwealth: in Poznań (1739), Kraków (1752), Vilnius (Wilno, 1760), Lviv (Lwów, 1765), and Toruń (1791). In all, about 980 bookseller's catalogs printed before 1800 are preserved in Polish institutions, most of them in only a single copy. The great majority, 787 catalogs, were published after 1765 and mostly issued by booksellers in Warsaw and Kraków. Typically these catalogs list from one to three hundred titles and might include atlases, maps, and other copperplate prints (Rudnicka 1975).

After the occupation of Dresden by Prussian troops in September 1756, the elector of Saxony and Polish king August III moved his court to Warsaw. The influx of court officials, artists, and artisans significantly increased the production in that city of official and parliamentary prints, books, and newsletters and produced more favorable conditions for the development of printing houses and book stores. Over twenty printing houses were established in the second half of the eighteenth century in Warsaw (Korotajowa et al. 2001). Of particular interest is Michał Gröll, a printer, bookseller, and publisher who moved from Dresden to Warsaw in 1759 (Pawiński 1896). He very quickly published his first catalog in 1760, and the next year he began to auction books and copperplate engravings in the Royal Castle. In May 1763 he opened a bookstore and auction house at number 19 in the Marywil shopping and residential complex, and a few years later added a reading room and lending library. By 1778 he was the most important publisher in the entire Polish market. He imported publications from printing houses in many Commonwealth towns: Vilnius (Drukarnia Akademicka), Kraków (Drukarnia Greblów), Poznań, Kalisz, Lublin, and Lviv, and from abroad, mainly France and Germany. He organized book stores in Lutsk (Łuck), Dubno, Berdychiv (Berdyczów), Łęczna, Minsk (Mińsk), Hrodna (Grodno), Navahrudak (Nowogródek), Nyasvizh (Nieśwież), Lublin, and Piotrków Trybunalski. He tried to introduce Polish books to foreign markets through book barterers. He attended the Leipzig trade fair (Leipziger Messe) and established business contacts with booksellers from Paris, Amsterdam, Berlin, and Wrocław (Breslau) (Staniszewski 1960–61).

Gröll was the only Polish publisher in the second half of the eighteenth century to include maps and atlases in his output. One such work, which addressed children's education and a new way to teach geography, was the *Atlas dziecinny* (1770 and later) by the Piarist father Dominik Szybiński (Gröll 1770, 5–6). The atlas featured twenty-four outline maps of different parts of the world



FIG. 490. STUDY MAP OF POLAND. Map 17 in Dominik Szybiński, *Atlas dziecinny czyli nowy sposob do nauczania dzieci geografii, krotki, łatwy, y naydoskonalszy* (Warsaw: Nakładem Michała Groella, 1772), between 112–13. Copper engraving. This map accompanies over one hundred pages of text in the atlas devoted to geographical descriptions of Poland by voivodeships. The text includes questions and answers that are keyed to the letters and numbers on this map. Size of the original: 9.5 × 12.5 cm. Image courtesy of the Biblioteka Uniwersytecka w Warszawie (5.13.5.51).

and a catechism-style text with questions like “What are the seas of Europe?” (fig. 490). A later catalog listed the 1772 edition of the atlas as selling for 10 złotych, 15 groszy (Gröll 1781, 8). Two copper-engraved sheet maps published by Gröll are also well known: *Carte générale et nouvelle de toute la Pologne du Grand Duché de Lithuanie et des pays limitrofes*, engraved by Bartolomeo de Folino (1770), and *Carte generale & itineraire de Pologne*, by Charles (Herman Karol) de Perthées (1773) (Krassowski et al. 1982, 157, 162, 165–66). Gröll’s catalogs also listed maps lumped together with other engravings in a generic lot—“different copper-plate engravings and geographical maps”—placed close to advertisements for Morocco snuff, playing cards, table clocks, and furniture (Gröll 1781, 48). In a 1769 catalog, Gröll made an extensive, and exceptional, announcement of atlases imported from abroad—*Atlas des enfans, Atlas methodique, Atlas de la geographie, Atlas hist. de France, Atlas minor, and Atlas Britannicus* (Gröll 1769, 4). The same catalog also listed several foreign geographic works including maps, such as *Geographie, abregé de la, moderne & ancienne* (1764) and *Geographia di Claudio Tolomeo nuovam. trad. di greco in italiano, da Girolamo Ruscelli, Venetia*, the latter obviously a used book, since it was last published 170 years earlier, in 1599 (Gröll 1769, 15).

On 14 October 1773 the Sejm (parliament) created

a commission on national education, Komisja Edukacji Narodowej, considered the first ministry of education. The commission and King Stanisław August Poniatowski, who supported Enlightenment ideals, stimulated the rapid development of Warsaw’s book trade. One of the commission’s supporters, Prince Adam Jerzy Czartoryski, invited Pierre (Piotr) Dufour, who was the printer and bookseller to the Sorbonne in Paris, to Poland. Dufour moved to Warsaw in 1775. After working independently, he was named in 1784 the general manager of Drukarnia Korpusu Kadetów, the printing house established in 1765 in the Szkoła Rycerska, the nobles’ academy of the corps of cadets, although he continued also to trade in his own publications. His catalogs were dominated by books in Polish, but most of these were translated works of literature and history. Dufour maintained very active sales all over the Polish state, sending peddlers to manors around the country. To improve sales he also employed traders and other booksellers from other towns throughout the Commonwealth, for example, in Hrodna, Lviv, and Kraków. In 1789, Dufour advertised Giovanni Antonio Rizzi Zannoni’s twenty-four sheet *Carte de la Pologne* (1772) (Dufour 1789, 2), but his catalogs normally do not mention sheet maps.

Another Warsaw bookseller, Jan August Poser, who seems to have been in business from 1769 to 1796, issued a *Katalog* of just a few pages in 1776. Among the items advertised are “geographic plates” of Italy, Germany, France, and Poland priced at 15 groszy each, and the twenty-five-sheet *Regni Poloniae Magni Ducatus Lithvaniae* (1770) by Theodor Philipp von Pfau priced at 72 Italian florins (Poser 1776, unpaginated).

The Kościuszko Insurrection and war across the Polish-Lithuanian Commonwealth in 1795 virtually stopped the distribution of books and printed maps. After 9 January 1796, Warsaw was under Prussian occupation, most local print houses and bookstores were closed, and there was a dramatic reduction in many public intellectual activities, including publishing and bookselling.

LUCYNA SZANIAWSKA

SEE ALSO: Poland

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**Map Trade in Portugal.** New maps of recently explored geographic regions entered Europe from Portuguese sources during the Enlightenment. These maps circulated in manuscript form through a network of participants directly involved in the military, diplomatic, missionary, and commercial aspects of Portugal's maritime expansion. From the sixteenth century, despite attempts to control their circulation, such maps reached French, Dutch, German, and British cities, where they were engraved, published, and ultimately sold back to Portugal and its empire.

Few Portuguese maps were published for commercial trade during the eighteenth century. However, the establishment of the Academia Real de História Portuguesa in 1720 helped to promote not only the acquisition of maps for historical research, but also the engraving of maps for inclusion in works sponsored by the institution. During the reign of José I (1750–77), the Crown employed the engravers at the Academia to produce detailed prints, sheet music, and maps. The Crown also encouraged the production of hydrographic charts as an important complement to nautical *roteiros*, which already enjoyed some dissemination. By the end of the eighteenth century, the famous editorial house Real Fábrica de Impressão de Música, employing the engraver Francisco Domingos Milcent, printed maritime guides and maps in addition to sheet music.

A significant change in printed cartographic production occurred with the founding of the Sociedade Real Marítima, Militar e Geográfica in Lisbon in 1798 and the Casa Litteraria do Arco do Cego in 1799. The Sociedade Real defined for the first time an official policy for the printing and sale of maps within the Portuguese Empire. The new institution's objectives included the examination, correction, and approval for sale of all published maps, both national and foreign. The Oficina da Casa Litteraria do Arco do Cego employed highly skilled engravers responsible for the creation of charts and maps to be sent throughout the Portuguese Empire.

With the transfer of the royal Portuguese court to Rio de Janeiro in 1807, some of the specialists from these institutions were incorporated into the Imprensa Régia, or royal press, which continued the work from 1809 in Portuguese America.

The map trade in Portugal and its empire can be characterized by the commission, importation, and acquisition from abroad of many thousands of published maps, atlases, separate sheets from atlases, various maps inserted in books, and wall maps. The best means for evaluating the quantity and diversity of these purchases are the customs registers and information from the office of the Real Mesa Censória, the royal censor, which controlled the entry of works by prohibited authors into the Portuguese Empire. These records contain information about the arrival of books, engravings, and maps from Germany, Holland, France, and Italy, and from specific cities—Hamburg, Amsterdam, Ostend, London, Genoa, Venice, and Cádiz (fig. 491) (Marques 1983).

The trade in books, engravings, and maps in Lisbon was controlled by booksellers and foreign book merchants, particularly the French, who formed a tight network of families originating from Monestier de Briançon (now Monétier-les-Bains, Hautes-Alpes). From the second quarter of the eighteenth century, Lisbon hosted these families: Aillaud, Bertrand, Bonnardel, Borel, Carbbonnel, Collomb, and Rey, as well as Reycent, from Turin, but with roots also in Monestier. Their establishments were concentrated around the Portas de Santa Catarina in Lisbon. Trade also occurred from the houses of engravers and editors, in convents, and in the hostels where street sellers were based. Many copies of the most popular maps indicate their place of sale in the city and even the price (Domingos 2000; Curto et al. 2006).

From Lisbon, maps were distributed to clients throughout Portugal and the cities in its colonies in South America and Asia. As in other countries, much of the Portuguese book trade took place in the markets of small cities and towns (Viseu, Évora, Setúbal, Golegã). The great publishers of Geneva, Neuchâtel, and Lyon sent their products directly to Portuguese clients in Lisbon, Coimbra (especially to the libraries of the University of Coimbra), and Braga (a religious center). Booksellers in Lisbon sent maps to be sold in Goa and Macau, but the principal export cities were in Brazil: Rio de Janeiro, Bahia, Recife, São Luís do Maranhão, and Belém do Pará. The inventories of Brazilian booksellers at the end of the eighteenth century reveal that the consumption of geography books and maps was quite large, although small in comparison to that of religious works or medical and legal texts (Araujo 1999, 235; Verri 2006, 1:101).

In the cities of Portuguese America there was prac-



FIG. 491. THE RANGE OF COMMERCE OF MAPS AND ATLASES BETWEEN PORTUGAL, THE REST OF EUROPE, AND HER OVERSEAS POSSESSIONS IN THE EIGHTEENTH CENTURY.

tically no specialization in the book trade. Books, engraved prints, and even maps were sold along with other goods in fabric shops, hardware stores, and general supply stores. To acquire maps it was necessary to rely on commercial agents of the Crown who could obtain authorization from royal and inquisitorial censors. Advertising for the purchase and sale of maps appeared in book catalogs and periodicals, such as the gazettes that from the beginning of the century included notices of both the infrequent Portuguese publications and books and maps imported from northern Europe.

The main buyers were the royal libraries (Lisbon and Mafra) and the academies, aristocracy and elite courtiers, diplomats, scholars, public servants, military institutions, religious orders (especially the Jesuits), and booksellers themselves (Mariette 1996–2003; Almeida 1991). After the end of the War of the Spanish Succession in 1714, when the Portuguese Crown was forced to protect its threatened maritime possessions, Portuguese ambassadors built a European network of cartographic exchange by commissioning maps from foreign booksellers and buying private collections. The resulting maps reached the secretaries of state, the military academies, and the collections of aristocratic families. In the military academies, teachers who wrote, translated, and published handbooks had also organized collections of charts, plans of military forts, and topographical maps,

most of which were foreign and were acquired either through purchase or as gifts.

In Brazil, India, and China, the Portuguese Jesuit colleges not only produced original maps, both public and confidential, but also maintained astronomical observatories and libraries that constantly acquired new books, atlases, maps, and scientific instruments. The inventories of college holdings attest to the significant presence of wall maps used to adorn libraries, dining rooms, and dormitories in addition to their use in teaching (Osswald 2011, 83). Often the income from the Jesuit pharmacies was invested in the importation and resale of books and printed engravings.

Auctions of libraries and private collections, especially in Lisbon, offered another venue for the map trade for both manuscript maps and printed atlases. After the Napoleonic armies sacked the Portuguese archives following the peace in Europe, Portuguese maps appeared in Parisian auction catalogs, such as the *Catalogue des livres rares et précieux de la Bibliothèque de Mgr Le Duc d'Abrantes* (1813), describing the collection of Jean-Andoche Junot, who had commanded the occupation of Lisbon in 1807.

Maps circulated through family inheritances, were sold as precious and decorative objects, or traveled the hidden routes of robbery, contraband, and espionage. During periods of war, the clandestine purchase and sale

of manuscript maps skirted political, diplomatic, and military policies of secrecy. Particularly energetic was the pursuit of cartographic images depicting colonial territories, such as the maps of South America produced in the second half of the eighteenth century when the Portuguese Crown was systematically endeavoring to map and demarcate its empire.

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SEE ALSO: Map Collecting: Portugal; Portugal

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**Map Trade in Russia.** Similar to other cartographic practices in Russia, the map trade may be viewed in two phases: the first in the late seventeenth century, and the second during the eighteenth century. These two phases differed in the manner of cartographic production. The cartographic documents of the first period were in manuscript and therefore unique, and the items of the second were engraved and reproduced.

During the first phase, the map trade was part of the book trade, which had existed in Russia since the twelfth century (Marin and Osipov 1974–80; Polivanovskiy 1974; Sikorskiy 1982). About a million manuscript books had been in circulation from the twelfth to the fifteenth century. Not only feudal lords, clergy, and rich men, but also craftspeople and peasants were among the consumers of books. Books differed in quality from parchment and paper to *beresta* (top layer of bark). This book trade was widespread but not well organized. From many small counters under awnings, so-called *polatki*, *runduki*, or *shkapchiki*, salesmen

(*sidel'tsy*) produced manuscript copies of books on request (Sikorskiy 1982, 268). Later in the sixteenth century, a special row of booksellers, the *knizhniy ryad*, was established in the market place (*torg*) of Moscow. The second-hand market for books and prints (*lubok*) was located at the entrance to the Kremlin on the Spasskiy Krestets. In addition, door-to-door salesmen engaged in the book trade. The Moscow printing house Moskovskiy pechatnyy dvor, founded in 1588, established several bookshops (*knizhnyye lavki*) and a book warehouse (*knizhnaya kazna*). Book prices were fixed by the czars based on the cost of materials and printing, and state printing employees were paid their living expenses (*kormleniye*). By 1654, numerous bookshops had been founded in other towns such as Novgorod, Chernihiv, even in Yeniseysk on the Siberian frontier.

It is not known whether maps formed a regular part of this trade. Considering that mapping in Old Russia was the exclusive right of the state, it is safe to assume that maps were not regular articles of free trade. Johannes Keuning's 1953 description of Isaac Massa's attempts to obtain maps in Russia in the beginning of the seventeenth century supports this supposition. However, manuscript copies of available maps could be made on request (Sikorskiy 1982).

A genuine map trade started with copperplate engraving and printing. To fulfill a growing demand for maps, several cartographic printing houses with privileges for maps were founded almost concurrently (Pekarskiy 1862; Rovinskiy 1899; Fel' 1960). The first step was the establishment of a roller press by Jan Tessing of Amsterdam. In May 1698, Peter I granted Tessing a privilege for fifteen years for the sale of all his printed works, including maps, and further ordered that all other printed works imported into Russia be confiscated by the treasury. Tessing's unexpected death in 1702 ended this arrangement. In October 1698, the Dutch engraver Adriaan Schoonebeek was employed under the czar's edict to engrave and print books, charts, maps, and other sheets. By contract, Schoonebeek would receive any profit from the trade in his work. During his seven years' residence in Moscow, Schoonebeek produced eighteen maps and several cartouches for maps by others. Under the jurisdiction of the armory board, Oruzheynaya palata, Schoonebeek's maps were sold in the Moscow bookshops, and by himself privately. Peter Picart was invited to Russia in 1702 at the instigation of Schoonebeek and was until 1708 the engraver of the Oruzheynaya palata and then the engraving master of the Moskovskiy pechatnyy dvor, where he worked with his pupils until they were sent on to St. Petersburg in 1714.

The czar's edict of 30 May 1705 set up a civilian press, Grazhdanskaya tipografiya, in Moscow "for printing and selling various books and sheets required

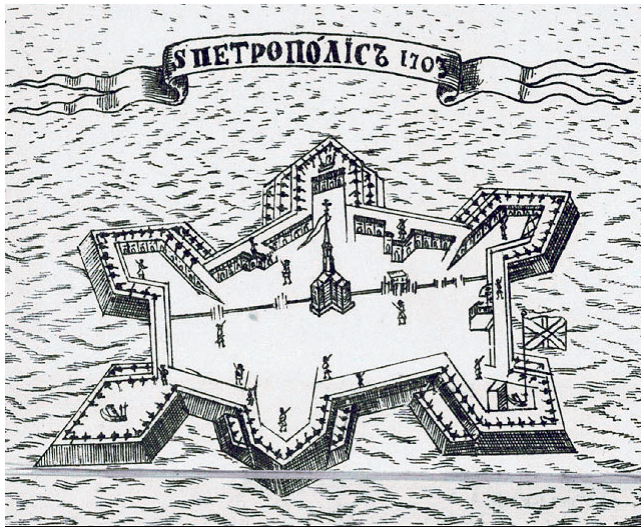


FIG. 492. S. PETROPOLIS 1703. One of the first map images compiled in the civilian press of Vasilii Onufriyevich Kipriyanov. The image of the Petropavlovsk fortress was published in the arithmetic manual *Novyy sposob arifmetiki, feoriki ili zritelnyya* by Kipriyanov in 1705. Copper engraving. Size of the original: 10 × 12 cm. Image courtesy of the Rossiyskaya gosudarstvennaya biblioteka, Moscow (Manuscript Department, 8 PΦ/P 58).

by citizens” (Borisovskaya 1992, 204). Vasilii Onufriyevich Kipriyanov, as the chief of the press, asked that Yakov Vilimovich Bryus supervise its work. From 1706 on, typographic publishing under the aegis of the Artilleriyskiy prikaz was subordinate to Bryus. Maps had formed a significant part of the press’s production (thirteen maps in a total of twenty-nine items published) (fig. 492), and the products were sold from Kipriyanov’s *polatka* and from the library at the Spasskiye Vorota (one of the entrances to the Kremlin), which opened in 1714. This library functioned both as an office supervising all Moscow booksellers and as a lending library (Borodin 1936).

In 1711, printing began in St. Petersburg, and several civil presses and printing houses of different authorities were established. During the eighteenth century, there were about twenty institutions with presses specialized for printing maps. Among them were the Akademiya nauk, Admiralteystv kollegiya, the Geograficheskiy departament of the Sobstvennaya ego imperatorskogo velichestva kantselariya, Moscow and St. Petersburg civil presses, St. Petersburg synodal press, Morskaya akademiya (later Morskoy shlyakhetskiy kadetskiy korpus and Morskoy kadetskiy korpus), the Gornoye uchilishche, the Voyenno-polevyye gravipoval’nyye masterskiye, the Oruzheynaya palata, Picart’s workshops, and the Komissiya ob uchrezhdenii narodnykh uchilishch. From 1714, the number of bookshops associated with these

institutions, presses, and workshops also rose. However, in the first third of the eighteenth century the map trade was not very brisk.

A moderate increase in the map trade began after the engraving board, Graviroval’naya palata, of the Akademiya nauk was established (Alekseyeva, Vinogradov, and Pyatnitskiy 1985). The Graviroval’naya palata existed from 1724 to 1805 and produced the overwhelming majority of Russian maps, prints, plates, images, portraits, tables, and graphs for scientific and artistic literature during this period. Several thousand copperplates were prepared by the Graviroval’naya palata, of which maps formed about one-third (Alekseyeva, Vinogradov, and Pyatnitskiy 1985, 36–37). The map board, or Landkartnaya palata, was established in 1730 as a special department of the Graviroval’naya palata to produce maps and atlases, and in 1759 it fell under the authority of the Geograficheskiy departament of the Akademiya nauk.

In 1728, the Knizhnaya palata of the Akademiya nauk was opened with a bookshop where all the products of the Graviroval’naya palata were sold. Atlases were usually offered for sale unbound. The copperplates of the Graviroval’naya palata were stored in the academy press during the eighteenth century and in the nineteenth century were moved to the academy bookshop, where orders for imprints were taken. In the early 1740s and in the 1760s all the accumulated copperplates were inventoried and additional impressions were produced. At the beginning of the nineteenth century, the cartographic copperplates were transferred to the map depot, the Ego imperatorskogo velichestva depo kart (or simply Depo kart). The products of the Graviroval’naya palata were sold until the middle of nineteenth century.

The map engravers who worked for the Graviroval’naya palata included Georg Johann Unverzagt, Aleksey Fedorovich Zubov, Ottomar Elliger, Ivan Alekseyevich Sokolov, Mikhail Ivanovich Makhayev, Vasilii Andreyevich Kudryavtsev, Andrey Semënovich Medvedev, Kirill Fedorovich (Kirillovich?) Frolov, and Prokhor Rodionovich Kholodov. Their most famous works were *Atlas userossiyskoy imperii* by Ivan Kirilovich Kirilov (1731–34), the *Atlas Rossiyskoy* (1745), and *Plan imperatorskago stolichnago goroda Moskvy* by Ivan Fedorovich Michurin (1741) (see fig. 925). The Moscow plan was in such high demand by customers of the academy bookshop that its copperplates were reengraved several times. The *Plan stolichnago goroda Sanktpeterburga* in nine sheets (1753) with its accompanying album of twelve prospective views, in constant demand both in Russia and abroad, became the work most reproduced by the Graviroval’naya palata.

Information about printed works for sale in the academy Knizhnaya palata and other bookshops was

published in trade catalogs (inventories and registers titled *rospisi* and *reyestry*). Altogether, more than two hundred such publications were issued in the eighteenth century. The listings did not always contain information about maps, but descriptions of maps for sale were inserted (Anonymous 1748, 1763, 1771). Sometimes advertisements were used instead of *rospisi* or *reyestr*. For example, a thousand copies of the special promotional booklet for the *Atlas Rossiyskoy*, prepared by the Akademiya nauk, were printed in 1745 and delivered to all offices of the academy bookshop, where the *Atlas* could be purchased unbound. The *General'naya karta Rossiyskoi imperii*, like the other maps of the *Atlas*, could be bought separately for eighty kopecks. In 1755–60, the academy bookshop sold about one hundred copies of this map. Due to popular demand, from 1749 to 1762 the bookshop made several requests to the academy press for supplemental printings of twenty-five, fifty, and one hundred copies of the *Atlas*. In 1747, the promotional booklet also was reprinted (*Svodnyy katalog*, 66 [nos. 344, 345]; Gnucheva 1946, 79; Alekseyeva, Vinogradov, and Pyatnitskiy 1985, 36–37, 175–211). The bookshop of the Knizhnaya palata had branches in Moscow and the provinces. Two Russian newspapers, *Sanktpeterburgskiye Vedomosti* (published by the Akademiya nauk 1728–1917) and *Moskovskiya Vedomosti* (1756–1917), and other Russian periodicals constantly published lists of recently printed works, noting their number of pages, both as news and as supplements to the newspapers.

Because book sale proceeds brought income to the Akademiya nauk, one of the directors of the Knizhnaya palata supervised its trade on a commission basis. Book dealers of this kind working for the benefit of Akademiya nauk and for other official institutions with presses often published their own *rospisi*. These small traders' catalogs looked like composition books with a home address indicated in the title (e.g., Anonymous 1784). Due to their ephemeral nature, they rarely survive to the present. Bibliographers at the beginning of nineteenth century counted more than one hundred of them. In addition, book peddlers (*knigonoshi*, *ofeni*) encouraged the retail book trade, with marketplaces located in Moscow at the Sukharevskaya Tower and Kitay-gorod and in St. Petersburg at Gostinny dvor and Apraksin dvor (fig. 493).

Until 1771, all the printing houses had been established and supported by the government and directed by official institutions. In March 1771, the first private press, that of Johann Michael Hartung, opened in St. Petersburg. By the end of the century, there were ten official presses in St. Petersburg, five in Moscow, thirty-nine in the provincial centers (among them Astrakhan, Chernihiv, Yekaterinburg, Ekaterinoslav) [Dnipropet-

	въ Спб.	въ Мос.
	р. коп.	р. коп.
Постоянная любовь сь помощію невнимности, 4. Алпская Пасипушка, 5. Взаимное изумленіе, 6. Особливый примѣръ остроумья женскаго разума, 7. Алонъ и Карлъ Испанская повѣсть. Переводъ съ Италіанскаго. Въ 12.	40	45
Любовь Палатія и Дирфіи поема, переводъ съ Французскаго. Въ 12.	0	35
М.		
Марсова (Книга), или воинскихъ дѣль отъ войскъ Его Императорскаго Величества Государя Императора ПЕТРА ПЕРВАГО учиненныхъ противъ войскъ Его Королевскаго Величества Свейскаго, съ фигурами, на бѣлой бумагѣ. Въ 4.	150	170

FIG. 493. THE PRICE OF SELLING ITEMS DEPENDED ON THE CITY. In this list, the price is shown in two versions, for Saint Petersburg and Moscow. Detail from *Rospis' Rossiyskim knigam, morskim kartam, gravirovannym prospektam i portretam, kotoryye prodavutsya pri Tipografii Morskago i Kadetskago Korpusa* (St. Petersburg, 1779), 8.

Size of the entire original: 20 × 14 cm; size of detail: ca. 13.5 × 14.0 cm. Image courtesy of Rossiyskaya gosudarstvennaya biblioteka, Moscow (Rare Books Department, Code No. CK XVIII 8906).

rovsk], Irkutsk, Kaluga, Kazan', Kostroma, Kursk, Perm', Ryazan', Simbirsk, Tambov, Tobol'sk, Tver, Ufa, Vladimir, Voronezh). There also were more than twenty private presses. The most famous of these were owned by Vasilii Alekseyevich Plavil'shchikov, publisher and bookseller, who in his bookshop opened a reading library and published more than three hundred books, and by Nikolay Ivanovich Novikov, a philosopher, writer, journalist, and publisher, who organized several presses, libraries, and bookshops in sixteen cities, and who published books on all the fields of knowledge. Vasilii Stepanovich Sopikov played an important role in the development of the book trade in Russia. His outstanding achievements in bibliography (1813–21) describe more than thirteen thousand printed works published in Russia until the beginning of the nineteenth century and has served as the main reference book on the history of Russian printing.

Also in the late eighteenth century, a whole series of private book trade enterprises (*knizhnaya torgovlya*) were established. However, a senate decree of 1796 closed all the private and free presses—the majority joined the district government enterprises—but the book trade institutions continued their activities.



The first private business completely specializing in map production and sales was that of Aleksey Afinogenovich Il'in. In 1859, Il'in, along with Vladimir Aleksandrovich Poltoratskiy of the General Staff, founded a private lithographic press to prepare a military-historical atlas. In 1863, Il'in became the sole owner of the business and in 1864 renamed it Kartograficheskoye zavedeniye.

LIUDMILA ZINCHUK

SEE ALSO: Kipriyanov, Vasilii Onufriyevich; Map Collecting: Russia; Russia

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**Map Trade in Spain.** Published map catalogs testify eloquently to the presence of an active cartographic trade in Spain. The oldest ones date from the second-half of the eighteenth century. Tomás López, the first Spanish

geographer to open an establishment specializing in the production and sale of maps in Madrid in 1760, published successive catalogs. With the exception of the French *Atlas d'Espagne et de Portugal* (1762), there is no evidence that he distributed imported maps, a task undertaken by booksellers. His son Juan López put his stock, imports, and works from other Spanish authors within the reach of Spanish society's pocketbooks. Before this period, booksellers had traditionally sold cartographic products, especially atlases. Tomás López, during his student years in Paris (1752–60), and Juan de la Cruz Cano y Olmedilla, during his entire life, sold their maps through booksellers based in Madrid. Advertisements in the *Gaceta de Madrid* reveal their names and the cartographic works they imported. There is less information available for book merchants established in cities such as Barcelona, Valencia, Zaragoza, and Cádiz (Capel 1990). *Estamperos* (printsellers) and engravers also competed in this trade. They were fewer in number than the booksellers, but they performed as efficiently in selling maps produced in Madrid as publishers of maps in Catalonia, Valencia, and the Balearic Islands. Among the engravers, Pablo Minguet in Madrid stands out. He offered a map of the Iberian Peninsula, an elementary atlas—the first produced in Spain (1763) (Hernando 2005, 21)—and several sheets illustrated with maps and instructional text (fig. 494). Minguet's catalog lists his cartographic works with prices and choices of presentation. Another source for the map trade may be found in the notices of acquisitions through inheritances, auctions, and bankruptcies of widows and heirs, especially during the seventeenth century.

The increase in cartographic works edited, number of establishments, and advertisements posted during the course of the eighteenth century evoke a growing map trade. Nonetheless, it does not seem to have been a particularly lucrative mercantile endeavor. Tomás López intimates bitterly the paltry demand for his goods (López 1775–83, 1:XI). This commercial weakness was a response to more general cultural, economic, and social factors. Monies invested in culture were limited, as were the material resources and means available for the geographic education of society, which were not very attentive to developments in scientific knowledge.

A dearth of competent map engravers and geographers with the prestige and economic or commercial interests to sustain such trade forced some of the market to move abroad. A desire to improve Spanish society's geographic awareness prompted Pedro Gendrón, an editor of Portuguese origins who was established in Paris, to publish several atlases in Spanish including the *Atlas ô compendio geographico del globo terestre* (1756) and *Atlas ô compendio geographico que comprende las provincias de España y la America* (1758)—two French

MAPA MUNDI, CON LOS MERIDIANOS, Y PARALELOS IGUALES COMO LOS DEL GLOBO TERRESTRE, y arreglado á las mejores, y ultimas relaciones.



EXPLICACION DEL GLOBO TERRESTRE, DE LOS MAPAS, DE LOS SIXTEMAS, Y OTRAS CURIOSIDADES.

**T**RATADO BREVE DEL GLOBO TERRESTRE, ó MAPA Mundi, y sus Circulos.

**L**OS Geographos pintan el Mundo partido desde un Polo al otro en dos Planisferios; el uno contiene la Europa, Asia, y la Africa; y el otro la America Septentrional, y Meridional; cada uno con 18. Meridianos, y 18. Paralelos, que figuran los grados de longitud, y latitud: (yo no sé el motivo porque los ponen mas angostos al medio, haviendo de ser iguales, como estan en los Globos; si es para demostrar la tierra, y agua, veanse puestos al contrario, y claro.

Y así digo, que el espacio, ó distancia del Circulo Artico, hasta su Polo, y el Circulo Antartico, tambien hasta su Polo, se llaman Zonas frias, porque su terreno qual siempre está helado: El espacio del Circulo Tropico de Cancer hasta el Artico, y el Circulo Tropico de Capricornio hasta el Antartico, se llaman Zonas templadas, porque igualmente carecen de extremos frios, y calores: El espacio del Tropico de Cancer hasta el Tropico de Capricornio, se llama Zona Torrida, y los que habitan en ésta, ó baxo la Linea Equinoccial no sienten excesivos calores.

El Equador, ó Linea Equinoccial, es un grande Circulo, que divide la tierra en dos partes iguales; tiene su asicnto entre los dos Polos, à igual distancia de uno y otro, y se divide en 360. grados: Los de longitud tienen su entero valor baxo la Linea Equinoccial; Pero siguiendo àzia el Meridiano, y àzia el Septentrion disminuyen, de forma, que baxo los dos Polos vienen à reducirse à nada; y así diremos, que toda la redondez de la tierra tiene 6300. leguas Españolas.

El Zodiaco, ó Ecliptica es un grande Circulo, que passa por una y otra parte del Equador, demuestra lo mismo en quanto à los 12. Signos, baxo los quales el Sol da buelta en el espacio de un año, llevandose 30. grados en cada Signo: Los 6. Septentrionales, ó Australes son Aries, Tauro, Geminis, Cancer, Leo, y Virgo: Los otros 6. Meridionales son Libra, Escorpion, Sagitario, Capricornio, Aquario, y Piscis.

Si algun Mapa no tuviese Escala, se ocurre à los grados de latitud: cada uno contiene 17. leguas y media Españolas, 20. Francesas, 15. Alemanas, y 60. millas Italianas; y el grado se divide en 60. minutos; y si no estan señalados los

Meridianos, y Paralelos; y se desea saber un Lugar à quántos grados está de longitud, se le passa un hilo por encima, y los num. de arriba y abaxo le señalan; pógatele el hilo al través, y los nú. de los lados demuestrá los grados de latitud; y para saber las leguas, que ay de un Lugar à otro, se mide la distáncia con un compás, y despues por la Escala se sabe; y andando de viage se hallan algunas mas, à causa de las subidas, y baxadas de los Motes, y bueltas, ó rodos de los Caminos.

**BREVE EXPLICACION de los quatro Sixtemas.**

**C**laudio Ptholomeo compuso un Curso completo de Astronomia; dexó su Sixtéma, en el que se ve la tierra estable, y firme en el centro del Universo, formando con el agua, que cubre lo mas de su superficie, un cuerpo espherico, ó bola ceñida por todas partes de la Region del ayre, que la rodea, y se estiende hasta la Region (si se da) del fuego, cuyo limite, ó termino es la concavidad de la Region eterea, ó Cielo de la Luna. Al rededor de la tierra, como centro, y sobre el exe, y polos del mundo, hace dar una buelta de Oriente à Occidente à nueve Cielos, con todos los

Astros, en el breve espacio de 24. horas, por el movimiento de un primer movíl, ó del superior Cielo. De modo, que la Luna da la buelta en 27. dias y medio; Mercurio, Venus, y Jupiter en 12; Saturno en 30, y el Firmamento de las Estrellas fijas en 36y. à razon de un grado en cada 100. años.

Nicolas Copernico pone à el Sol fijo en el centro de el mundo, quiere que Mercurio dé su buelta al rededor del Sol en 88. dias, Venus en 225, la Tierra en un año, y en su propio exe en 24. horas, la Luna al rededor de la Tierra en 27. dias y medio, Marte en 686. dias, Jupiter en 11. años, 315. dias, Saturno en 29. años, 164. dias, y corresponde à su nombre, se establece fijo, y firme el Firmamento có las estrellas. Este Sixtéma, aunque tan ingenioso, y seguido de muchos, le condenó la Congregacion de Cardenales, è Inquisidores, por contrario à las Divinas Letras; pero permite seguirle como hypothesis, ó suposición, para mas facilmente averiguar los movimientos Celestiales.

Ticho Brahe, supone, como Ptholomeo, la tierra inmóvil en el centro del mundo, y al rededor de ella como cen-

tro, hace mover la Luna, el Sol, y Estrellas fijas con sus propios movimientos. Los otros cinco Planetas, Mercurio, Venus, Marte, Jupiter, y Saturno, dice moverse al rededor de el Sol, de fuerte, que los primeros en sus circulos no abrazan à la tierra, los otros tres sí, y el de Marte corra el circulo anual del Sol, por lo que à veces se observa mas cercano à la tierra, que el Sol mismo.

Marciano Capela sacó con el nombre de Sixtéma compuesto, un Extraño, ó mezcla de los dos Systemas de Ptholomeo, y Ticho. En el centro del mundo se pone la tierra inmóvil, sirviendo de centro à los Orbes de la Luna, Sol, Marte, Jupiter, y Saturno, Firmamento, y primer movíl, como en el Sixtéma de Ptholomeo; y los dos Planetas inferiores Mercurio, y Venus tienen sus Orbes concentricos al Sol, como el Sixtéma de Ticho. Los Planetas pequeños son 9, 4. que rodean à Jupiter, y 5. à Saturno, y se llaman Satelites.

No explico sino lo preciso para no cansar al Lector, y no pueda ser buen Historiador, si no entendiendo los Mapas. VALE.

Con Licencia: En Madrid, en la Imprenta del Auro, 1760. dode se hallará todas sus Obras.

Por Pablo Minguet, Gravador de Sellos, Laminas, Firmas, y otras cosas.

manuals of geography translated into Spanish by Juan Manuel Girón. Gendrón also published a folio atlas with maps signed in Paris and London; no complete copy exists, only loose map sheets. Given the scarcity of copies and traces of these publications, Gendrón's initiative does not appear to have been particularly successful. As the frontispiece on the 1756 atlas indicates, they were sold at bookstores in Madrid, Cádiz, and Lisbon and later by Juan López (Hernando 2005, 14–15).

Evidence indicates that the map trade intensified in the second half of the eighteenth century. Thanks to Tomás López, Spanish society had within its reach maps of different Spanish regions, the colonies, and other countries. Not until the end of the century do the first educational atlases of geography (1792) and history (1801) appear, as well as Tomás López's most ambitious cartographic work: *Atlas geográfico de España* (finished in 1792). His son Juan completed the job by publishing an *Atlas universal* (1817) (Hernando 2005, 24).

Several factors contributed to this growth in trade. First, the political realization of society's intellectual backwardness and its economic consequences and the awareness of achievements attained in neighboring France inspired the drafting of several proposals for a *carta geográfica de España*. Second, with the advent of the Bourbons and the Enlightenment, secrecy surrounding cartographic work disappeared; it was recognized that this policy had hurt political administration and economic development the most. What had developed as a defensive strategy protecting Spanish interests was now understood as inefficient and harmful. Finally, progressive economic recovery and the cultural enrichment of society contributed to increasing consumption, both by newly created institutions as well as by more traditional segments, such as the nobility, bourgeoisie, scholars, clergy, and professionals. Notwithstanding these healthy stimuli, in the face of scarce documentary evidence and preserved works, the map trade does not seem to have been very buoyant. In a few cities, such as Madrid, Barcelona, and Valencia, which enjoyed higher economic well-being and availability of local cartographic works, there was an increase in the supply and second editions of some of these works.

AGUSTÍN HERNANDO

SEE ALSO: López de Vargas Machuca, Tomás; Map Collecting: Spain; Spain

(facing page)

FIG. 494. PABLO MINGUET, *MAPA MUNDI, CON LOS MERIDIANOS, Y PARALELOS IGUALES COMO LOS DEL GLOBO TERRE* (MADRID, 1760). Minguet, an engraver working in Madrid, offered pedagogic broadsheets such as this with instructional text to explain the map.

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*Map Trade in Sweden-Finland*. Map publishing in Sweden-Finland was limited in the period 1650–1800. Before 1735 it was forbidden to publish maps based on data from Lantmäterikontoret (land survey office). Only some fifty maps were published until that year, half of them in books (figs. 495 and 496). The only large undertaking was the Baltic chart book *General hydrographisk chart-book öfwer Östersjön, och Katte-Gatt* by Werner

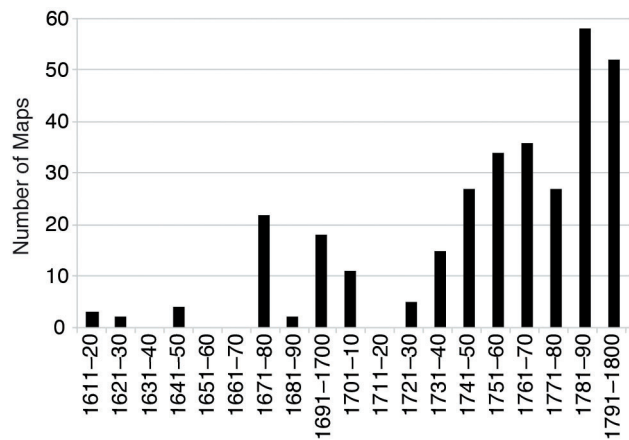


FIG. 495. TOTAL NUMBER OF MAPS PRINTED IN SWEDEN-FINLAND BY DECADE, 1611–1800. Almost all of the total 316 maps were printed in Sweden; fewer than 10 were printed in Finland (all in Åbo [Turku]). An analysis of type of map in each decade is shown in figure 496. Data compiled by Göran Bäärnhielm from the Libris online database; Carl Gustaf Warmholtz, *Bibliotheca historica sueo-gothica: Eller Förteckning uppå så väl tryckte, som handskrifne böcker, tractater och skrifter, hvilka handla om svenska historien*, vol.1, *Sveriges geographie* (Stockholm: Trykt hos Anders Jac. Nordström, 1782), 1–38; and the *Kungliga Svenska Vetenskapsakademiens Handlingar*.

Size of the original: 14.5 × 17.5 cm (map); 27.5 × 18.0 cm (page). Private collection.

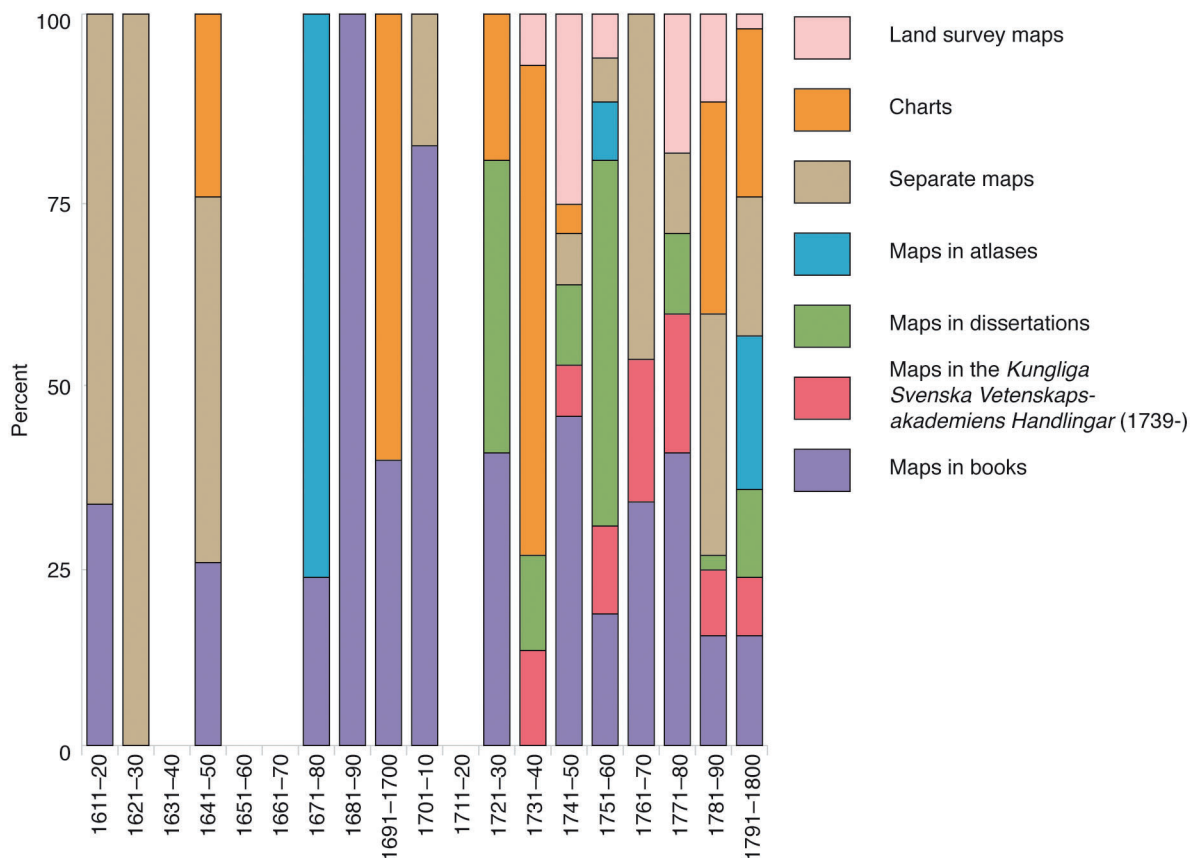


FIG. 496. PROPORTION OF MAPS PRINTED IN SWEDEN-FINLAND BY DECADE AND CATEGORY, 1611–1800. The categories are Lantmäteriet (land survey) maps, sea charts, separately published maps, maps in published (not composite) atlases, maps in academic dissertations, maps in the *Kung-*

*liga Svenska Vetenskapsakademiens Handlingar* (1739–), and maps in books. See figure 495 for data sources. Note the varying quantity of maps counted in each decade; total numbers are not reflected in this figure.

von Rosenfeldt and Petter Gedda printed in Amsterdam 1696 in Swedish, Dutch, and English editions.

The new demands of the Enlightenment for economic and scientific progress encouraged the lifting of map secrecy. Lantmäteriet applied to the king for the right to publish, and from 1739 until 1793 it printed some twenty-five maps. Map publishing increased threefold during this time but remained a costly and risky business.

There is scant evidence for how these maps reached their consumers. In 1697, Stockholm printer-bookbinder Henrik Keyser had in stock twenty copies of Rosenfeldt's navigation handbook (*Navigationen eller styrmans-konsten*, 1693) with the first entirely Swedish chart, a precursor to the Baltic chart book, assessed at twenty-four öre (Schück 1923, 1:242). Such a sales price would be equivalent to the price of one kilo of bacon or four kilos of herring, or half the wage for one day of heavy work in the mines (Lagerqvist and Åberg 1994, 63). The first book auctions that included Swedish maps were held in 1730 and 1732; Lantmäteriet maps appeared at auctions in 1742, but not until 1766 and

1775 were these maps included in booksellers' catalogs. Anders Åkerman's globes of 1759 and later were sold through the Vetenskapsakademien and specific shops and were also exported.

The map trade was itself part of the book trade, which had begun about 1520 and was managed by traveling booksellers, usually from Germany, or by local printers and bookbinders competing for the right to sell bound books. According to the bookbinders' guild statutes of 1630, the import of books by foreign booksellers was restricted; only books illustrated with maps and prints were allowed. As an exception, the Amsterdam publisher Johannes Janssonius was engaged as the state printer from 1647 until 1656, although he never lived in Sweden, running his business through agents. His Stockholm bookshop issued extensive sales catalogs, including several atlases and maps published by himself and by Gerardus Mercator, Joan Blaeu, Pieter Goos, and Nicolas Sanson.

By about 1700, there were fourteen printer-publishers in Sweden. Finland had only three and no real publishing

trade. In 1750 there were ten booksellers in Stockholm, twenty in 1775 and seventeen in 1800 (statistics compiled from Bonnier and Hånell 1935). The leading booksellers between 1750 and 1770—Gottfried Kiesewetter, Lars Salvius, and Carl Christoffer Gjørwell—issued catalogs that occasionally mentioned a few maps. Later, the big enterprises of Johan Christoffer Holmberg (from 1766 to 1803) and Anton Fyrberg (from 1776 to 1813) issued stock lists of thirty to sixty maps, mainly Swedish, German, and French but also some English, Spanish, and Russian. Outside Stockholm, Horn in Västerås and Hjelm in Norrköping were well-stocked in maps.

In Finland, a bookstore was founded in the university town of Turku (Åbo) in 1723. Beside market sales, maps and charts such as those from Olof Rudbeck's *Atlantica* (*Atlands*) were auctioned. An auctioneer set up in Helsinki in 1759. Printers and bookbinders, clergymen, school directors, and cathedral chapter clerks were agents for Swedish book suppliers in Turku, Porvoo, Helsinki, Loviisa, and Vaasa, and later in Kuopio and Hämeenlinna (Tavastehus).

Although efficient, the postal services to Finland sometimes had difficulties such as bad weather that made the route via Åland impassable. Good communications favored Germany, as Leipzig had foreign book agents in the seventeenth and eighteenth centuries. These agents also worked in Tallinn, through which maps came to Finland.

One means of advertising was the first newspaper, *Tidningar utgifne af et sällskap i Åbo*, founded in 1771, with over 370 book advertisements dealing with geography and travel from the late eighteenth century on. Turku had about ten bookstores in the late eighteenth century.

There was brisk trading in Finland by *colporteurs* (men going from village to village selling books and maps) (Laine 2006). In addition, preserved records attest to fifty-five auctions with ninety-two lots in the period 1747–1806 with a peak in the war year 1789: thirty-three auctions took place in Helsinki, and three to seven auctions in the towns of Oulu, Porvoo, Tornio, and Turku, resulting in sales of 112 single maps, 26 volumes containing 624 maps, and 20 volumes with unspecified content, accounting for around 800–900 maps, 50 sellers, and 59 buyers. Among these were seafarers who auctioned nautical charts. (Figures compiled from the Henrik online database of books and their owners in Finland to 1809.)

In Sweden, maps were also sold by other merchants, e.g., Joseph Schürer Sr. from Bohemia, seller of glass and fancy goods at his Storkyrkobrinken shop in Stockholm. He marketed Åkerman's globes (Björkbom 1936, 207) and is listed, together with one "Mr. Allardi" at Lantmäteriet, as Homann's agent in Stockholm from 1742 to 1759 (Bäärnhielm 2003). Schürer's son Joseph Jr. continued selling Åkerman globes, also for export in 1772 (Lagerquist 1981, 187), maps, atlases, and geographical instruments.

In addition to map publishing and the map trade, book auctions were also part of the picture. In Sweden-Finland they are documented in printed catalogs from 1664 held in Kungliga biblioteket and in the Stockholm Bokauktionskammaren records (since 1781 in Stadsarkivet). As in bookshops, maps were only a tiny sector of the trade. Between 1692 and 1800, over two thousand lots of maps were auctioned (fig. 497), usually one or two at each auction; only ten auctions included more

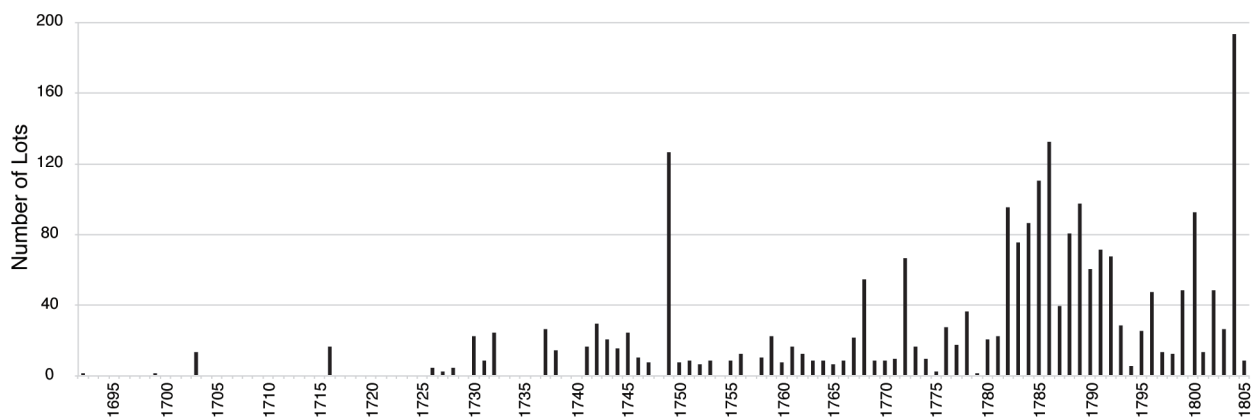


FIG. 497. NUMBER OF LOTS OF MAPS SOLD ANNUALLY AT SWEDISH BOOK AUCTIONS, 1692–1805. The implications of the data are rather uncertain, as the number of maps within a lot was not always specified. One of the largest single auctions for maps was Johan Norn's auction in May 1737, in which twenty-five numbered lots included 319 maps, exclud-

ing globes, or 12–13 maps per lot. Lots also included atlases as well as individual maps. Data compiled by Göran Bäärnhielm from printed auction catalogs in Kungliga biblioteket, Stockholm, and from manuscript auction records (1781–) in Stockholm Stadsarkivet.

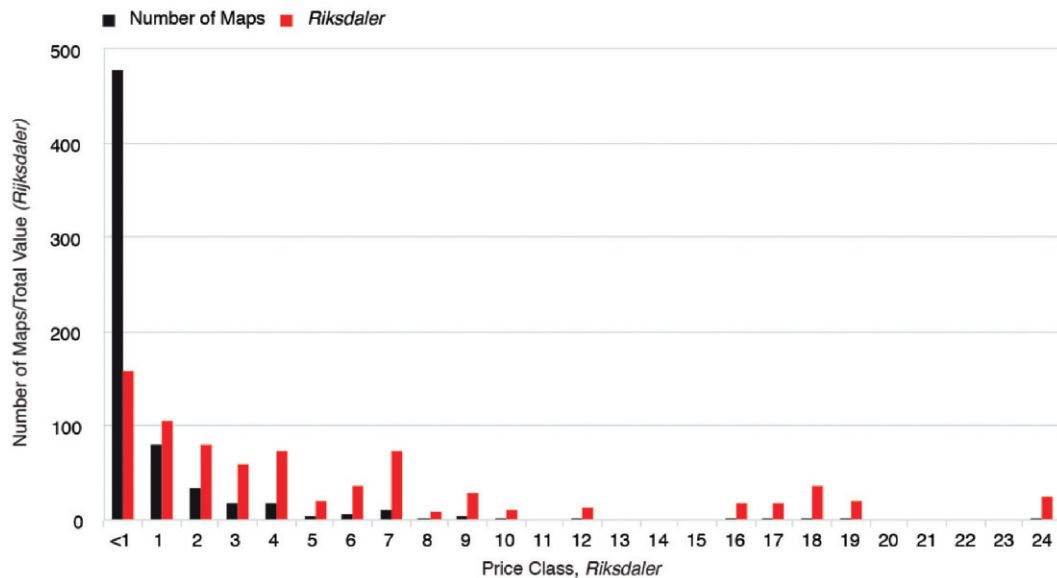


FIG. 498. VALUE OF MAPS SOLD AT SWEDISH BOOK AUCTIONS, 1759 AND 1781–1805. This graph shows the number of maps sold (black), together with their total value (red), for each price realized at auction. All prices are in the riksdaler, of forty-eight skilling, introduced in 1776. Prices in

the two auctions in 1759 were recorded in “daler copper coin” and have been converted to the later currency at a rate of nine dalers to one riksdaler. Data compiled by Göran Bäärnhjelm for auctions for which realized prices were recorded in the same sources as figure 497.

than fifty maps. In Stockholm 1780–1800, some fifteen thousand books were auctioned yearly. Maps were only 0.4 percent of that number, never more than 1 percent in any single auction.

In the same period, 1780–1800, just over four hundred names of buyers and sellers of maps can be found in the catalogs and archival listings. Frequent buyers were booksellers supplementing their stock, sea captains buying sea charts, school directors, military officers, and officials at the Kommerskollegium, all with a professional interest in maps; some of them were also collectors.

Prices were generally modest, a little above that of ordinary books (fig. 498). The median value of auction prices was 22 skilling (0.46 riksdaler, equivalent to the price of a shirt or 1½ liters of brandy). The highest prices, from 7 to 19 riksdaler (equivalent to the price of one or two horses) were paid for the modern French atlases by the Robert de Vaugondy family, Rigobert Bonne, Jean-Baptiste Bourguignon d’Anville, and for Åkerman globes. Homann atlases dominated greatly in number, but not in value, being priced up to 7 riksdaler, while early atlases (e.g., editions of Claudius Ptolemy and Abraham Ortelius) were less common but were sold in the same price range up to 7 riksdaler, sometimes much less. Generally demand was for current reference rather than for the antiquarian, a preponderance that was to change at the very end of this period.

GÖRAN BÄÄRNHJELM AND  
ANNA-MAIJA PIETILÄ-VENTELÄ

SEE ALSO: Map Collecting: Sweden-Finland; Sweden-Finland

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*Map Trade in Switzerland.* There was no map trade as such in Switzerland in the seventeenth and eighteenth centuries, in that no one specialized in selling maps and geographical works; the few maps sold in Switzerland during the era were published and distributed through the book trade. Thus, there has been little research into the subject. For example, in the imprint running across the bottom margin of the 1710 edition of his large map of Switzerland, *Helvetia Rhætia, Valesia*, Heinrich Ludwig Muoss listed the various “book printers and sellers” who sold the products of “the Muoss

Print Shop”: Johann Caspar Morff in Zurich, Daniel Tschiffeli in Bern, Heinrich Renward Wissing in Lucerne, Johann Georg König in Basel, Johann Rudolf Frey in Schaffhausen, and, of course, Muoss himself in Zug.

In the second half of the eighteenth century, advertisements offering new domestic and foreign maps were placed by booksellers in journals and periodicals. That maps could be bought and sold in great numbers is evident in the case of Bernese statesman Johann Friedrich von Ryhiner, who accumulated a very large map collection. Fascinated by geography and maps, in about 1800 Ryhiner prepared a two-volume geography and explanation of map collecting (“Geographische Nachrichten”), a twenty-three-volume catalog of his own collection, and a twenty-five-volume cartobibliography, all of which remain in manuscript (Klöti 1994, 351–64, 368–69). In the second volume of his “Geographische Nachrichten,” he wrote about his experiences working with a poorly developed map trade. To build a large map collection, Ryhiner observed that the collector must gain knowledge of every map that has appeared, which requires the review of every book that lists maps, and acquire every catalog issued by map publishing houses, as well as those of art sellers and booksellers who offer maps. Correspondence with geographically knowledgeable friends and scholars across Europe provided information about particular maps and suppliers in their respective countries (Klöti 1994, 292). These catalogs and Ryhiner’s correspondence have not survived, but he mentioned many catalogs in his cartobibliography, and he recorded prices of maps in the catalog of his own collection.

Ryhiner described multiple problems caused by buying maps from distant booksellers, giving insight into some of the conditions of the eighteenth-century map trade (Klöti 1994, 292–94). Sellers had to organize the shipping of purchased maps either directly to the buyer or via a bookseller in the map collector’s own town. However, shipping could be inordinately expensive, as maps could not be shipped with other goods and had to be separately handled, which often deterred map lovers from buying from remote dealers. Nonetheless, the transportation costs would be more reasonable, and no higher than for other merchandise, if a large number of maps were to be shipped together. A major problem in the acquisition of older maps, Ryhiner argued, was that most map consumers focused on the relevance of the content of the map, which meant that there was less demand for older maps. Old maps were discarded as new and better maps entered the market, so they grew ever scarcer until they became quite rare and would soon only be found in libraries, from which they could not be acquired. The determined collector

could find an owner of a desired old map only with great effort and then still had to pay more than the map was worth. However, acquisition of new maps was relatively trouble free as they could be purchased from publishers and booksellers at customary prices. A persistent problem was that book- and mapsellers often provided inadequate information. Advertisements in periodicals and catalog descriptions could be inaccurate or lead to misunderstandings, and Ryhiner seemed to think that they were made deliberately vague. The cost of the ensuing mistakes could be considerable. Finally, purchases from the map trade were augmented by a trade among individuals and by auctions; here, too, there were problems, at least for those who collected on the same scale as Ryhiner, because a significant portion of a large collection sold en masse would likely comprise a number of duplicates, effectively inflating the price of the rest.

Ryhiner recognized that these problems were significantly fewer for those who lived in major markets where the sharing or bartering of information and products could ease the acquisition process and reduce shipping costs (Klöti 1994, 294–95). Larger towns offered a greater chance to sell off unneeded maps. Also, great collectors such as kings and princes were aided in acquiring materials for their libraries by subordinates and especially by envoys to other courts. One example of such diplomatic trade in maps occurred when, in 1747, Swiss mathematician Leonhard Euler sent a series of letters from Berlin to Johann Kaspar Wettstein, who worked in London as a chaplain for the British royal family. Among other items of mutual scientific interest, Euler asked Wettstein to purchase maps produced in England on behalf of Count Hermann Karl von Keyserling, who was then the Russian envoy to the Prussian court in Berlin (*Euler Archive*, correspondence, 4 March, 20 May, 27 June, and 5 December 1747). The informal map trade was dependent on these networks of scholars and diplomats. But the poorly developed map trade in Switzerland’s small cities offered few, if any, of the advantages that large cities, ports, and political capitals could offer, and the Swiss collector had to pay much more than his lowland confrere.

THOMAS KLÖTI

SEE ALSO: Map Collecting: Switzerland; Switzerland

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*Marine Atlas*. See Atlas: Marine Atlas

**Marine Chart.** By the eighteenth century, the English language had already clearly distinguished the word “chart” (sometimes “nautical chart” or “marine chart,” even “maritime chart” or “sea chart,” although “chart” sufficed on its own without qualification), which specifically concerned the depiction of water, from “map,” which visualized land. This distinction was equally apparent in Spanish (*carta* for sea, *mapa* for land) or Portuguese (*carta marítima* versus *mapa*), but it was not as apparent in French, where the word *carte* (the Latin root *charta*—paper—is identical to that of “chart”) did not distinguish between the sea or land, at least not until the middle of the century. Other languages required a prefix or another word to determine the meaning: e.g., German (*Seekarte*, *Landkarte*), Italian (*carta hydrografica*, *carta nautica*, *carta geografica*), and Dutch (*Zeekaart*, *Landkaart*).

During the Enlightenment the design of the marine chart changed, gradually losing its ornamentation and becoming less speculative as it gained positional accuracy. Yet the chart’s marine contents did not immediately improve with better nautical information. The chart did not actually achieve its current modern shape and contents until the beginning of the nineteenth century, when soundings began to dominate the maritime section, and decoration faded away entirely, confirming the dominant principle of bathymetric data selection, if not comprehensiveness.

A remarkable graphic synthesis of symbols, the nautical chart remained *the* instrument privileged by those rather knowledgeable practitioners who understood a more advanced theory of navigation (Chapuis 1999, 139–46). In the eighteenth century, the chart was far from being a universal tool for all types of navigation because a large number of sailors still did not have access to it; many relied solely on the guidance of pilot books. This was certainly true of open sea navigation (*grand cabotage*), while inshore coastal navigation (*petit cabotage*) used few if any nautical guides, relying instead on the sailor’s visual memory of a familiar layout and oral transmission from pilot to pilot (Chapuis 1999, 148–50).

So the chart as a tool for navigation was not sought or known by all sailors, in spite of its visual language, which tended toward the universality of signs. However, the chart did not always have an intuitive connection with language and could be regarded as inferior to a verbal sea language, specific to sailors in their own “nautical garden,” which somehow connected with their senses. On the contrary, the visual language of the chart aspired to be a place of reason, of rational scientific thought. Training was required to master the chart’s code in order to make the multiple and specific interpretations that depended on the needs of the moment; the

marine chart was multifunctional, serving naval officers, captains of deep-sea voyages, and inshore sailors equally well. The skills required for reading the marine chart’s complex navigational aspects made it indecipherable to novices. The chart was built from a language all its own, reserved for the art of navigation. This special technical language for marine cartography supported the adage: “A good chart is worth more than a discourse” (Chapuis 1999, 212–13).

**VISUAL CHARACTERISTICS AND SCALE** In the eighteenth century, the white or empty spaces of the nautical chart depicted deep stretches of the sea. This underwater expanse, hidden from view, remained both unverifiable and feared. A historical paradox of the marine chart lay in that it was first designed to depict the land and its shallower surroundings. For the sailor, these coastal zones were places of hope (landing) and danger (the site of the majority of sea’s misfortunes). The life-saving nature of the nautical chart was not the least of its characteristics, as expressed by Charles-Pierre Claret de Fleurieu: “Deficient geographic charts can be published without jeopardizing the lives of men. But publishing flawed marine charts is like laying traps on a highway” ([Fleurieu] 1785, 38). Murdoch Mackenzie the Elder was aware of the gulf between terrestrial maps, created by engineers within a geometric framework of good angle measurements, and marine charts, built on directions and distances estimated with a compass on water. In *A Treatise of Maritim Surveying*, Mackenzie recommended that one should take advice from local practices for approaching the coastline and its hazards instead of relying on general charts (Mackenzie 1774, ix–xvi, xxi–xxii, 4–10; Chapuis 1999, 114–17). The first theoretician of hydrography, the Scotsman was also the first to offer constructive criticism of marine charts during the Enlightenment, presciently pointing out the limits of contemporary marine mapping (Mackenzie 1750, 3).

In light of Mackenzie’s views, the requirements for the marine chart both in the eighteenth century and today comes down to two essential functions: location (point) and course—the static and the dynamic, position and movement. Yet mapmaking and navigational principles rarely coincided before the nineteenth century. First, the chart had to allow for plotting position at sea, which was determined largely by astronomical observations (latitude and longitude from the middle of the century onward, and the latter only by the most advanced navigators) or by dead reckoning (directions and distances) and by the bearings related to the land in the context of coastal sailing or landings. However, navigators’ calculations of these bearings using the compass with other instruments and methods were prone to miscalculation and sometimes based simply on sight, following the



winds along rhumb lines, which were still included on a number of charts, even at large scale. The three-point fix method of resections and intersection survey by horizontal angular observations with a reflecting instrument was not used, even by the better hydrographers, until the last quarter of the century. Few navigators practiced coastal navigation by marine triangulation from landmarks, a method used extensively only from the mid-nineteenth century, when better sextants followed by better bearing compasses allowed adequate precision.

The chart had to provide water depths as well as the characteristics of the sea bottom as it corresponded to position. This information, graphically presented with numerals (for soundings, usually in fathoms) and signs and/or text (for different types of bottom), was far from precise in the eighteenth century. It was exceptional to find contour lines joining the sounding data; with contour lines or a cluster of soundings navigators did not need to make their own soundings. Yet by making their own soundings, navigators could compare them to those on the chart and use them as a positioning aid. Of all navigators, the hydrographer who made charts was the most demanding of accuracy in terms of positioning. Hydrographers did not use positioning to locate themselves on the chart, but to construct the chart by placing all its elements at their precise positions according to absolute latitude and longitude, often marked along the sides of the chart, or at relative positions by marine triangulation or the three-point fix method. The importance of soundings was even greater at sea, since they provided the only means to view underwater relief, in contrast to the land topographer, who could control data by sight.

The chart also had to indicate legibly all the hazards a ship needed to avoid, not only for areas that were too shallow, but also those that were not adequately explored for safe navigation. Hazards were represented by specific signs or graphic patterns (e.g., stipple, dots, crosses). Since the chart also provided sometimes valuable data for tides and currents, information that was usually provided in the written instructions accompanying the chart, it had to ensure the plotting of a reliable route to the destination port, while taking dead reckoning into consideration (Chapuis 1999, 212–13).

All the nautical information integrated on the marine chart was dedicated to the two objectives of position and course and responded to three basic questions: Where am I? How do I proceed? Which way is the best or least dangerous route? The plotting of the coast, islands and rocks, and their graphic representation provided some of the crucial answers. This representation aimed to evoke as accurately as possible the nature of the coastal terrain as seen from the sea (especially its relief and particular coastal elevations that allowed for positioning and distance calculations). Only terrain vis-

ible from the deck of a ship was included on the plan of the chart.

If navigators came upon an unfamiliar coastline, they had to be able to identify clearly from the chart what the landscape offered visually; charts had to provide this information at different scales, from the view of the high coastal peaks at the time of the landing to the smallest boulder noted upon arriving at the anchorage. The representation of man-made landmarks by various signs (sometimes with their heights and altitudes for distance calculations and often enlarged in relationship to scale), beacons or buoys (still very rare), alignments, magnetic declination, and toponymy served as essential additions to the chart. Only information useful for navigating was included; other information less appropriate for quick reading and not crucial to safety was omitted (Chapuis 1999, 212–13). The long eighteenth century saw the marine chart continually optimized, from the work undertaken by Dutch cartographers from the end of the sixteenth century to the publication in 1693 of both *Great Britain's Coasting-Pilot* in London and *Le Neptune françois* in Paris. The most spectacular visual change in this development was the gradual disappearance of rhumb lines from coastal charts in the latter half of the eighteenth century in England and Spain in particular (fig. 499); in France rhumbs were only partially removed by the turn of the nineteenth century.

From the end of the seventeenth century and throughout the eighteenth century, marine charts were classified according to their scale (or *point*, as the abstract concept of map scale did not appear until the beginning of the nineteenth century), yet not so tightly defined until around 1825 in France. Essentially, a distinction was made between general charts (oceanic charts or track charts) at a very small scale and general coastal charts at a small scale (or *petit point*), particular charts (coastal charts at a large scale or *grand point*), and harbor charts (very large scale, very detailed). The general charts of the eighteenth century were at a scale less than or equal to 1:1,000,000 for oceanic routes and less than or equal to 1:100,000 for general coastal charts. These charts met the needs of a range of seagoing coastal sailing activity and navigation along the coasts, at a sufficient distance to avoid major hazards. Detailed coastal charts, most often at a scale between 1:60,000 and 1:40,000, responded to the practice of inshore coastal sailing, even if, in reality, it was the seagoing navigators who might use them for landing instead of a pilot (Chapuis 1999, 718–19). Most importantly, in the eighteenth century, the scale of these last charts did not presume a level of detail sufficient for either the representation of the hazards and soundings or accurate positioning.

Therein lay a major problem for marine charts intended for use in navigating along the coasts, negotiating



**CIUDA ESPERANZA**  
**DE LAS ISLAS DE IUIZAY FORMENTERA.**  
*Devotada*  
**AL REY NUESTRO SEÑOR,**  
*Por el R. E. S. B. E. D. Astrologo Valdeis*  
*Secretario de Estado, y del Despacho Universal de Marina*  
*(Christiánico)*  
**Por el Ingénieur de la R. Armada,**  
*D.º Pedro Torrojo de S.º Mateo,*  
*Director de las Academies de Grammatica, Marina, Sc.*  
*AÑO 1760.*  
*Los Mineros de la Santa Cruz de Borgoña de S.º de las Españas.*

tricky channels, and entering into bays and river mouths for anchoring or accessing ports. To access information on these land-based seaways, French sailors could use harbor plans drawn at either ca. 1:15,000—six lignes (ca. ½ inch or 12 mm) for 100 toises (that is, a cable's length or about 195 m, which was the measurement used by the French navy), or sometimes at ca. 1:7,500 or one pouce (ca. 2 cm) for 100 toises (Chapuis 1999, 718–19). Except for these harbor plans, which were plane charts drawn at the same scale at which they were surveyed, charts in the eighteenth century were increasingly drawn on a Mercator projection, and their scales varied with latitude. This succession of scales, from the smallest to the largest, from the least detailed chart to the most detailed, is the equivalent of a progressive zoom movement in a camera and represents the movement from open sea to a landing to take shelter (Chapuis 2009, 18). The question of scale uniformity was considered regularly in European marine cartography in the eighteenth century, and it was one of the inspirations for the *Nouveau Neptune François* project in 1775 (Chapuis 1999, 257–62). Similarly, *The Atlantic Neptune*, which covered the east coast of North America, employed standardized scales, which were listed on the page with the conventional signs at the beginning of each volume: the general coastal navigation charts (coasting charts) were drawn at ca. 1:115,000, detailed charts for pilotage at ca. 1:29,400, and intermediary charts at ca. 1:51,400 (Des Barres 1780; Chapuis 1999, 122).

**OCEANIC CHART** Hydrography was not as imbued with ideology as other forms of cartography. The choice of a projection illustrated the neutrality of a fundamentally pragmatic representation of the world. Even though it substantially distorted the surfaces of the temperate and polar zones and endorsed enlarged representations of Europe, Asia, and America in relation to the rest of the planet, the Mercator projection fulfilled its essential purpose: convenience for navigation, which it accomplished by consistently preserving angles (to the detriment of distances because of the increasing latitudes) and by offering navigators the opportunity to plot their distances and bearings with the compass in a straight line.

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FIG. 499. VICENTE TOFIÑO DE SAN MIGUEL, *CARTA ESFÉRICA DE LAS ISLAS DE IUIZA Y FORMENTERA*, [MADRID], 1786. Scale, 1:90,340 (determined along the mean latitude of the chart, 38°48'N). Composed on a Mercator projection (*carta esférica*), this plate from the *Atlas marítimo de España* (1786, chart no. 8) is one of the best European marine charts of the end of the eighteenth century. Geographic north is at the top, magnetic declination is not mentioned (and was noted on only one chart in the atlas). The frame is gradu-

ated with a scale of longitudes established from the meridians of Paris, Tenerife, Cádiz, and Cartagena, and a detailed plan of the harbor of Ibiza fills an inset, without a reference frame but including a scale in “Varas Castellanas.” Soundings, though far from systematic in the atlas, are present as is the nature of the coastline (sandy or rocky). Astronomical and geodetic data were used by the French to correct the maps after 1800. Size of the original: 80 × 56 cm. Image courtesy of the Biblioteca Nacional de Portugal, Lisbon (C.A. 10 R).

From the very early seventeenth century, thanks to new mathematical tools, including logarithms and integral calculus, the Mercator chart was used on oceanic voyages by Europeans but not widely until the eighteenth century (*History of Cartography*, vol. 3, passim), as it was only introduced in France by *Le Neptune François* (1693). Plane charts still continued to be used after the middle of the eighteenth century, indicating the inertia of conventions in the maritime world and the level of navigational tolerance still acceptable (Chapuis 1999, 51–52, 151–52). On plane charts, the minutes of latitude and longitude were all given the same value even though that value was accurate only at the equator, the only place where the earth has the characteristics of a perfect sphere. Apart from the center of the area depicted, the flat map or plane chart did not conserve angles or distances, and so it functioned well only for the representation of very limited areas of the earth's curvature, in other words for coastal plans, for which it endured until the nineteenth century.

Paradoxically, it was the sailor of long sea voyages who mainly used the chart for landings and for plotting position at sea, as well as he could with observed latitude and estimated longitude. In fact, apart from a handful of knowledgeable naval officers who after 1760 sought to master the system of lunar distances or who benefited from the early adoption of marine chronometers and watches, measured longitude was not really accessible to merchant sailors until after the third quarter of the eighteenth century, with the wider distribution of the sextant and with *The Nautical Almanac* and the *Connaissance des temps*, both publications that recorded the distance from the center of the moon to the center of the sun and to the brightest stars (Chapuis 1999, 70). Finally, at the end of the century, the simplified reduction of lunar distances further led to accurate longitude observations (Chapuis 1999, 67–82, 653–55).

The first test voyages with marine chronometers at the end of the 1760s solved the longitude problem and allowed the correction of positions on charts compiled from the results. These voyages allowed the accurate location or suppression of various danger spots (*vigies*) or observed hazards (Chapuis 1999, 174, 178–79). The

Atlantic expedition of the *Flore* (1771–72) provided a long list of errors on the charts of the Dépôt des cartes et plans de la Marine (Verdun de la Crenne, Borda, and Pingré 1778), information of use in updating charts (fig. 500). The Atlantic expedition undertaken by Fleurieu in 1768 and 1769 was the most emblematic (Chapuis 1999, 78–79), given that the work he published afterward (Fleurieu 1773) became the authority on the subject of determining position at sea. Highly critical of Jacques-Nicolas Bellin, Fleurieu was not satisfied simply with emphasizing the importance of mastering longitude for the correction of marine charts (Chapuis 1999, 179–83). He illustrated his account with the *Nouvelle carte réduite de l’océan Atlantique ou Occidental* (1772), in which he corrected the North Atlantic’s east-west dimension by reducing it by an amount equivalent in 1750 to three days of good sailing (Chapuis 1999, 186–87, 26) (see fig. 240). This chart effectively represented the oceanic routes in an era when the application of astronomical techniques at sea was begun by a small elite of knowledgeable European officers. Fleurieu also classified the errors of latitude made by land-based (and office-based) chart compilers, even though latitude had long been understood and measured, and in particular he noted the compilers’ usually inaccurate construction of the increasingly spaced latitudes on Mercator charts.

The new generation of knowledgeable European officers wanted to follow a principle of transparency concerning the selection of sources for chart compilation, which still relied essentially on logbooks, for which much better standardization was needed (Chapuis 1999, 182–83). Two experienced mariners and navigators understood this perfectly: Alexander Dalrymple in Great Britain and Jean-Baptiste-Nicolas-Denis d’Après de Manneville in France, who both accompanied their charts with justificatory memoirs (Chapuis 1999, 184–85).

In addition to voyages dedicated to the testing of the chronometers and marine watches, essentially carried out by Great Britain and France in the Atlantic Ocean, it was the major exploratory voyages, notably those of James Cook, Jean-François de Lapérouse, and Joseph-Antoine-Raymond Bruny d’Entrecasteaux with Charles-François Beautemps-Beaupré, that contributed most to

the development of the marine chart. Their work may be measured by the evolution of the number of fixed points determined by astronomical observations of latitude and longitude, which attested to the acceleration of the geography of position at the end of the Enlightenment. Although the *Connaissance des temps*, the source of the following data, did not contain all of the astronomically determined points at sea, as its audience included astronomers as well as sailors, who could find additional positions in other specialized documents (charts or nautical instructions), this compendium of French and foreign observations from the four corners of the earth offers a good indication of the development of global knowledge of the period. The 1699 edition provided approximately 90 positions, mostly in France and Europe. In the first quarter of the century, there were almost 130 positions with twenty or so from the Atlantic (Cape Verde, Canary Islands, Azores), America (Brazil, Valparaiso), and Asia (India, China, Siam). Of the 220 positions in 1753, fewer than 30 were found outside of Europe. Twenty years later, in 1773, the total number had increased marginally to 250 positions, of which 60 concerned coasts of the entire world, but fewer than 10 corresponded to actual useful navigational landmarks. While new positions or recalculations of the eclipses of 1764 and 1769 were added, the position of Tahiti was not included nor were other points from Cook’s first voyage.

The birth of the astronomically based charting of the world occurred around 1777. The *Connaissance des temps* published in 1777 contained 390 positions, almost double the number of the preceding year. The additions resulted from the voyages for testing instruments in the Atlantic Ocean, and the major scientific expeditions around the world and in the Pacific Ocean: 140 positions related to France, 120 to the rest of Europe (Russia included), 30 to continental Asia and Indonesia, 25 to continental America, 20 to islands in the Atlantic, 15 to Africa, and 15 to islands in the Americas. Many of the positions in India and Africa came from d’Après de Manneville. Their longitudes were not the result of astronomical observations but of dead reckoning and should therefore not be taken into account. For the islands in the Atlantic and the Americas, the majority

(facing page)

FIG. 500. JEAN-RENÉ-ANTOINE DE VERDUN DE LA CRENNE, JEAN-CHARLES BORDA, AND ALEXANDRE-GUI PINGRÉ, *CARTE RÉDUITE D’UNE PARTIE DE L’OCEAN ATLANTIQUE OU OCCIDENTAL* [PARIS], 1775. Scale ca. 1:8,875,000 (at mean latitude, 31°00’N). This map corrects the dimensions and astronomically determined places in the North Atlantic, typical of maps made following the voyages to test marine chronometers undertaken primarily

by the British and, as here, the French navy. Produced initially by the Dépôt des cartes et plans de la Marine in 1775, the map was integrated into the published volume describing voyages of 1768–69 and 1771–72 (Verdun de la Crenne, Borda, and Pingré 1778).

Size of the original: 62 × 91 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge SH 18 pf 117 P 15/1).



of the positions come from Fleurieu, Jean-René-Antoine de Verdun de la Crenne, Jean-Charles Borda, and Alexandre-Gui Pingré. Finally, and certainly the result of Cook's first two trips, were the almost 25 positions in the Pacific Ocean from Cape Horn to the American Northwest coast to the China Sea (Asia including Indonesia by the Indian Ocean). The positions from these two expeditions are not incorporated into the *Connoissance des temps* before the 1777 edition. The vast majority of longitudes were based on the measurement of lunar distances.

Eight years later, the *Connaissance des temps* contained about 870 positions, or twice the number of 1777. In the 1785 edition, the Pacific Ocean was marked out in squares by 270 astronomical points, or more than 11 times as many as in the 1777 edition and largely as many as in Europe without France (240 positions including all of Russia). The paradox of this crucial period was the knowledge gap that was widening between the scientific and maritime elite and the mass of seafarers: only seven landmarks were determined astronomically along the French coastline. While the far-off and vast Pacific Ocean, still frequented almost exclusively by the most prestigious expeditions, benefited from the talent, methods, and latest instruments (120 positions alone were attributed to Cook's third voyage), certain distant islands were found to be better located on the general and detailed charts published in the atlases of these voyages than were the much-frequented sea banks of Europe. A huge amount of work remained to be accomplished that included the well-known waters of the old continent. However, these were regions that were familiar to the local sailors who navigated without, or with minimal, nautical guides and who instead relied on a strong oral culture that began with the veterans of in-shore coastal sailing who rarely strayed from the coast and from its hazards (Chapuis 1999, 26–27, 123–25).

**COASTAL AND HARBOR CHARTS** Coastal charts had to display land in order to guide ships to a destination. First of all, they were supposed to aid the transfer of dead reckoning—or the point carried out by the bearings to land—and the plotting of the course (Chapuis 2009, 5–43). Thus, for the determined position, the coastal chart had to indicate the depth of the water and the nature of the seafloor as they related to position and offer hazard-free routes for a ship to find shelter. The terrestrial part of the chart had only to represent the landmarks (natural or artificial) that were observable from the sea. This refined depiction of lands visible from sea was one of the older features of the coastal chart.

However, the difference between topographic maps of coastal areas and detailed marine charts was neither obvious nor distinct in France until the 1750s (Chapuis

1999, 38–40). After 1800, there were gradually fewer hybrid charts of the coast, topographical and hydrographical. (They were revived at the end of the twentieth century, for integrated purposes, such as amphibious military operations and littoral development in the civilian sector; Chapuis 2007, 11.) Not until the end of the eighteenth century was topography defined as something precise on marine charts, including the contours of the coast (or coastline) and islands, permanently emerged rocks, and littoral terrain visible from the sea, particularly its relief. This characteristic was depicted by Dalrymple and others in England during the same period (1789) (Chapuis 1999, 38–39).

Coastal charts on a scale larger than 1:100,000 did not appear in significant numbers until 1625, but increased after 1650. The work in France by Louis-Nicolas de Clerville marked the first attempt after 1662 to represent the French littoral at a sufficiently large scale using detailed surveys carried out in the field, even if they were rough and incomplete and resulted in very inaccurate mapping (Chapuis 2007, 71–79). In 1671, Jean-Baptiste Colbert ordered Clerville's work to be resumed by the *ingénieur des fortifications* La Favolière and the *ingénieur de la Marine* Denis La Voye, who were the most qualified for preparing detailed charts (Chapuis 1999, 101; 2007, 107–15) (see fig. 511). The manuscript charts by La Voye and La Favolière were kept secret for almost twenty years for strategic reasons and were assembled with those by other authors, including Clerville, in a collection of the coasts of France bearing Colbert's coat of arms. They were used to provide a baseline for the French coast along the Atlantic and northern Brittany for the realization of *Le Neptune françois* in 1693 (fig. 501) (Chapuis 2007, 107–14, 130–35).

Employing a principle of overlapping sheets, the specialized maps in *Le Neptune françois* were drawn at a scale of ca. 1:100,000 for the French coastline, quite detailed for the period (Chapuis 1999, 104; 2007, 134–35), and they adopted the still innovative practice of uniform scale established by the Dutch over the previous century. A concern for standardization and the replacement of disparate manuscript maps, such as those of the Thames School or Drapers' Company in seventeenth-century London or those of the Verenigde Oost-Indische Compagnie (VOC; Dutch East India Company), with printed atlases at the end of the same century became standard practice for countries with more advanced hydrography. Users, however, were slow to adopt the large inconvenient atlases. They preferred cheaper one-sheet charts, even in manuscript, for particular seas and coasts, well into the eighteenth century, because they could be updated and above all they were easier to use on board ship. In England, the publication of *Great Britain's Coasting-Pilot* by Greenville Collins (1693) and its nu-



FIG. 501. DETAIL FROM [DENIS LA VOYE], 7<sup>ME</sup> CARTE PARTICULIERE DES COSTES DE BRETAGNE DEPUIS L'ISLE DE GROA JUSQU'AU CROISIC [PARIS, 1693]. Scale ca. 1:100,000. This map from the first edition of *Le Neptune françois* (1693), like all the others constructed from La Voye's surveys, remained the best work for the coasts of Brittany at the end of the seventeenth century and remained so

until the beginning of the nineteenth century. It offered a detailed legend, the presence of landmarks visible only from the sea, and rhumb lines but no framework of graduated latitude and longitude.

Size of the entire original: 60 × 80 cm; size of detail: ca. 20.5 × 38.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [1122 B]).

merous subsequent editions over the course of the eighteenth century was a state initiative comparable to *Le Neptune françois* (Chapuis 1999, 111–12). Like Colbert, Samuel Pepys, chief secretary to the Admiralty, played an important role in recognizing the shortcomings of British and Dutch cartography in the face of increasing needs of the British Isles and overseas. A century later, Dalrymple, hydrographer of the East India Company, insisted on the need for uniform scales for both general and specialized marine charts in order to simplify their use by encouraging sailors to become accustomed to the different sizes ([Dalrymple] [1790?], 49).

While topographical and geodetic mapping concentrated on fixing terrestrial positions in Europe and the Americas during the Enlightenment, French marine cartography concentrated on the solution to the longitude problem in the open sea rather than along the coastline, where it lagged substantially behind land-based mapping efforts (Chapuis 1999, 104–10; 2007). By comparison to the coastal project by Jean Picard and Philippe de La Hire, astronomers from the Académie des sciences, from 1679 to 1682 (Débarbat and Dumont 2002, 241), the Académie's triangulation took much longer and sailors

had to wait for its results to appear on marine charts. Although first to develop a major geodetic framework on land, France missed its opportunity to implement a similar approach to hydrography. The central government only envisioned terrestrial applications of this advanced technique.

While *Le Neptune françois* continued as the major reference in France until 1800 and beyond (long afterward for some charts) for lack of a better alternative, no coastal marine chart appeared that relied on France's geodetic network in the eighteenth century, with rare exceptions. The private initiatives of Michel Magin in the estuaries of the Loire and the Gironde (1757) and those of Jean-Baptiste Degaulle in the Seine estuary (1788) were not part of any larger scientific initiative, despite their claims of geodesy, accuracy, and reliability without a pilot (Chapuis 1999, 134, 149, 318). However, the geodetic network was incorporated into the *Nouveau Neptune françois*, the first modern hydrographic project in the eighteenth century on the French coastline (Chapuis 1999, 257–62), but it was limited to efforts in Picardy and Normandy between 1776 and 1778. The charts surveyed by Louis-Bon-Jean de la Coudre de La

Bretonnière and Pierre-François-André Méchain only appeared during the Revolution. French hydrography was held back by *Le Neptune français* (Chapuis 1999, 101–10), a cherished but outdated model. Its 5<sup>e</sup> *carte particulière des costes de Bretagne* remained the officially accepted image for Brittany until 1822 (Chapuis 1999, 614; 2007, 130–35) (see fig. 596). While Cassini's *ingénieurs* and the army's *ingénieurs géographes* were very active along the coast, they never ventured beyond the foreshore, with very rare exceptions (Chapuis 1999, 127–28; 2007, 173–84).

Other states agreed to the charting of their coastline with a focus more in keeping with the economic necessities and technical requirements of navigation of the eighteenth century. From the end of the seventeenth century, coastal survey methods at sea in Great Britain still relied primarily on the compass, even if the actual bearings of the landmarks (relative to true north) were carried out increasingly with angle-measuring instruments, particularly under the aegis of the Royal Society (Robinson 1962, 49, 55–57). While scientific activity in Great Britain sought more practical and commercial applications than in France (Rodger 2003, 12–13), some began applying the major principles of terrestrial triangulation to coastal hydrography following Mackenzie, who was the first to implement this practice in the Orkney Islands in 1747 for the benefit of kelp producers (Chapuis 1999, 112–13; Ritchie 1991, 16–17). Mackenzie was also the first to explain the practice while emphasizing its limits and shortcomings (Mackenzie 1750, 3). The results he obtained on the northwestern coast of Scotland, in Ireland, and on the west coast of England were not comparable to his theoretical method. Mackenzie's charts, published in 1776, were oriented toward magnetic north (while those of the Orkneys, surveyed almost thirty years prior, were oriented toward true north). Although useful at the time as it liberated navigators from having to calculate magnetic declinations, this practice, still common in the eighteenth century, quickly rendered many charts obsolete (Chapuis 1999, 114–15).

With the exception of extensive projects carried out in Sweden and Denmark, those of Cook and Samuel Holland on the northeast coast of North America (fig. 502), and of Vicente Tofiño de San Miguel y Vandewalle along the Spanish Mediterranean coast (see figs. 499 and 593) (Chapuis 1999, 121–23, 233), regular coastal surveying was still rare in the eighteenth century. Even though they made good use of surveying, the Russian expeditions along their Pacific coast nonetheless remained singular and unrepeated events. Their methods were more akin to the surveying under sail practiced by the major discovery expeditions, which were an exercise on their own, even if Beautemps-Beaupré gave them a significant

qualitative boost when he introduced a survey paired with a summary triangulation ashore for the first time in May 1792 in Tasmania, foreshadowing what he would do in wartime along the coasts of the Napoleonic Empire (Chapuis 1999, 325–88, 421–39, 511–23). Alejandro Malaspina's hydrographic surveying in the Spanish colonies between 1789 and 1794 can be recognized for its use of astronomy, but not geodesy.

A qualitative and quantitative analysis of French hydrographic production validates this scarcity of coastal charts. Technically, a modern coastal map could have been produced; however, in spite of several isolated attempts, including those mentioned above, none appeared. Almost 75 percent of the charts edited by the official French hydrographic service until 1772 were general charts, not detailed large-scale coastal charts (Chapuis 1999, 309–10).

This situation improved after Bellin's death: with



FIG. 502. DETAIL FROM A CHART OF THE HARBOUR OF RHODE ISLAND AND NARRAGANSET BAY [LONDON] CA. 1780; FIRST PUBLISHED 1776. Scale, ca. 1:51,400 (41°40'N). Originally surveyed by Charles Blaskowitz, Thomas Wheeler, and others, working for Samuel Holland, this is one of the charts in J. F. W. Des Barres's monumental four-volume *Atlantic Neptune* (1780) and shows an impressive density of soundings, not only in the bays and estuaries but also along the banks. Yet the station points in the sea are not positioned according to trigonometric determinations on land, as might be expected from Holland, who was a military geographical engineer and whose marine cartography focused particularly on the coastline visible from the sea. The ships are those of the French and British forces at the moment of Admiral Charles-Henri d'Estaing's arrival in the estuary 29 July 1778. Size of the entire original: 106.5 × 74.5 cm; size of detail: ca. 12.5 × 16.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge BB 203, vol. 3, no. 14).



mastery of the longitude, while general charts continued to be made, half of the sixty-four plates published at the *Dépôt des cartes et plans de la Marine* between 1773 and 1791 were detailed larger-scale maps (Chapuis 1999, 310). This magnification of scale resulted in large part from the translation, from the English, of British coastal charts. While the charts copied from British sources account for 45 percent of all French charts published during this period, they account for 62 percent of the detailed charts. During these eighteen years, more than half of the charts published by the *Dépôt des cartes et plans de la Marine* that offered sufficient definition for true coastal navigation came from British surveys. A small number of these charts resulted from terrestrial triangulation methods, and France did well to republish them, for its own publications were devoid of such triangulation data (Chapuis 1999, 310).

Of the 193 significant plates stored by the *Dépôt des cartes et plans de la Marine* in December 1791 (Chapuis 1999, 314), fewer than thirty were reliable, detailed maps, and were essentially of British origin. As for harbor charts drawn at a very large scale (more than 1:10,000, often more than 1:5,000), they were rarely published in France because they did not depend on hydrography but on coastal planning by the state, mainly for maritime engineering (public works). These plans were surveyed in the eighteenth century by military engineers (*ingénieurs du Génie* or *ingénieurs de la Marine*) and by civil engineers (*ingénieurs des Ponts et Chaussées*), as well as by a few *ingénieurs de la Marine* (navy engineers) who were also hydrographers, such as La Voye, Magin, and Degaulle (Chapuis 2007, *passim*).

Just a decade before the end of the century, less than 15 percent of the charts published by the French hydrographic service presented positions comparable to what could be obtained given the capabilities of terrestrial surveying. This proportion was not much different elsewhere, including in Great Britain, Spain, and even Denmark, where a general triangulation had begun in 1761. In other countries the proportion was even less, showing that they were even further behind. As the state was the only institution capable of investment in ambitious and expensive surveys regarding coastal charts, private publishers carried sizeable stocks of old and outdated charts. Thus, in the 1780s, France was unquestionably poised to strengthen its maritime cartographic production by regulating private hydrography (Chapuis 1999, 311).

In England, the major collection of publications by Dalrymple, the most prolific British hydrographer of the period, further exemplified this situation of heterogeneous quality. In *Nautical Memoirs and Journals*, he gathered many charts and maps relating to the ports on

route to India and China. They seemed to be of very inconsistent quality: some maps represented cities in an enlarged perspective compared to the scale; others gave exceptional details of recent triangulation activities; some charts offered only a simple contour line for the coast without any other characteristics and few soundings; yet others furnished the details expected by a knowledgeable navigator. This variety is explained by Dalrymple's overall purpose to accumulate all the cartographic resources for the region without necessarily qualifying them (e.g., old Dutch or Spanish manuscripts as well as recent British surveys).

**PUBLICATION OF CHARTS** In France the *Dépôt des cartes et plans de la Marine* engraved an average of 3.29 plates per year between 1737 (the year of the first publication by the *Dépôt*) and 1772 (death of Bellin), and an average of 3.67 plates per year from 1773 to 1791. By comparison, Dalrymple published 454 plates (charts and especially maps) on his own before 1 June 1789, and 5 charts and 22 maps the following year (until 1 June 1790): an average of more than 18 plates per year between 1765 and 1790, a figure probably unmatched by any other region in Europe or the rest of the world, whether by private publishing houses or state-supported enterprises. While it is true that Dalrymple mainly published charts produced from compilation, nonetheless, British hydrographers—private, or semi-official, achieving better quality—produced many more charts than the French official hydrographical department at the end of the century. Even the semi-private French venture supporting the *Neptune du Cattegat et de la mer Baltique* produced almost four times as many plates as the *Dépôt des cartes et plans de la Marine* from 1786 through 1790 (Chapuis 1999, 316). Yet quantity did not mean quality, and on both sides of the Channel only a scarce few coastal charts that were geometrically surveyed stand out from this massive production.

At the end of the eighteenth century, European marine cartography had not yet issued its major hydrographic works, which incorporated the considerable progress made in geodesy from the end of the seventeenth century. Aside from charts of the foreshore, any exceptional marine charts for this period were few in number and far from the quality of the topographic surveying at the time. At the very moment when France enjoyed the Cassinis' private initiative on the one hand and the major work of the *ingénieurs géographes militaires* on the other, the solution to the longitude problem at sea, which involved observation and measurement on open waters, was the major marine challenge of the eighteenth century. With their prestigious expeditions to the Pacific Ocean, though fluctuating between competition and sci-

entific cooperation, Great Britain and France were at the forefront in establishing longitude from an astronomical viewpoint so that the secondary geodetic points could then relate to the primary points of the oceanic charts, a process initiated in 1791 with the d'Entrecasteaux expedition, which employed Beautemps-Beaupré's methods (Chapuis 1999, 237–49, 325–88, 511–23). By guaranteeing trigonometric precision, the chart would finally be able to gain better resolution. This would be the role of the major surveying campaigns along the European and colonial coastlines in the nineteenth century.

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SEE ALSO: Atlas; Marine Atlas; *Connaissance des temps*; Longitude and Latitude; Marine Charting; Navigation and Cartography; Projections; Marine Charts; Sounding of Depths and Marine Triangulation

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### Marine Charting.

ENLIGHTENMENT  
DENMARK AND NORWAY  
FRANCE  
GERMAN STATES  
GREAT BRITAIN  
NETHERLANDS  
OTTOMAN EMPIRE  
PORTUGAL  
RUSSIA  
SPAIN  
SWEDEN-FINLAND

*Marine Charting in the Enlightenment.* In contrast to most other modes of cartography considered in this volume, marine charting covers the widest range of scales from very small-scale ocean charts to large-scale coastal charts and harbor charts. Many technical challenges faced the observer in gathering data necessary for marine charting at most scales: the problem of measuring distances and determining location, often accomplished by dead reckoning (that is, the conversion of observed distance and direction to obtain position), aided by observations of latitude, but not of longitude (with few exceptions before 1775). The observation, measurement, and representation of depths, ocean bottom, and currents also added to the technological and graphic hurdles. The advances, both instrumental and mathematical, made late in the century were slow to be incorporated, except by the best officers of state navies. Trigonometrical techniques of surveying, increasingly common on land, were difficult to apply on water; hydrographical engineers were much scarcer than topographical engineers, and very few naval officers were trained in those techniques.

Most of the states of Europe undertook the systematic hydrographic surveying of their shorelines and overseas possessions only in the latter part of the century. They began these surveys only when it became clear that private chartmaking firms could not invest enough money in work with such a low profit margin to fill the knowledge gap with reliable and accurate charts on scales demanded by governments and the public. Thus, these states still published charts mainly at too small a scale, as became apparent right at the beginning of the nineteenth century. Unlike the other modes of cartography, with the possible exception of celestial mapping, marine charting concerned itself little with questions of possession and sovereignty (property and geographical mapping), except in the overseas colonial context, or with planning and political aggrandizement (urban mapping), or with state administration (administrative and military cartography). While marine charts were

important for both war and trade, previous national policies of secrecy and subterfuge had run their course and proved to be counterproductive in the systematic gathering of information.

In 1650, European marine cartography was still largely dominated by the Netherlands, where the older Portuguese and Spanish chart designs had been incorporated into the institutions of a strictly capitalist economy and especially the Verenigde Oost-Indische Compagnie (VOC; the Dutch East India Company). The VOC was so powerful that it quickly became a state within the state. It supported an official chartmaker who was responsible for supplying all of the company's ships, reviewing and maintaining logbooks, and enriching the charts and sailing directions produced under his supervision. This work was partly commercial in that the supervisor could carry on and profit from his own editorial activity and was able to employ outside craftsmen to carry out company work. The company maintained its own hydrographic service in Batavia (now Jakarta) with its own cartographers. It was the first hydrographic service established in Asia, even though at the beginning of the seventeenth century, the Japanese had already started producing marine charts, modeled after Portuguese portolans (Unno 1994, 347). Although Chinese and Korean marine mapping practices were very old, their marine charts were not yet comparable to those from Europe, even though they included sailing directions and produced detailed coastal charts from an early date, as had mapmakers from the Gujarat region in India (Schwartzberg 1992, 494–503; Sheikh 2009). While Arabs produced marine charts under state supervision well before the Europeans entered the Indian Ocean, and the Ottoman Turks enjoyed a high point with the works of Pīrī Re'īs (Tibbetts 1992, 256–62; Soucek 1992, 263–92), by the eighteenth century, hydrographic production in the Middle East did not offer particular innovations.

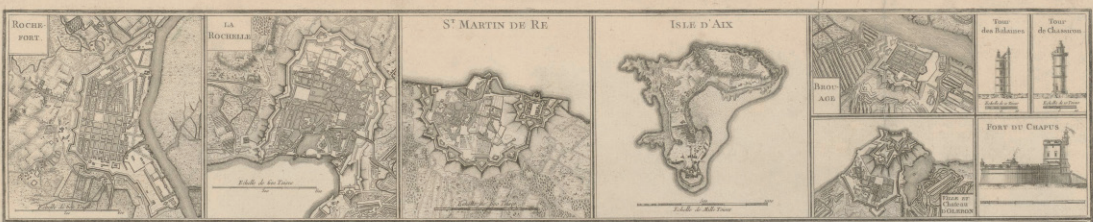
**STATE INTERVENTION** By the 1690s, the Dutch were losing ground in terms of the quality of their marine charting, which was dominated by a commercial sector that relied on multiple sources, including the works of other nations, for its charts. In the same period, several nations initiated state-sponsored hydrographic surveys. Petter Gedda's hydrographic survey of Sweden's Baltic coastline began in 1680, and the results first appeared in 1696 and then were privately published in Amsterdam in 1697. In Denmark, the private work of the navigator Jens Sørensen was rewarded with his appointment by the king as director of marine charting in 1695, although his charts were not widely distributed, being regarded as state secrets. France implemented the first official hydrographic service, initiated by Jean-Baptiste Colbert, minister of Louis XIV, who in 1676 ordered the collection

of all nautical charts with their accompanying journals and in 1681 requested the submission of logbooks by pilots to establish a geographic database. In 1693 the publication of *Le Neptune françois* began, the first state-sponsored maritime atlas, including the first charts of the French coastline by fortification engineers who had begun their survey work in 1662 (Chapuis 1999, 159; 2007, 69–105). Although a hydrographic office similar to the Spanish Casa de Contratación had been unsuccessfully proposed in England in the mid-sixteenth century, by the seventeenth, the single-minded purpose of the Crown and a minister like Colbert was lacking, as civil war and monarchic change disrupted the country.

In 1720 France established the *Dépôt des cartes et plans de la Marine*, with a primary goal of protecting manuscript documents from falling into foreign hands. The *Dépôt* copied manuscript and printed charts (French or foreign) and maintained and updated from logbooks the existing printed charts (primarily Dutch), under the supervision for thirty-one years of Jacques-Nicolas Bellin, who became the first *ingénieur hydrographe de la Marine* in 1741 (Chapuis 1999, 160–61). Reliance on foreign charts for war motivated the *Dépôt* to prepare French charts, assuring national independence (fig. 503). With this aim, Bellin increased the compilation of charts for successive versions of *Le Neptune françois* and later for the *atlas factice*, the *Hydrographie française* (from 1756), which included the first chart printed by the *Dépôt* in 1737 (see fig. 206). From that period onward, the collection of French marine charts continued to expand into the twentieth century (Chapuis 1999, 151–52, 170–71, 833–34).

In France, the *Compagnie des Indes*, founded in 1719, eventually established its own hydrographic service (1762), which it maintained until the company's bankruptcy in January 1770. It was directed by Jean-Baptiste-Nicolas-Denis d'Après de Manneville, author of *Le Neptune oriental* (1745), and run by active officers.

As maritime trade developed beginning in the mid-eighteenth century, the demand for nautical documents for commerce increased, and the *Dépôt des cartes et plans de la Marine* responded, countering private production. In 1773, France became the first country to institute legislation to regulate the editions and circulation of marine charts. Complete control of hydrographic production was the sole responsibility of the *Dépôt des cartes et plans de la Marine*, and every private publication was required to have prior authorization from the *Dépôt*. Transparency of sources was also required (and continues to be demanded today). In 1775, the *Dépôt* received an exclusive privilege for engraving and printing charts with authorization to seize counterfeit plates and copies. It established a commercial structure with



**CARTE DES ISLES DE RE ET D'OLLERON**  
 LES PERTUIS D'ANTIOCHE BRETON ET DE MAUMUSSON AVEC PARTIE DES COSTES DE POITOU AUNIS ET SAINTONGE  
 Dressée au Depot des Cartes et Plans de la Marine Pour le Service des Vaisseaux du Roy  
 Par Ordre de M. de Marine Ministre et Secretaire d'Etat pour le Departement de la Marine  
 Par le S<sup>r</sup> Bellin Ingenieur de la Marine et de Depot des Plans Cartes et Plans de la Marine, &c. de la Couronne Royale de France.  
 Echelle de Latex Marines de France et d'Angleterre dont Vingt font un Degre



**AVERTISSEMENT**

Les Roches et le Banc de Sable sont marqués  
 comme de tout autres de Blanc sur Blanc.  
 Les Ciffres marquent la quantité de Pieds.  
 Les chiffres qui y sont joints sur des chiffres arabes.  
 Cinq Pieds font une Toise.  
 La Mer morte ordinairement de six Pieds  
 dans son Port.  
 L'Esprit de la Haute Mer les Jours de la  
 Nouvelle et Pleine Lune est  
 A 1 lieue de Re à 3 heures de marée.  
 Dans les Pertuis Breton et d'Antioche à  
 3 heures et marée.  
 A la Rochelle à 3 heures 45 minutes.  
 Au Chapeau à 3 heures 30 minutes.  
 A Bourgneuf à 3 heures 45 minutes.



nationwide control of chart pricing and sales. This approach recognized that the staggering costs of hydrographic missions in the field and of map conservation, production, and distribution could be maintained only by an institution not driven by profits. Thus, the concept of a publicly subsidized hydrographic service appeared for the first time, confirmed by a decision of the Conseil du Roi in 1786 that outlined sanctions against authors and editors of unreliable marine charts that misled clients (Chapuis 1999, 190–95, 202–11).

STATE AND PRIVATE ENTERPRISE JOINED Other governments aimed to strengthen a central role for the state as they confronted similar difficulties in gathering and disseminating marine data. “Europe and the principal maritime nations have created establishments similar to those in France for the creation of marine charts, so that the fate of navigators was no longer left up to greedy geographers lacking knowledge and sufficient resources,” wrote Joseph-Bernard, marquis de Chabert, in a manuscript report to the *ministre de la Marine* on 5 July 1788 (quoted in Chapuis 1999, 198).

After Jean Picard’s trigonometrical survey of the Sound in 1671–72, as part of his determination of the location of Tycho Brahe’s observatory at Uraniborg, on Hven, similar work in the Baltic from the end of the seventeenth century benefited marine charting, even if initially it was not based on terrestrial triangulations. In 1756, Sweden undertook the geometric survey of its coasts, with the triangulation of a portion of the coastline completed in 1768. Maritime missions were considered part of the general triangulation of the Kingdom of Denmark begun in 1761, when the Danes began geodetic land operations along both Danish and Norwegian coastlines (fig. 504) ([Fleurieu] 1794, IX–XIII, XV–XVI). While he was working on the French *Neptune du Cattégat et de la mer Baltique*, Charles-Pierre Claret de Fleurieu praised the abundant, available, and reliable data in Sweden and Denmark: “There was no part of the world that can offer such a large number [of fixed positions] in such a tight space” ([Fleurieu] 1794, XIV).

Despite this careful work along coastlines, the Baltic was also the subject of charts that claimed to be drawn up from new methods of triangulation, but this was not always the case, for example in the translations pub-

lished in England in the 1780s (Chapuis 1999, 196). While the Swedish Admiralty made Rear Admiral Johan Nordenankar director of charts in 1772, Denmark sent its officers for training with naval allies in the early 1770s to educate them on new navigation methods. A brilliant product of this effort was Poul de Løwenørn, who directed numerous expeditions and initiated surveys of the Danish and Norwegian coasts after spending time in Paris during the American Revolutionary War, where he had been inspired by the *Dépôt des cartes et plans de la Marine*. Løwenørn created the Danish national hydrographic service, *Søkort-Arkiv*, in 1784. In Sweden, the Crown and the *Kungliga Vetenskapsakademien* pressed the Admiralty for improvement of charts; chartmaking services were unified, if briefly, under the direction of Nordenankar as head of the Sea Chart Authority, which published an atlas of the Baltic and Gulf of Bothnia from 1782–97. In 1797, however, the state discontinued its publication program, and commercial enterprise once again took over. In Finland, marine cartography tasks were assumed by *Rekognoseringskontoret* (reconnaissance office) from 1785 until its dissolution in 1805. Yet state control did not always guarantee the best results. When British ships sailed into the Baltic at the turn of the nineteenth century they found room for improvement on the local charts they encountered (Davey 2011).

In Russia, hydrographic work was vitally necessary for Peter I’s geographic and political expansion, which attracted many cartographers and European scientists to Russia, notably from France and Germany. The czar established the School of Mathematics and Navigation (*Shkola matematicheskikh i navigatskikh nauk*) in Moscow in 1701 to train the first cadets of the new Imperial Navy (*Imperatorskiy flot*), as well as a number of hydrographers and explorers. The Naval Academy (*Morskaya akademiya*) in St. Petersburg took over training in 1715, with its charting activities supervised by the College of Admirals from 1724. A hydrographic office was set up in the 1760s and was fully functioning by 1777. Under Catherine II, ever mindful of the European Enlightenment, Russia applied developments made in astronomy, notably during its large expeditions in the northern Pacific Ocean where Russian geographic activity was the most intense during the eighteenth cen-

(facing page)

FIG. 503. JACQUES-NICOLAS BELLIN, *CARTE DES ISLES DE RÉ ET D’OLLERON* [PARIS: 1757]. Engraved map printed in black and white, ca. 1:161,050 (determined along the mean latitude of the chart, 46°02′). This exact plan of the coast was a rarity by Bellin; the rich topography was doubtless influenced by Claude Masse, and the soundings come from the

work of La Favolière. It was edited in the year the English attacked the Ile d’Aix (1757) and inserted in the *Hydrographie française* of 1765 (Chapuis 2007, 200–201, 204). Size of the original: 87.5 × 56.0 cm. Image courtesy of the Bibliothèque nationale de France, Paris (*Cartes et plans*, Ge DD 2987 [1325 B]).

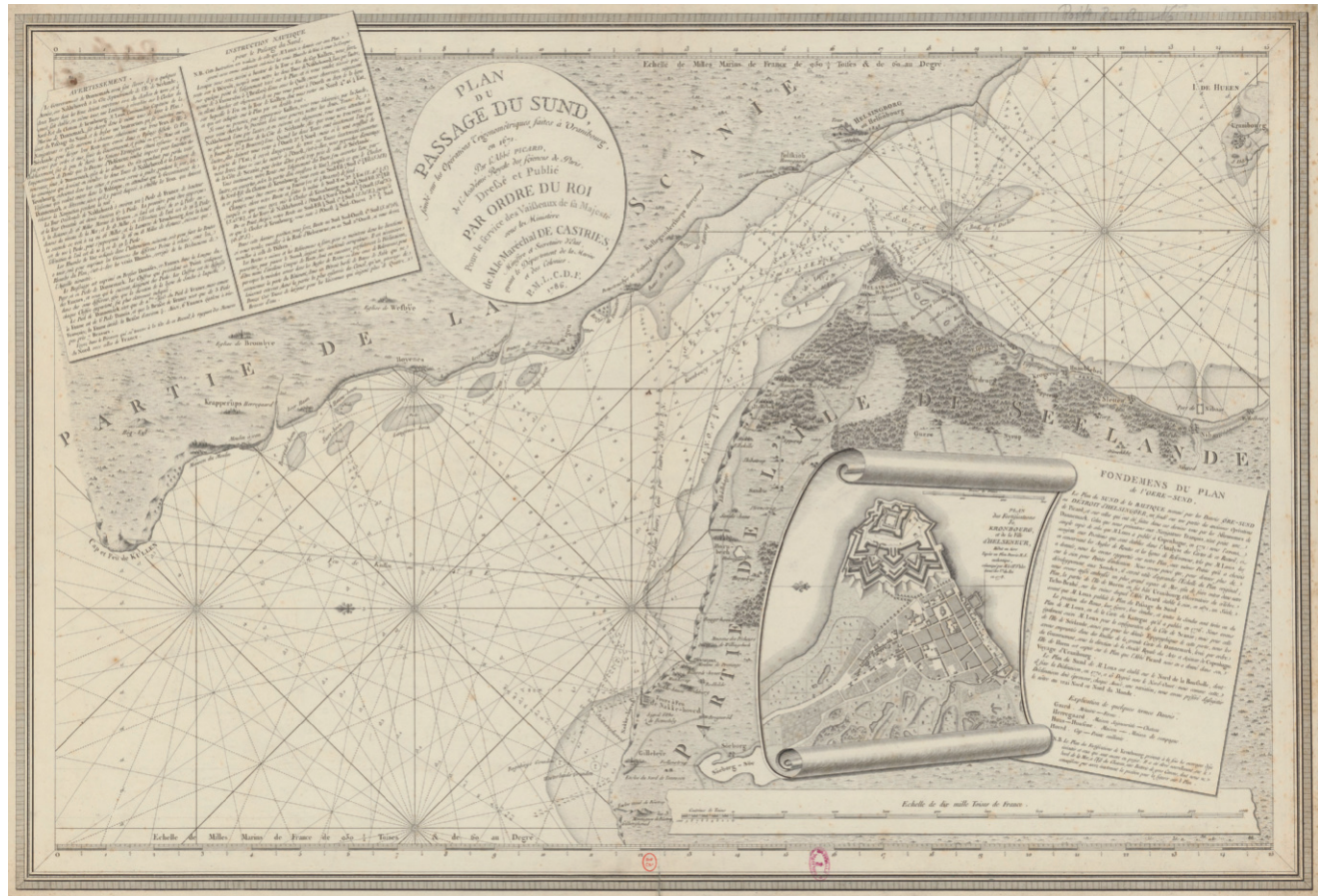


FIG. 504. CHARLES-PIERRE CLARET DE FLEURIEU, *PLAN DU PASSAGE DU SUND, FONDÉ SUR LES OPÉRATIONS TRIGONOMÉTRIQUES FAITES À URANIBOURG EN 1671 PAR L'ABBÉ PICARD* ([PARIS], 1786). Engraved map printed in black and white, ca. 1:160,000. This map acknowledges the importance of the geodetic work of Jean Picard, both in the title and by the inclusion of the island of Hven, to the right, where Picard had made observations from the ruins of

Tycho Brahe's Uraniborg observatory. The contents of the map are credited to charts published in 1771 and 1776 (see fig. 510) by Christian Carl Lous, the Danish marine officer who surveyed the Sound and instituted a system of fire towers to guide ships through the tricky passage of the Sound.

Size of the original: 60.0 × 85.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge SH 18 pf 8 div 2 P 16).

tury (Wagner 1937, 1:156–57). The first Russian hydrographic manual to integrate chartmaking practices appeared only in 1804.

Further south and west, in 1797, Spain founded its national hydrographic service, the Dirección de Trabajos Hidrográficos, based on the French model. But its older institutions were also involved in the new approaches to navigation, such as the Academia de Guardiamarinas de Cádiz. One of the Academia's directors, Vicente Tofiño de San Miguel y Vandewalle, was Spain's most acclaimed hydrographer, to whom the Spanish government had entrusted the astronomical surveying of the coastline in 1783. Tofiño de San Miguel's work often surpassed the French models on which it was based (Chapuis 1999, 233). After the peace of 1783, Spain had the political will to undertake the modernization of its hydrography and to move away from a policy of secrecy, which had

long surrounded the route of the Manila galleons. Spain escaped this autarkic trap thanks to a few scientifically trained and dynamic officers, such as Antonio de Ulloa and Jorge Juan, who were in contact with the French scientific community and involved in significant scientific voyages in Spain's imperial regions. Responding to British charting efforts, Spanish exploratory voyages began anew with considerable cartographic results during the years 1770–80, particularly those of Alejandro Malaspina between 1789 and 1794 (Chapuis 1999, 247–48).

**PRIVATE ENTERPRISE DOMINANT** The Netherlands exemplified the domination of private enterprise in marine charting through the seventeenth century. The German states, which relied on Dutch charts for much of their nautical information, also developed a scattered commercial response to thin nautical demand. As an

ever-expanding maritime power, Great Britain might have been expected to develop a state interest in marine charting, yet it continued with a private commercial model, periodically subsidized by the government. The contrast with France symbolized the way the two cultures envisioned political intervention: France driven by centralized royal authority and Great Britain by a Parliament wary of incurring debt. At the end of the seventeenth century Britain, like France, was driven to improve its coastal cartography, entrusting the task to Captain Greenville Collins from 1681 to 1688. Commissioned by the king and published in London in 1693, *Great Britain's Coasting-Pilot* was reedited regularly during the eighteenth century, like *Le Neptune françois*, which appeared the same year. At the same time, of all the large commercial companies founded by the Europeans in the seventeenth and eighteenth centuries, only one had a cartographic office as powerful as that of the Dutch VOC. Although established in 1600, the British East India Company created its hydrographic service much later. Meanwhile, it relied on the manuscript charts produced by the chartmakers along the Thames, at least from the time of John Thornton, who styled himself the hydrographer to the East India Company. Nonetheless, the Company took the quality of chart production seriously, culminating in the work of Alexander Dalrymple late in the eighteenth century. The same is true of the Royal Navy, which extended its power and its charting activities through the work of particular naval officers, especially in the Far East and in the Pacific, with the individual support of admirals rather than as an institutionalized activity. Not all marine research activity was commercial, however. In 1714, England formed a Board of Longitude, well before other nations, including France, whose Bureau des longitudes in Paris was not created until 1795.

On 19 February 1779, the East India Company formalized its charting activity by appointing Dalrymple as hydrographer. Having begun his career in the company, he became Britain's most prolific chart compiler of the time. He was also the first theorist on hydrography: his *Essay on the Most Commodious Methods of Marine Surveying* (1771) was published three years before the more thorough manual, *A Treatise of Maritim Surveying* (1774), by his compatriot Murdoch Mackenzie the Elder, who had also authored the *Orcades* (1750), based on the best hydrographical survey of the midcentury.

In Great Britain, state control over maps and books was generally limited to Parliament's regulation of copy-right (a system parallel to the *privilege du roi* in France). The engraved notification, "Publish'd according to Act of Parliament," appeared at the bottom of each printed map, along with the date of publication. This notice was not a guarantee of quality; it merely guaranteed publica-

tion rights of British commercial publishers who undertook the risk of expensive engraving and printing based on the assumption that sales would subsidize the costs of production, even though the prices remained too high. The private sector removed the financial burden of publication from the state, although in some cases the chartmaker or publisher turned to the state for financial support and reimbursement, as with J. F. W. Des Barres for *The Atlantic Neptune* and Lewis Morris for his survey of the coast of Wales (Robinson 1962).

The question of quality control remained. Commercial publishers tended to limit frequent map corrections, which incurred the unwanted expense of additional engraving, a reluctance that limited the reliability of printed charts (Chapuis 1999, 198–201). Much of the East India Company's chart production was affected by this routine, and Dalrymple expressed annoyance with the directors whom he deemed to be interested only in the Far East (Chapuis 1999, 253–54). Most of the Company's charts remained in manuscript until the last quarter of the eighteenth century, when Dalrymple published many, making the results of exploratory voyages available to navigators; some of the charts were of high quality, especially along politically or commercially sensitive coastal areas (fig. 505).

More and more naval officers such as James Cook spoke out against the scandal of inaccurate charts produced by commercial publishers. Even though publication of official works required Admiralty approval ("Under the directions of the right honourable the Lords commissioners of the Admiralty"), and though they were created by officers and military engineers on commissioned missions, they were nevertheless published by commercial publishers without further review or correction.

There was growing recognition in Great Britain, as the leading world maritime power, that marine charting and publication were essential for commercial needs as well as military demands. Certain professors of hydrography and leading naval figures had called for an official hydrographic organization since 1750 and even earlier. Yet there was a lack of political will and even of confidence. The Royal Navy's chief of staff was concerned that Dutch officers were more familiar with the Thames Estuary than the Navy's own English officers, even as late as 1771, when Murdoch Mackenzie the Younger and Graeme Spence rushed to Margate to survey the Kentish coast. Based on their results, the Southern Channel through the estuary was abandoned for the much deeper Queen's Channel, and Trinity House marked it out in 1775 (Ritchie 1967, 26, 92). Fine, reliable charts were available from military engineers and land-based surveyors like Cook on the northeast coast of North America and in the Pacific, or like George Vancouver

C. D. D. 2987 (7108)

Note.  
A. Situation of SCARBORO'S SHOALS by Account from P<sup>r</sup> SIBATA.  
B. D<sup>r</sup> to GR. LADRAW.

This Shoal is placed according to the Spanish Account,  
having been seen in 1755 by a Ship bound to  
Manila from Macao.

NB. This Shoal was seen in the Royal Captain on  
12<sup>th</sup> Dec 1773 on the passage from China  
towards Balambangan. The Situation  
is conformable to that in which it  
is here laid down. But they  
represent it to be at 140  
Leagues.

Note.  
P.C. Portuguese Map Chart.  
P.W. Prince of Wales 1785.  
H. Hancock 1794.



A  
CHART of the CHINA SEA.  
Inscribed to  
Messrs D'APRES & MANNEVILLETTE  
the ingenious Author of the  
NEPTUNE ORIENTAL:  
As a  
TRIBUTE due to his LABOURS  
for the benefit of  
*Navigation*;  
and  
in acknowledgement of his many signal Favours  
to  
*D'Anville*.



Note.  
R.C. Royal Charlotte 1773  
Ss. Ayren 1774  
S. | de Sa Haro | 1752  
S.H. | | 1752  
C.S. | | 1752  
C. | | 1752  
R.C. | | 1752  
G. | | 1752  
L. | | 1752  
L. | | 1752  
L. | | 1752  
E. | | 1752  
Y. | | 1752  
N. | | 1752

7108

C. D. D. 2987



along the northwest coast of the continent, from 1791 to 1795; the latter's surveys were exceptional with regard to contours, coastal information (including significant mountain summits for locating the ships' position off shore), and ocean depths (soundings) (Chapuis 1999, 248). But these efforts formed only a small part of the total printed chart production, whose mediocre quality may be accounted for by the state's inability (or lack of desire) to exercise real control over commercial chart production (Chapuis 1999, 200–201; Fisher 2001).

In the decade 1770 to 1780, the British state contributed men, equipment, and the gathering of data to the production of marine charts, with exceptional subsidies, while publication and distribution were assumed almost exclusively by the private market. London map publishers requested new surveys since they could neither afford nor staff such undertakings, especially on the high seas; thus, a profitable synergy emerged between the Admiralty and the map publishers (Blewitt 1957, 24–25, 163; Ritchie 1967, 22). Into the nineteenth century, some commercial enterprises, like Norie, Laurie & Whittle, and notably Imray, maintained strong traditions of good-quality chart publication (Fisher 2001).

The commercial approach, however, tended to follow the market in an ad hoc way; it did not lead on the scientific front. Such an approach could not continue indefinitely, and the war with France accelerated change. The Hydrographical Office of the Admiralty was created in August 1795 in London with Dalrymple, who understood the need for quality control, appointed hydrographer. The war focused his work: the first printed Admiralty chart was of Quiberon Bay in Brittany (1800), a symbolic evocation of the loss of the HMS *Resolution* at Quiberon in 1759 (see fig. 383).

While Great Britain was late in creating its own hydrographic service, its former colony, the young United States of America, newly independent, created its Survey of the Coast under the aegis of the Treasury Department. Long familiar with private hydrographic chart production, President Thomas Jefferson and Congress created this organization in 1807, later renamed the U.S. Coast Survey, and appointed the Swiss-born Ferdinand Rudolph Hassler as its first superintendent (Guthorn 1984). It was the first governmental scientific organiza-

tion in the United States, confirming the importance of hydrography for the new nation's existence.

COOPERATION, COMPETITION, AND THE DEMISE OF SECRECY From the beginning of the eighteenth century, England and France, the two great maritime and scientific powers, dominated hydrographic production in very different ways. The Enlightenment spirit of inquiry and scientific exchange was maintained through personal correspondence between scientists, such as Fleurieu and Dalrymple or Dalrymple and d'Après de Manneville, that even wartime rarely interrupted. More formal relations continued between scientific societies including the Académie des sciences in France, the Royal Society in England, and the societies of other regions. In addition, occasional astronomical data exchanges between the observatories of Paris and Greenwich, as well as the exchange of hydrographic data or nautical documents, resulted in many translations from one language to another.

This hydrographic cooperation, which developed during the peaceful intervals of the eighteenth century and accelerated toward the end of it, was at the same time influenced by competition, espionage, and misinformation, both in peace and at war. The desire for military secrecy meant that sensitive information had to be handled carefully. France discovered *The Atlantic Neptune* just after the American Revolutionary War, yet the Dépôt de la Marine made use of its plates earlier and had consistently purchased English charts during the 1770s for their fleet and for the publication of their own *Neptune Americo-septentrional* (1778) (Pedley 2005, 146), mainly from *The North American Pilot* (1775) by James Cook and Michael Lane (Chapuis 1999, 834). It was not until more lasting peace returned in the nineteenth century that more consistent exchanges developed between the hydrographic services. The great powers had an interest in more transparency: they were the first to profit, as they had already done at the end of the seventeenth century from *Le Neptune françois*, *Great Britain's Coasting-Pilot*, and the *English Pilot* for oriental navigation, works that broke the Dutch monopoly. The English and, to a lesser degree, the French preferred to publish their works, realizing that in return for their

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FIG. 505. ALEXANDER DALRYMPLE, *A CHART OF THE CHINA SEA* ([LONDON], 1771). Engraved map printed in black and white, ca. 1:4,350,650 (at mean latitude, 13° 00'). The continued title of this map ("Inscribed to Mons.<sup>r</sup> d'Après de Manneville the ingenious Author of the Neptune Oriental: As a Tribute due to his Labours for the benefit of Navigation and in acknowledgement of his many signal Favours to A. Dalrymple") underscores the international exchange

among cartographers: Dalrymple, hydrographer of the East India Company from 1779, and d'Après de Manneville, hydrographer of the Compagnie des Indes until its bankruptcy in 1770.

Size of the original: 64.5 × 49.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [7108]).

“generosity” in sharing knowledge, they would profit from the knowledge of others (Chapuis 1999, 248–49).

The more ships crisscrossed the seas of the earth, the more the world opened up and the less a strategy of national secrecy could be considered sensible in the long term. For some, national secrecy lasted far too long. In Denmark and Norway, it inhibited the publication and distribution of the best charts until the beginning of the nineteenth century, and Sweden did not want to disclose the bathymetry of the entrance straits to the Baltic, essential to navigating that sea and vital for the northern European economy. Jealously protecting its knowledge, Dutch hydrography gradually slowed down; finally the operations of the VOC closed at the end of the century. Certainly Dutch nautical atlases and charts continued to be used by all European ships in most of the oceans, but less regularly at the end of than during first half of the eighteenth century. From its leading world position in the middle of the seventeenth century, the Netherlands was overtaken by France and England in the 1690s and surpassed by Spain and Denmark, at least for quality, by the 1780s. Although the Van Keulen family firm became the chart suppliers to the VOC in 1743, new marine charts created in Amsterdam and Batavia steadily declined and finally ceased in 1799 (Ritchie 1991, 15). The Dutch published old material or the charts of others, like Mackenzie or Tofiño de San Miguel, before beginning coastal surveys in 1796 that remained in manuscript. The French *ingénieur hydrographe* Charles-François Beautemps-Beaupré surveyed the first marine charts of the Netherlands using the new hydrographic standards of the nineteenth century, for which his exceptionally detailed and precise map of the Escaut (Scheldt) (1799–1800) stands as an example (Chapuis 1999, 422, 430–31) (fig. 506).

The Dutch production of charts declined also because of the fossilized secrecy policy in the Far East; the Portuguese production of charts declined for the same reason in the second half of the sixteenth century as a result of Dutch espionage (Chapuis 1999, 233, 247). Yet Portuguese military engineers performed triangulation along their estuaries and promoted interesting initiatives in their colonies, mainly Brazil. At the end of the eighteenth century, the Chinese seem to have played an important role in the traffic of nautical documents involving the Far East: a Dutch map in particular was sent to England by this route (Chapuis 1999, 247). While d’Après de Manneville included a Portuguese manuscript among his sources for his chart of the China Sea—as did Dalrymple, using the abbreviation “P.C.” (see fig. 505)—the Portuguese increasingly used new charts produced by the major European producers from eighteenth-century cartography.

Although the historiography is far from complete, and much manuscript material remains to be studied, it appears that those regions that had been at the forefront of nautical science and engineering in the Renaissance, such as the Ottoman Empire, Portugal, and the Netherlands, were now absent from the cutting-edge research in chronometry and hydrography in the eighteenth century. They were also late in establishing institutions that oversaw marine charting or integrated the data produced by other countries into their own charting efforts. The Netherlands established a scientific commission in 1787, consisting of two professors of mathematics and the publisher Gerard Hulst van Keulen, to oversee chart production. Portugal set up a comparable scientific society with similar objectives in 1798, eight years after beginning the triangulation of the country.

European competition in exploring the Pacific Ocean spurred charting activity, even though the resulting marine charts contained little information and were rather poor in soundings. Nonetheless, Pacific exploration produced some of the major developments of the century, first with the work of Cook, then of Beautemps-Beaupré. The outlines of various bodies of land and their coasts benefited from new methods of marine surveying (Chapuis 1999, 511–23) and new instruments, such as the reflecting circle of Jean-Charles Borda, used by Beautemps-Beaupré (Chapuis 1999, 266–71). The numerous, precise, and simultaneous astronomical observations for latitude and longitude and the taking of the angles between the sun and remarkable points of the coastline were all employed for the first time in a systematic, reliable way during the large scientific expedition of Joseph-Antoine-Raymond Bruny d’Entrecasteaux in 1791–93 (Chapuis 1999, 325–88). These graphic constructions were realized in real time and allowed trigonometry to verify astronomy, and vice-versa, because the relative and absolute position of each location were determined independently of each other. When, ten years later, Beautemps-Beaupré surveyed the Flemish coast, he positioned the very dense soundings by marine triangulation with Borda’s reflecting circle (see fig. 86) (Chapuis 1999, 552–54). Thus, at the turn into the nineteenth century, a synthesis flowed between three-point fix angle resectioning (*les arcs capables*) and astronomical bearings.

**LACK OF SYSTEMATIC SURVEYING ALONG EUROPEAN COASTS** While the principles of modern state hydrography were established in France, and were defined by transparency of sources, legislation to ensure reliability, and emphasis on public service, such institutional standards did not easily translate into operational procedures. Financing an office post was always less costly than funding an operation in the field. Aside from the

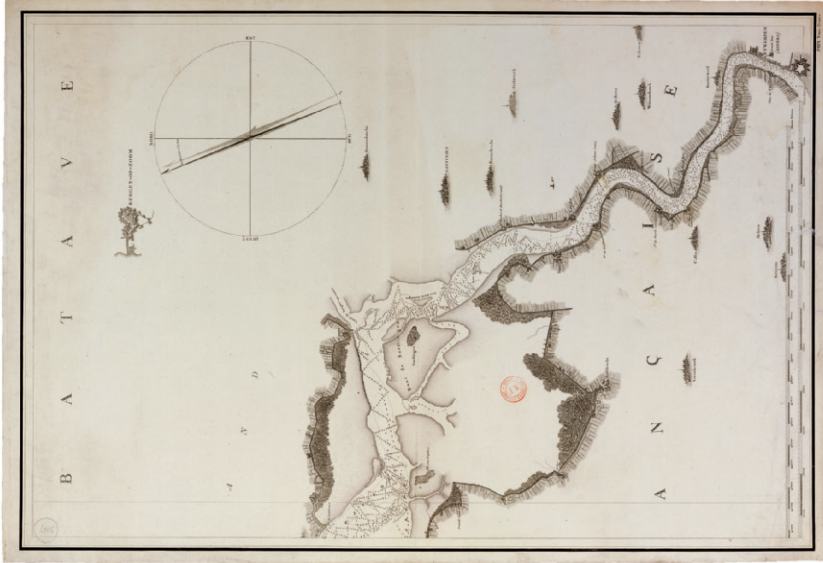


FIG. 506. CHARLES-FRANÇOIS BEAUTEUPS-BEAUPRÉ, *RÉCONNOISSANCE DU COURS DU HONT OU WESTER SCHELDE (ESCAUT OCCIDENTAL)* [PARIS, 1800]. Engraved map printed in black and white, 1:41,200, in three sheets. The first map surveyed on European soil by Beauteups-Beaupré covers the course of the Scheldt from Antwerp to its mouth, indicating with great precision soundings of the numerous banks scattered about the river bed, which posed problems for French warships. One of the very few charts the

Dépôt des cartes et plans de la Marine published during the Revolution and Napoleonic Wars (for strategic reasons they usually were kept secret), this map was copied in England by the commercial London publisher Steel (19 January 1804) for use of the Royal Navy officers (Chapuis 1999, 430–31). Size of the original: 90 × 61 cm each sheet. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge ARCH 3067 [A, B, C]).



FIG. 507. SAMUEL HOLLAND'S CHART OF THE HARBOR OF BOSTON ([LONDON], 1781). Engraved map printed in black and white, ca. 1:24,500. This map, from J. F. W. Des Barres's monumental *Atlantic Neptune*, bears witness to the particular attention given by military engineers to the coastline visible from the sea, notably the coastal relief. The

maritime portion was based on the surveys of the Royal Navy master George Callendar, performed in 1769.

Size of the original: 82 × 122 cm. Map reproduction courtesy of the Norman B. Leventhal Map Center at the Boston Public Library.

abortive attempt involved in the *Nouveau Neptune François* (Chapuis 1999, 257–62) and some very rare missions, such as those of Tofiño de San Miguel in Spain, the European coastline was not the locus for an ambitious hydrographic campaign using trigonometric surveying, even though military geographical engineers were employing it everywhere on land. Generally speaking, states were reluctant to invest specifically in nautical cartography, other than those multidisciplinary missions (both military and scientific) led by naval officers. Yet beyond solving the problem of longitude, what did these missions offer that was innovative for marine charting? What did they contribute to the accuracy required of the latest advancements in science and nautical technology?

Although critical for geographical positioning, the problem of longitude was hardly the sole factor in marine charting's slow development. More than a century

separated the integration of triangulation in terrestrial maps from its use for hydrographic charts (Chapuis 1999, 307). Curiously neglected by professors of navigation, mathematicians, sailors, and marine cartographers, no manual including the techniques of terrestrial and marine triangulation in hydrography was available until Dalrymple's *Essay* (1771). Mackenzie followed in 1774 with his *Treatise* in which he warned: "No Branch of practical Geometry has been so little considered by Men of Science as Maritim Surveying. This Subject has never been particularly treated of by any Author, nor taught by a Master; nor have Surveyors given any Account of their Operations and Procedure in such Surveys" (Mackenzie 1774, ix). While Mackenzie's work had a number of flaws, he was the first hydrographer to clearly advocate trigonometrical surveying at sea (Chapuis 1999, 115–17).

To participate in marine charting, it was best to be a sailor. But motivation was not enough; one also needed to be a hydrographic engineer. The Navy had difficulty grasping the specifics of the complex art of marine cartography, and it was always quick to ignore that which did not originate with itself and even quicker to reject “nourishment of the land.” Very few naval officers had studied works by terrestrial surveyors; for every James Cook, trained in terrestrial triangulation by a military surveyor (Samuel Holland), many officers were ignorant of its potential. This deficiency was even more alarming in that the terrestrial cartography of France was far in advance of what had developed in the rest of the world. The situation in Great Britain was somewhat better, even if Dalrymple’s and Mackenzie’s theories did not produce concrete results. There was no comprehensive work in France comparable to the charts of Cook and Des Barres (fig. 507). Although both countries used their terrestrial military engineers overseas, only England employed, and then only occasionally and only in North America, its military engineers (many foreign-born) for maritime work, which aided them during the American Revolutionary War. Once again, diversity leaned more toward the pragmatic than the scientific, which required competence and technology. On the nautical side of cartography, notwithstanding its great advantages, France was content to keep up appearances only. Fleurieu’s observation on the abundant and reliable data on the Baltic Sea (quoted above) tended to confirm the internationally poor track record of hydrography for not embracing astronomy and geodesy. While the century of Denis Diderot and Jean Le Rond d’Alembert’s *Encyclopédie* was one of specialization, led by France with other states gradually joining in the pursuit of education in science and technology, hydrography universally fell outside this general movement. This was not the least of all paradoxes of a practice in need of science and technology.

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SEE ALSO: *Atlantic Neptune, The*; Atlas: Marine Atlas; Fleurieu, Charles-Pierre Claret de; Heights and Depths, Mapping of: (1) Isobath, (2) Bathymetric Map; Instruments for Angle Measuring: (1) Back Staff, (2) Marine Compass, (3) Octant and Sextant; Marine Chart; Measures, Linear: Marine Measures; Modes of Cartographic Practice; Navigation and Cartography; Pilot Book; Projections: Marine Charts; Sounding of Depths and Marine Triangulation; Traverse: Marine Traverse

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*Marine Charting by Denmark and Norway.* In the mid-seventeenth century, the combined monarchy of Denmark-Norway was a considerable seafaring nation with possessions in Central America, Africa, and India. Greenland, Iceland, and the Faroe Islands were also part of the kingdom. Denmark comprised approximately 500 islands with a coastline of almost 7,000 kilometers and Norway’s coastline, with islands, was over 80,000 kilometers. Centered at the entrance to the Baltic and the trade situated there, the Danish straits were some of the most trafficked in the world. Considering this location, as well as the widespread fishing industry that always existed there, and that trade relied on the oceanic transport, it is amazing that practically no charts of internal Danish-Norwegian waters or of the waters surrounding its possessions around the globe were produced in the kingdom at this time. There are

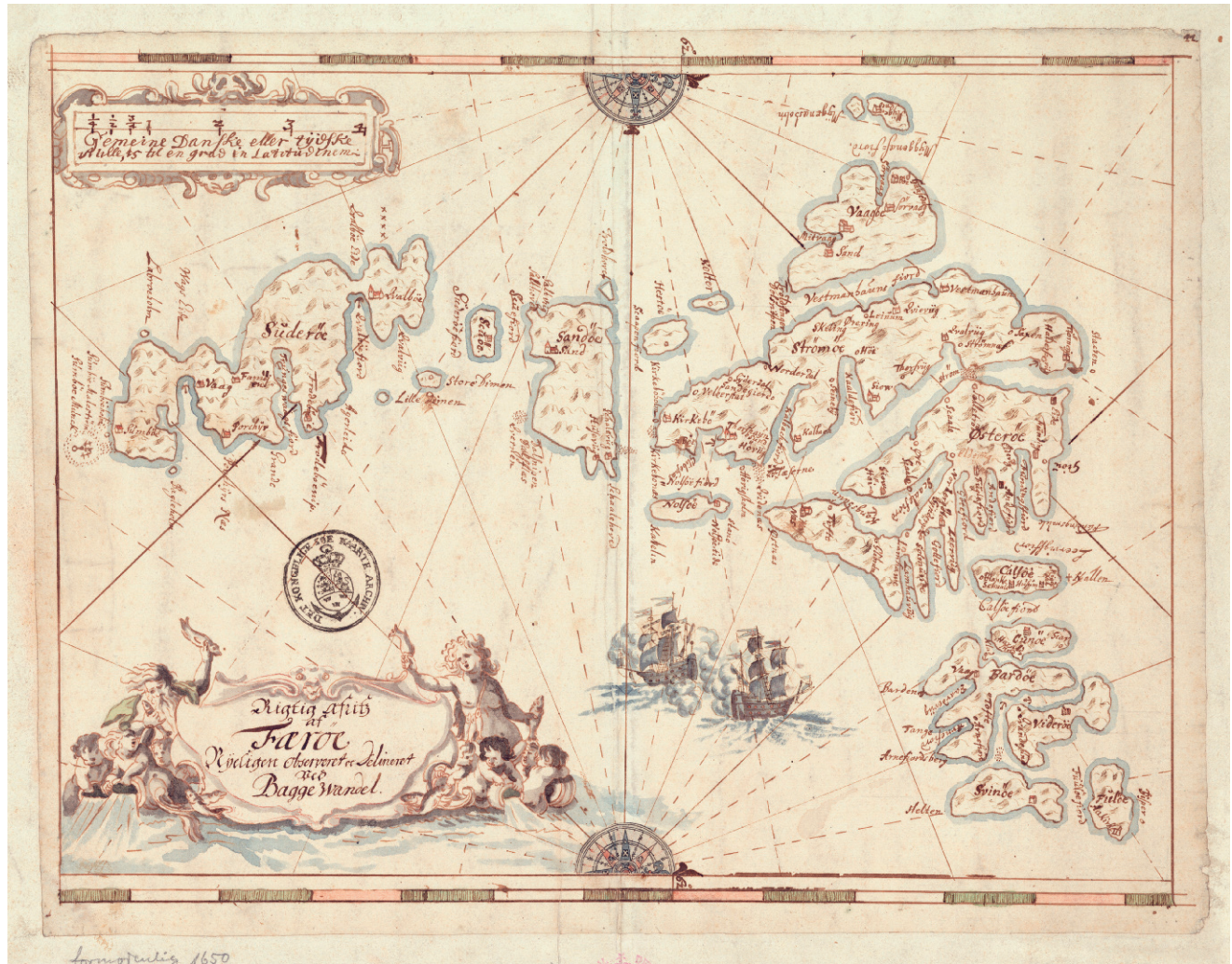


FIG. 508. BAGGE WANDEL, *RIGTIG AFRITZ AF FÆRÖE*, 1650. Oriented with north at the right, this manuscript map of the Faroe Islands is the oldest preserved chart in Denmark-Norway.

Size of the original: 34 × 45 cm. Rigsarkivet, Copenhagen (Søkort-Arkivet, Map A18/004). Image courtesy of the Geodatastyrelsen, Nørresundby.

only two known Danish charts from that period: one dating from 1650 of the Faroe Islands (fig. 508) and one from 1653 of the southern part of the Danish Sound. These are the oldest surviving charts made in Denmark-Norway and were drawn by Bagge Wandel, who was the director of the Navigationskolen in Copenhagen (Ravn 1928, 3–4).

At that time, the navigational charts most commonly used in Danish-Norwegian waters were Dutch. Numerous establishments in the Low Countries, including those of Lucas Jansz. Waghenaer and Johannes van Keulen, published charts covering all the waters of the world. Centrally positioned in Europe, Holland was the largest and most powerful seafaring nation and was located at the crossroads for traffic through the Atlantic to the

new world of the Americas. However, the specifics of the Dutch charts were poor and insufficient (Bramsen 1965, 79–88, 101–12). The charts were often embellished with fine decorations of sea monsters and mermaids regularly placed where content was missing. Crucial information about depth, ground, rocks, and reefs—all of which could be disastrous for ships—was often lacking. The rendered coastline was primitive and often incorrect. In most cases, cartographers drew the charts based on observations, drawings, and verbal descriptions of traders who had sailed the Baltic.

At the end of the 1600s, however, the Danish businessman Jens Sørensen effected a revolution in Denmark-Norway with regard to the production of reliable charts. Throughout his youth, Sørensen had worked with his fa-







French warship to profit from France's contributions to the maritime sciences. In Paris, Løwenørn became acquainted with the *Dépôt des cartes et plans de la Marine*, established in 1720, and its collections.

Fascinated and impressed by what he had experienced in Paris, Løwenørn was inspired and determined to establish a similar institution in Denmark-Norway, which would help shipping and could prevent navigational disasters and loss of life. In 1784, he persuaded the king and admiralty that such an institution was in the nation's best interest. On 22 April the same year, the Kongelige Danske Søkort-Arkiv (1784–1973), the royal hydrographic office, was established in Copenhagen with Løwenørn as its director (Bjerg 1984, 50). One of the first projects of the Søkort-Arkiv was to collect, register, and file all the charts, harbor plans, sailing directions, ocean descriptions, and related materials of Danish-Norwegian as well as foreign waterways. Numerous copies of these charts were made for use by the king's ships, but the original charts could under no circumstances leave the office. In addition, Løwenørn was ordered to plan, organize, and survey the most trafficked Norwegian and Danish waterways as the foundation for producing more reliable and explicit charts and to expand the safety of navigation. The Søkort-Arkiv now took back the previously awarded privileges to chart Kattegat and the Sound and received the exclusive rights to reproduce charts in Denmark-Norway. Several of the internal waterways were speedily surveyed, resulting in new charts. Surveys were undertaken along the coasts of Norway, the Faroe Islands, and Iceland. At first these surveys did not result in marine charts but provided valuable information for Løwenørn's pilots. Much secrecy surrounded the charts, as the surveys were intended for use by warships, not by commercial fleets or the general public.

With Løwenørn a new era had begun, as he ultimately became the father of the modern systematic survey, charting and expanding the knowledge of Danish-Norwegian waters. Through an energetic pioneering effort, he organized a lighthouse authority, a buoy service, a piloting authority, and the improvement of Danish harbors. Løwenørn's work was continued by his successor, Vice Admiral C. C. Zahrtmann. In time, the Merchant Marine needed more and more reliable charts of domestic waters and succeeded in eliminating the military's

penchant for secretiveness (Ravn 1928). In 1830, Zahrtmann was officially allowed to publish a number of new charts of the Danish-Norwegian coast (Bramsen 1965, 153). The publication of his *Den Danske Lods* in 1843 began the consistent, continuous marine charting that continues into the twenty-first century.

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SEE ALSO: Denmark and Norway; Sørensen, Jens

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**Marine Charting by France.** Any study of marine cartography in France between 1650 and 1800 requires clarification of vocabulary. The term *hydrographie* appeared in the French language in the mid-sixteenth century, and from the outset it meant marine mapping in both its textual and graphic forms. More specifically it incorporated “the description and situation of maritime places, their longitudes, latitudes, distances, itineraries, and differentiations of climates and winds,” as defined by Oronce Fine in 1551, in contrast to geography's “description of earthly places” (Dainville 1964, 97, 133–34). Yet in French from the 1630s to the 1650s, *hydrographie* also began to refer more and more frequently to the art of navigating or piloting, a definition that prevailed until around 1800 (Chapuis 1999, 38).

Nonetheless, *hydrographie* also still referred to marine mapping from the sixteenth century through the beginning of the eighteenth century, when Nicolas Aubin's influential marine dictionary included the entry on *cartes hydrographiques* to describe marine charts (Aubin 1702, 499). That said, the development of hydrography's current definition as a form of cartography dates from the 1750s, concurrent with the significant breakthroughs in navigation. Jean Le Rond d'Alembert defined hydrography in the *Encyclopédie* first as the act of “constructing marine charts” (d'Alembert 1765, 8:373), and the most significant example was the 1756 publication of the first

(facing page)

FIG. 510. CARL CHRISTIAN LOUS, *ET NÏT PAS KAART OVER KATTEGATTET*, 1776. Copperplate print. In the years before the foundation of the Danish hydrographic office in 1784, the publication of charts was in private hands. Lous had the privilege to publish charts of the Danish waters, such

as this one of Kattegat, which influenced foreign charting of the same area (see fig. 504).

Size of the original: 85 × 54 cm. Image courtesy of Det Kgl. Bibliotek; The Royal Danish Library, Kortsamlingen, Copenhagen (KBK 7153, 2-1-1776/1).

edition of the *Hydrographie française*, Jacques-Nicolas Bellin's collection of marine charts. Bellin himself held the title of *ingénieur hydrographe de la Marine* from 1 August 1741.

In his significant treatise on navigation of 1753, Pierre Bouguer insisted particularly "on the development of marine or hydrographic charts, and on all that relates to their usage" (Bouguer 1753, 55). His emphasis was understandable as hydrography was certainly connected for sailors to the art of navigation, a point of view that the elite adopted over the course of the next half century. In the marine volumes of the *Encyclopédie méthodique* (1786), the article dedicated to cartography was titled "Carte," but the one titled "Hydrographie" held true to its modern definition, even if it still resonated with the common naval meaning:

It is the knowledge of seas, waters, coastlines, islands, ports, harbors, streams, rivers, etc. that are spread out over our globe and that have been designated on hydrographic charts for sailors to recognize, because hydrography also instructs ways to position ships on charts, to navigate courses, and to make astronomical observations, the calculations it requires; in a word, everything that involves marine science in relation to navigating. ([Blondeau and Vial du Clairbois] 1783–87, 2:549)

In the same volume, a hydrographer was defined as "an individual who was trained in the art of navigation and who taught piloting and all its related areas to sailors expected to understand hydrography in order to steer ships all over the world" ([Blondeau and Vial du Clairbois] 1783–87, 2:548–49). In 1792, L. de Lassale considered hydrography as the science of navigation, which he taught, but he also devoted chapter four of his course to "hydrographic or marine charts" (Lassale 1792, 126). Five years later, the fourth edition of the marine vocabulary of Daniel Lescallier (1797, 2:625–26), defined hydrographer (*hydrographe*) as a professor of navigation, insisting that this designation should be reserved for experts who knew all the coastlines well enough to prepare charts of them.

Finally, in July 1791, the nomination of Charles-François Beautemps-Beaupré as *ingénieur géographe* of the d'Entrecasteaux expedition was a sign of the influential position of geography, also known as topography. For the most part, his traveling companions considered him the geographer of the expedition, yet fifteen years later he was regarded as the *l'ingénieur hydrographe* of this same voyage, evidence of a substantial and definitive evolution. By the early nineteenth century, those responsible for surveying for marine charts on land and then drawing them were systematically referred to as *ingénieurs hydrographes* or hydrographers, now well

rooted in the definition of hydrography that continues in use even today (Chapuis 1999, 40).

STATE CONTROL OF COASTAL MAPPING Determinism does not necessarily operate in geography: a large and beautiful coastline does not establish a maritime nation. In the eighteenth century, France was what it had always been: a landed nation with more plowing and pasturing than navigating the coasts and knowing the tides; a country that, for the most part, viewed the sea as a one-dimensional site or an unfathomable universe. Yet the minority who constituted the brotherhood of seafarers with a common language and lifestyle felt closer to their fellow mariners of other European nations, even to their "hereditary" enemies, than to their fellow citizens. The maritime tradition was indeed stronger in France's neighbors such as Great Britain and the Netherlands. One has to differentiate between the seafarers and the denizens of coastal communities who never ventured beyond the low-tide watermark, not even visiting the foreshore, at least not until modern times. The situation was not simple; though fundamentally land-based, France was also maritime (Chapuis 2007, 9–10).

Jean-Baptiste Colbert, the powerful minister of state serving in the wake of Armand Jean du Plessis Cardinal Richelieu and Jules Cardinal Mazarin, strengthened state control over cartography in the 1660s (Konvitz 1987, 1–2). The desire to know and master the national space became a fundamental characteristic of eighteenth-century France (Gillispie 1980, 3–32). As *intendant des Finances* (1661) and then *contrôleur général des Finances* (1665), Colbert controlled the administration of France, unofficially directing the Marine even before assuming the official charge of it at the end of 1665. In 1669 he became *secrétaire d'État à la Marine*, a position from which he legislated in support of hydrography schools responsible for teaching navigation (Chapuis 1999, 136).

In 1664, the minister created a commission to procure winter storage and dry docks for the naval fleet, a project that involved a new cartographic effort to map the coastline (Chapuis 2007, 70–71). Louis-Nicolas de Clerville, a member of this commission, was not always personally involved in the field surveys, which he entrusted to the topographers who worked under him. They were recruited from the *ingénieurs du roi*, as established under Henri IV, and prepared the maps, which were done extremely quickly and concisely, focusing only on major ports.

Clerville's commission marked the first attempt to represent the French coastline at an adequately large scale (in addition to his detailed plans, usually much larger than 1:100,000), reduced from detailed surveys carried out in the field, even from incomplete and rough drafts. The scale of Clerville's works was the sole satisfactory

result of this cartographic effort, which otherwise lacked accuracy and was essentially limited to areas around major military ports, such as Brest and Rochefort. His missions were more akin to those of a coastal planner than those of a surveyor with sailors in mind. Though Colbert thought both planning and surveying could be accomplished, the weak results confirmed that even a powerful state extremely conscious of sea matters could underestimate the nautical demands and the specificity required for nautical charts (Chapuis 2007, 71–79).

Sébastien Le Prestre, marquis de Vauban, criticized Clerville's work at every opportunity and succeeded him as *commissaire général des fortifications* in 1678, the year after Clerville's death. In fact, the changing of the guard had taken place well before Clerville's death, while he was still serving Colbert in the Marine, and Vauban took charge of fortifications almost everywhere in France, especially along the coasts. Vauban became very interested in the French coastline in 1679, studying coastal barriers as well as naval ports and even lighthouses, for which he launched the first construction program in France. Vauban's engineers, though not concerned directly with marine cartography, did take note of high and low tide lines, which did not appear regularly on maps until the seventeenth century, when they became the basis of early, if not the first, contour lines (Chapuis 2007, 88).

Vauban and Clerville were not the only ones traveling the coasts. At the request of the Académie des sciences, member astronomers Jean Picard and Philippe de La Hire made observations along the coast from 1679 to 1682 (Débarbat and Dumont 2002, 241), particularly in Brest, to determine latitude and longitude. These positions, together with those provided by Jean-Dominique Cassini (I), constituted part of the basic framework for the maps of *Le Neptune français*.

*LE NEPTUNE FRANÇOIS* The inaccuracy of Clerville's work forced Colbert to review it, with the triple goals of reducing the number of shipwrecks, facilitating defense, and developing the coastline. The *ingénieur des fortifications* La Favolière worked along the coasts of Poitou, Aunis, and Saintonge between 1670 and 1677 (fig. 511). The *ingénieur de la Marine* Denis La Voye worked north of the Loire along the coasts of Brittany around 1670 with excellent results, even surpassing those of La Favolière in spite of the ongoing geomorphological change, which was more pronounced south of Noirmoutier than along the rocky coasts of Brittany (Chapuis 1999, 101).

Although surveyed by landlubbers, the maps by Colbert's engineers were nevertheless fundamentally maritime, unlike those produced under Vauban and Clerville, emphasizing how the definitions of hydrography and topography were still muddled in the third quarter of

the seventeenth century, though change would be very rapid in the coming decades. Before the 1750s, this dissociation was far from evident and consistent, and it was not until 1800 that hybrid maps, incorporating the land and sea of the French coastline, would no longer be produced (Chapuis 1999, 38; 2007, 107–9).

La Voye's and La Favolière's coastal maps were kept secret for almost twenty years for strategic reasons (Chapuis 1999, 101). Nonetheless, along with the work of other authors such as Clerville, they served as the basis for the graphic representation of the French Atlantic coastline, including north Brittany, of *Le Neptune français* published in Paris in 1693 (Chapuis 1999, 101–4; 2007, 107–14, 130–35). This was the first maritime work to benefit from astronomical observations of the Académie des sciences, which was also then preparing to begin the triangulation of France. These astronomically determined positions were integrated after the fact, having been completed at the beginning of the 1680s, while the maps by La Voye and La Favolière had been prepared in the 1670s. However, despite these improvements, *Le Neptune français* was not based upon any specific geodetic framework (Chapuis 1999, 102). Yet its design included mapping layout techniques such as overlapping content at the edges of the charts, a useful principle that still exists today, and its scale of approximately 1:100,000 for maps of the French coastline was relatively detailed for the period (Chapuis 1999, 104; 2007, 134–35).

In 1693, the cartographic dimensions of the Mediterranean, like those of Brittany, were shrinking from the effect of the astronomical observations taken along its shores, mostly done by Jean-Mathieu de Chazelles (Pelletier 2007, 572). In 1675, Chazelles was assistant to Cassini I, one of the instigators of *Le Neptune français*. Chazelles was later responsible for training future officers of the forty galleys based in Marseille in 1690 in navigation and the use of charts. While resident on the Provençal coast, Chazelles took bearings and made notes in order to correct the cartography of the Mediterranean (Kellman 2002, 266–68). He also collaborated on *Le Neptune français* as a cartographer, working in the English Channel, and as an editor, under the direction of Charles Pène, working mainly on the second volume of *Le Neptune français*. Focused on the Mediterranean, the second volume was proposed to the Académie des sciences in 1701 but never published in spite of the determination and later efforts by Joseph-Bernard, marquis de Chabert, between 1753 and 1778 (Chapuis 1999, 165). With Chazelles's work, the east-west extent of the Mediterranean was reduced by measurement by almost one hundred kilometers. Only in 1737 did Bellin produce a printed chart of the Mediterranean, the first official chart of *Dépôt des cartes et plans de la Marine*,

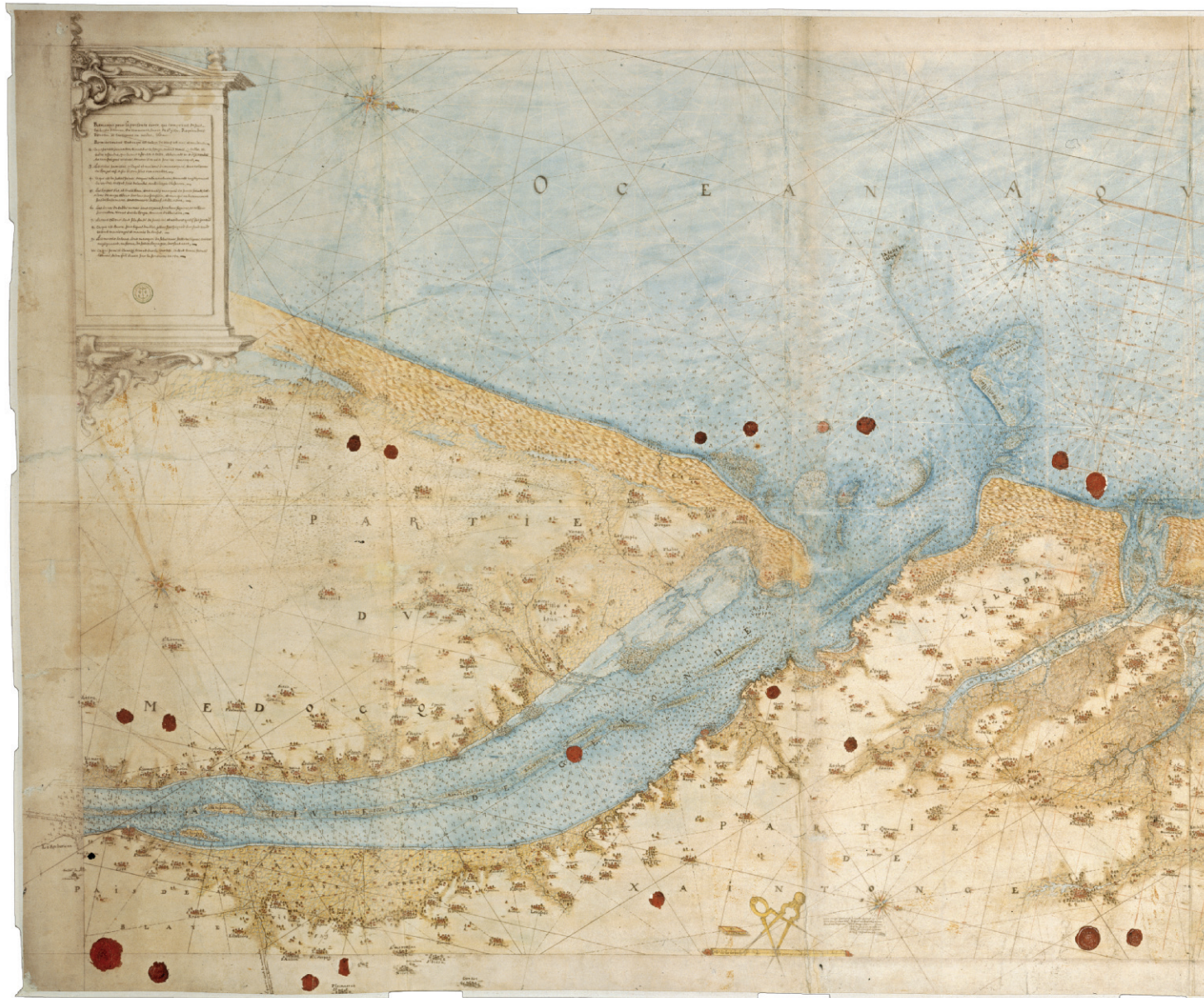


FIG. 511. LA FAVOLIÈRE, “CÔTES DEPUIS LES SABLES D’OLONNE JUSQU’À CARIGNAN EN MÉDOC AVEC LES SONDES,” 1674. Manuscript, scale ca. 1:70,000. This map was surveyed from 1670 and completed in 1674, though the seal of verification and certification is dated 1677. The very dense soundings in both fathoms and feet allowed the largest

war ships to negotiate entrance to the Charente River in order to reach the new port city of Rochefort. The various red seals marked certification of soundings by local pilots.

Size of the original: 115.5 × 276.0 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge SH 18E pf 53 pièce 12).

and the first to incorporate the work of Chazelles and others (see fig. 206). Their work had been synthesized in 1735 by Philippe Buache in manuscript on a Mercator projection (just like the 1737 chart), a format that navigators accepted with great reluctance (Pelletier 2007, 573–75; Chapuis 1999, 151–52, 170–71).

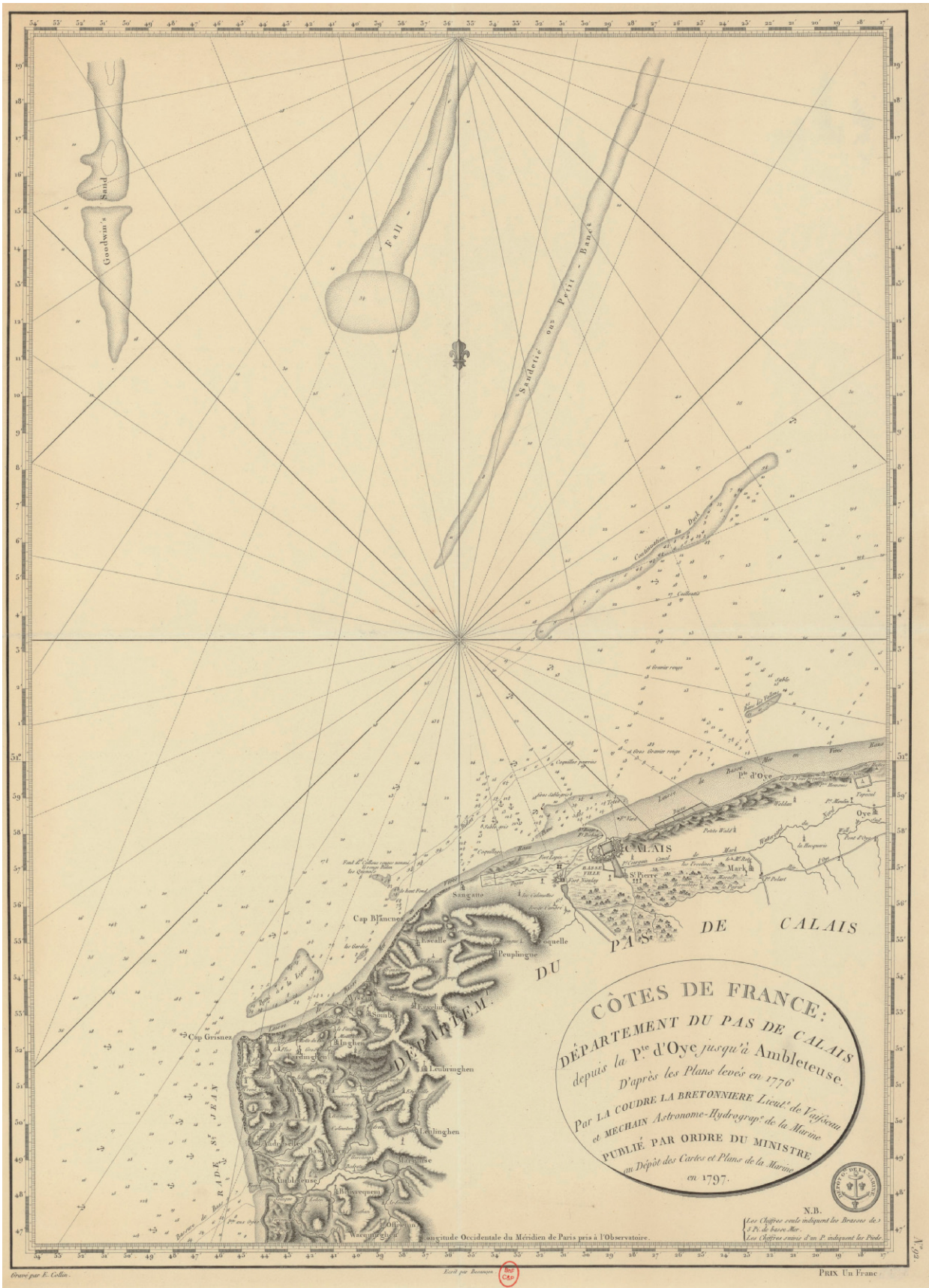
Because *Le Neptune françois* continued as the major

reference until 1800 and beyond for lack of a better alternative, very few naval coastal maps made in the eighteenth century were based on France’s geodetic network. The private initiatives of Michel Magin in the Loire and Gironde estuaries (1757), along with those of Jean-Baptiste Degaulle in the Seine estuary (1788), did not use the triangulation network, despite their claims that



with their charts navigators could forgo hiring a pilot to enter these rivers (Chapuis 1999, 134, 149, 318). However, the *Nouveau Neptune français* did incorporate the geodetic network, though it was limited to Picardy and Normandy between 1776 and 1778, and some maps surveyed by Louis-Bon-Jean de la Coudre de La Bretonnière and Pierre-François-André Méchain, which did not

surface until the Revolution, demonstrated the best hydrographic surveying on French coasts in the eighteenth century (Chapuis 1999, 257–62) (fig. 512). Saddled with this sacred but obsolete model, French hydrography was bogged down by *Le Neptune français* (Chapuis 1999, 101–10). Its *5e carte particuliere des costes de Bretagne* remained the official image of the tip of Brittany until



the early nineteenth century (Chapuis 1999, 614). At the same time, César-François Cassini (III) de Thury's *ingénieurs* and the *ingénieurs géographes militaires* became increasingly active on the coastline, but without venturing beyond the foreshore, except in rare instances (Chapuis 1999, 127–28; 2007, 173–84).

**A NEW HYDROGRAPHY** Some navigators nevertheless consulted the geodetic works carried out on land by Cassini III and Giovanni Domenico Maraldi (resulting in the *Nouvelle carte qui comprend les principaux triangles qui servent de fondement à la description géométrique de la France*, 1744; see fig. 19), and other hydrographic officers in the Marine used this new geodetic data to rectify principal positions and the coastal outline, which still were essentially small-scale compilations. The solution to the longitude problem allowed positions to be corrected on compiled maps drawn after the initial trial voyages of marine chronometers in the late 1760s. These voyages had also enabled the correct positioning or removal of numerous mistaken danger spots (*vigies*) on the charts, those hazards that sometimes proved to be either imaginary or simply a whale or a reflection on the water (Chapuis 1999, 174, 178–79). French marine expeditions such as that of the *Flore* across the Atlantic (1771–72) compiled long lists of such errors on the charts of the Dépôt des cartes et plans de la Marine (Verdun de la Crenne, Borda, and Pingré 1778).

The expedition led by Charles-Pierre Claret de Fleurieu in the Atlantic from 1768 to 1769 was the most emblematic in its contribution to marine cartography (Chapuis 1999, 78–79). The instructional work published afterward became the authority on the subject of the position at sea (Fleurieu 1773). Highly critical of Bellin, *ingénieur hydrographe de la Marine* from 1741 to 1772, Fleurieu did not just emphasize the importance of mastering longitude in order to correct marine charts (Chapuis 1999, 179–83), he illustrated it with the *Nouvelle carte réduite de l'océan Atlantique ou Occidentale* (1772) (see fig. 240). This chart corrected the east-west dimension of the North Atlantic (Chapuis 1999, 186–87), a reduction in breadth that corresponded to about three days of good sailing in 1750 (Chapuis 1999, 25–26). This chart suitably represented the first oceanic routes in the era of longitude, opened by a small elite

of learned European officers. Fleurieu also classified the errors made by the Dépôt's charts that involved latitude. Though easily measured and defined, as on the increasing latitudes of a Mercator projection, they were not always correctly reproduced by some cartographers.

The deeper problem concerned the regulation of transparency of production and the selection of the best sources for cartographic compilation, especially log-books that were in great need of improved standardization, a task that a new generation of educated officers wanted to undertake. Jean-Baptiste-Nicolas-Denis d'Après de Manneville put this approach into practice by including justificatory memoirs with his charts (Chapuis 1999, 182–85).

A qualitative and quantitative analysis of French hydrographic production confirms the scarcity of the hydrography of the French coasts. Technically, a more observed and measured coastal cartography was possible, but despite several isolated attempts such as those mentioned above, nothing happened. Navigation along the coast was far from the main concern of the scientific and maritime elite of the Enlightenment. They were completely preoccupied with hydrographic positioning out of sight of land, which was understandable within the context of the longitude problem (Chapuis 1999, 42–86). The new editions of *Le Neptune français* (1753 and 1773) contained a single chart on a tiny scale (less than or equal to 1:1,500,000), but nine on very small scale (less than or equal to 1:800,000) and nine on a small scale (less than or equal to 1:300,000), eleven on a medium scale (less than or equal to 1:100,000), and none on a larger scale. Those of the *Hydrographie française* published until Bellin's death in 1772 included four plans, two large-scale charts and sixteen medium-scale, twenty-two small-scale charts, forty-nine very small scale, and seven very tiny scale. Thus of the 130 engraved plates of the two so-called masterpieces of French hydrography distributed by the Dépôt des cartes et plans de la Marine between 1737 and 1772, ninety-seven charts were small scale. In other words, almost 75 percent of the charts published by the official French hydrographic service through 1772 were general charts (Chapuis 1999, 309–10).

While France had been one of the most scientific states in the eighteenth century (Gillispie 1980, 3–32), it

(facing page)

FIG. 512. LOUIS-BON-JEAN DE LA COULDRE DE LA BRETONNIÈRE AND PIERRE-FRANÇOIS-ANDRÉ MÉCHAIN, *CÔTES DE FRANCE: DÉPARTEMENT DU PAS DE CALAIS DEPUIS LA P<sup>TE</sup>. D'OYE JUSQU'À AMBLETEUSE* (PARIS: DÉPÔT DES CARTES ET PLANS DE LA MARINE, 1797). Scale ca. 1:110,000 (determined along the mean latitude of the chart, 51°02'). This map is one of eight

sheets surveyed and engraved as part of the abortive project of the *Nouveau Neptune français*. Although it linked up nicely with the land triangulation, it was clearly not sufficient for sailing beyond the intertidal zone.

Size of the original: 68.5 × 50.0 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge SH 18E pf 34 div 1 pièce 25/D)

revived its involvement with sciences at the beginning of Louis XVI's reign with his minister Anne Robert Jacques Turgot. Hydrography's position improved after Bellin's death and after the mastering of longitude, which produced yet more general charts. Half of the sixty-four plates published by the *Dépôt des cartes et plans de la Marine* between 1773 and 1791 were detailed charts (Chapuis 1999, 310). Beyond the foreshore, exceptional marine charts for this period were few in number and far from comparable to the terrestrial topography being undertaken on the Cassini family's private initiative on the one hand and the major work of the *ingénieurs géographes militaires* on the other.

The maritime concern in the eighteenth century was the solution to longitude, a matter for open water. The dimension of longitude required astronomical observations to allow the primary points of oceanic charts to connect to the secondary geodetic points. Joseph-Antoine-Raymond Bruny d'Entrecasteaux's expedition in 1791 carried this out using Beautemps-Beaupré's method (Chapuis 1999, 325–88, 511–23), which led to a major development in the following century: guaranteed trigonometric precision that would allow the marine chart to achieve higher resolution. This was the goal of the major surveying campaigns along the European coastlines of the Napoleonic empire and of nineteenth-century France. A chart of the Flemish coast, *Reconnaissance hydrographique [et carte] de la côte nord de France*, surveyed in 1801–2 and published in 1804 by Beautemps-Beaupré (see fig. 86), articulates this precision. The very dense soundings were all positioned by the triangulation using Jean-Charles Borda's repeating (i.e., reflecting) circle. A bathymetric classification was also introduced using an innovative color system. This chart marked the transition from the eighteenth to the nineteenth century for the representation of soundings, for their reduction using the closest possible observations of tidal graduated scales, and for extending triangulation to the ocean (Chapuis 1999, 552–54).

**HYDROGRAPHY AS A PUBLIC SERVICE** In terms of a state hydrographic organization, France began early to create a model of modern public service that would be copied by the majority of the large European maritime countries, beginning with the *Dépôt des cartes et plans de la Marine*, created 19 November 1720. The *Dépôt's* goal was chiefly to prevent the bulk of manuscript documents from falling into foreign hands. The *Dépôt* also copied all manuscript and printed charts, French or foreign, for naval purposes, and updated the existing printed cartography, primarily Dutch, with the help of logbooks (Chapuis 1999, 160–61).

Following the tradition of the first half of the eighteenth century, Bellin's work as *ingénieur hydrographe*

*de la Marine* involved compiling notes collected from sailors and travelers. The resulting maps were usually drawn at a small scale with little detail. The reliance on foreign charts in wartime became an incentive for the *Dépôt* to prepare French charts, assuring its national independence in this arena, since maps confirmed possession and remained instruments of national prestige. Bellin increased the number of chart compilations for successive versions of the *Hydrographie française*, and from 1756, the collection of state-produced French marine charts continued to expand until the twentieth century (Chapuis 1999, 833–34).

The *Compagnie des Indes* (founded 1719) did not establish its own hydrographic service until 1762, which it maintained for eight years, until its bankruptcy in January 1770. Directed by d'Après de Manneville, author of *Le Neptune oriental* (1745), it was run by very active officers. By the mid-eighteenth century, maritime trade was developing substantially, and the *Dépôt des cartes et plans de la Marine* needed both to respond to a growing trade in nautical documents and to counter privately produced charts, whose rigor was unsatisfactory.

By regulating the editions and circulation of marine charts, France became the first country to institute legislation in this area. The decision of 5 October 1773 established complete control of hydrographic production under the sole responsibility of the *Dépôt*, which at times clashed with the *Académie de marine* (Chapuis 1999, 154–58). Defined as one of the tasks of the current *Service hydrographique et océanographique de la Marine*, this ruling remained in effect in the early twenty-first century: every private marine publication must have prior authorization from the *Dépôt des cartes et plans de la Marine*. Transparency of sources continued to be required, as confirmed by the recommendations of the *International Hydrographic Organization*, formed in 1921. Moreover, on 18 August 1775, exclusive privilege was granted to the *Dépôt* for the engraving and printing of charts, along with the authorization to seize illicit plates and counterfeit copies. Finally, the order of 28 October 1775 set up a commercial structure for a primary establishment with commissioned agents to control the sale of charts and to guarantee distribution at the same fair price throughout the entire country. This apparatus was reinforced by a new judgment of the king's council on 10 June 1786, together with sanctions against authors and editors of unreliable marine charts that misguided clients. From its inception on 30 September 1776, the administration of the *Entrepôt général* (general warehouse) for the sale of charts and works was entrusted to Jean-Nicolas Buache, who passed control, along with his geographic collection, to Jean-Claude Dezauche in 1780—a transfer that took a year to become effective (Chapuis 1999, 190–95, 202–11).



The staggering costs of hydrographic missions in the field and of the conservation, production, and distribution of maps (to the Marine on one hand and to the trade on the other) could be maintained only by a state that was not driven by profitability. Thus, the concept of a hydrographic service as a public good was born.

OLIVIER CHAPUIS

SEE ALSO: Beautemps-Beaupré, Charles-François; Bellin, Jacques-Nicolas; Buache, Philippe; Chabert, Joseph-Bernard, marquis de; Fleurieu, Charles-Pierre Claret de; France; Longitude and Latitude; Military Cartography: France; *Neptune du Cattegat et de la mer Baltique*; *Neptune françois* and *Hydrographie françoise*; *Neptune oriental*, Le; Sounding of Depths and Marine Triangulation

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*Marine Charting by the German States*. Marine charting by German states and cities bordering the coastlines of the North and Baltic Seas was relatively limited in the eighteenth century. The reasons were manifold. From a nautical point of view the hydrographic chart, *Seekarte*, did not then play its modern role as one of the most important aids to navigation. The majority of mariners in the sea areas in question relied on tradition: the collected experience of generations, grown over centuries. All the information needed was gathered in personal manuscripts or printed books of sailing directions, which did not change much from the sixteenth to the end of the eighteenth century.

Whatever demand there was for marine cartography in the German language or of German waters was largely met by the flourishing Dutch trade in charts and atlases. It was Lucas Jansz. Waghenauer's famous *Spieghel der zeevaerdt* (German edition 1589) that first presented German readers with some large-scale charts of German seas. For the Baltic Sea, Sweden, the ambitious sea power focused on developing a *Dominium Maris Baltici*, played a similarly dominating role, exemplified by Petter Gedda's 1695 atlas of the Baltic (Ehrensverd 1977).

The few German charting initiatives of the eighteenth century were private or semiofficial and depicted only coastal areas or estuaries in the German Bight leading to such important ports as Emden, Bremen, and Hamburg. These efforts began with the first printed chart (1642) of the River Ems with titles in Dutch, French, and Latin by Martin Faber. Faber was an important figure in Emden who also served as the commissioner of fortifications and municipal engineer; the chart was commissioned by the burgomaster and municipal council. Copied and adapted by Dutch publishers such as the Coloms and Van Keulens, Faber's chart continued to be influential well into the eighteenth century (Lang 1952; 1960; 1969–85, no. 19).

The next German chart, created some three-quarters of a century later, was commissioned by the city council of Hamburg because new channels had formed in the Elbe estuary. The *Typus orarum maritimarum ab insula Helgelandia* of 1721 shows the mouths of the Elbe and Weser Rivers and the German Bight as far out as Helgoland. The authors were Samuel Gottlob Zimmermann, who signed himself "inspector of mills and milling" and is elsewhere referred to as a master-builder and "hydraulicus" (hydrographic engineer), and Johann Otto Hasenbanck, a captain of artillery also engaged in dike construction. The chart stands out for its careful depiction of sandbars and channels and numerous soundings. It was regarded as the finest German chart of its time and retained this standing to the end of the eighteenth century (Lang 1968, 51; 1969–85, no. 27).

From the 1760s through the 1780s, a number of charts

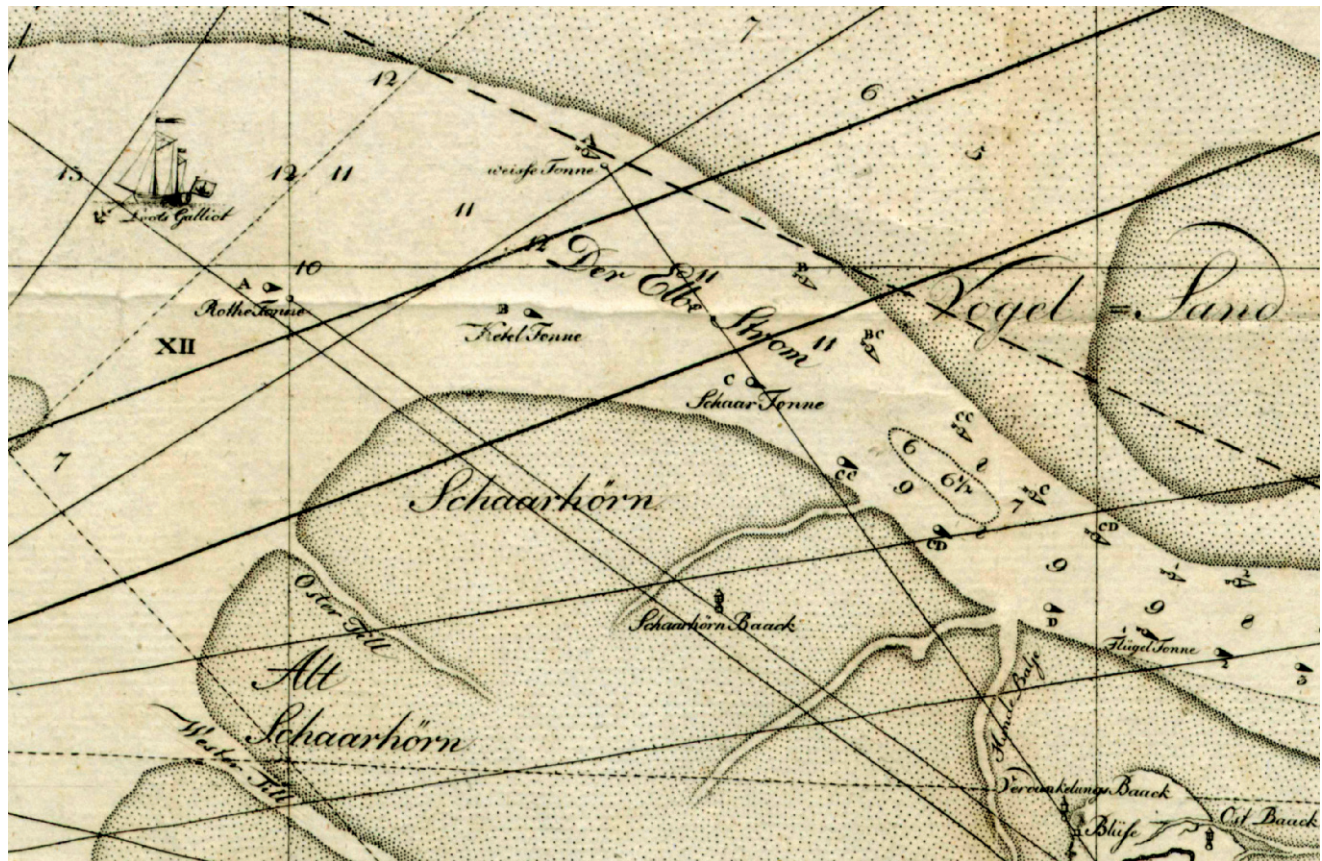


FIG. 513. DETAIL FROM JOHANN THEODOR REINKE AND J. A. LANG, *KARTE VON EINEM THEILE DER NORDSEE, DES ELBE-STROMS, DER MÜNDUNG DER WESER* (HAMBURG, 1787). Copper engraving; ca. 1:945,000. Soundings are given in fathoms at low water. Note

the buoys, keyed by letters to the accompanying sailing directions, and the lightship at upper left. Size of the entire original: 65 × 95 cm; size of detail: ca. 13 × 19 cm. Image courtesy of the Deutsches Schifffahrtsmuseum, Bremerhaven (I 1 I 023).

were published by the Altona ship captain Johann Diedrich Trock and the Hamburg captains Cornelius Martin Wohlers and his son Christian Peter Wohlers, but Arend W. Lang (1968, 52–53) characterizes the charts as “the low point of German hydrography in the 18th century.” They were also criticized by contemporaries. In fact, the Hamburg *Commerz-Deputation* (chamber of commerce) requested that the Wohlers cease dedicating their charts to it, but this did not stop publishers like the Van Keulens from blindly copying them.

All of these maps continued in the tradition of the Dutch *scheetskaart* (sketch map), drawn from on board with the help of the compass and distance estimations. It was only when topographical surveys of the shorelines began to be available in the second half of the eighteenth century (in Denmark 1762–77, in the Duchy of Oldenburg 1782–85), that *scheetskarten* began to be replaced by charts informed by scientific triangulation on shore.

Among the first German charts to benefit from being tied to these surveys were two by the Hamburg border inspector Johann Theodor Reinke and J. A. Lang, an inspector of pilots. Both were sponsored by the *Commerz-Deputation* and published in Hamburg in 1787. The *Karte von einem Theile der Nordsee* (fig. 513) was accompanied by separate letterpress sailing directions in five languages (Dutch, English, French, German, and Spanish), while the Dutch-titled *Zee Kaart van't Helgoland* included engraved sailing directions in Dutch, English, and French (Lang 1969–85, nos. 37 and 38). Reinke and Lang published a significantly updated version of their map in 1798. They revised it using a triangulation survey by Hinrich Carsten Behrens of the Jade estuary, part of a topographical survey of Oldenburg in 1789–90. Behrens’s work then informed the 1793 “Karte von den Mündungen der Weser und der Jade,” which would in turn be published by Aaron Arrowsmith

in London in 1799 as *A Chart of the Iade, and Mouth of the Weser, from an Actual Survey* (Harms 1961, 15; Lang 1969–85, no. 42).

Charting of the Baltic coast of Germany was, as indicated earlier, almost completely dominated by Sweden, although many of these charts found their way into Dutch marine atlases. Swedish mapping activities in the southern Baltic were frequently performed by Germans such as the Greifswald professor of mathematics and astronomy Andreas Mayer, who made a chart of part of the Pommeranian coast in 1741 (Ehrensward, Kokkonen, and Nurminen 1995, 233). His triangulations of the coast from 1757 onward—commissioned by the Swedish Kungliga Vetenskapsakademien—set the groundwork for later detailed charting of the southern Baltic coast.

What has been called the first Prussian sea atlas, Isaak Bruckner's *Nouvel atlas de Marine*, was published in 1749. Although Bruckner was Swiss and the title is in French, the work carries a dedication to the Prussian field marshal (and notable cartographer) Samuel von Schmettau, who provided many of the sources, and bears the approval of the Königlische Akademie der Wissenschaften in Berlin, where it was engraved by Nicolaus Friedrich Sauerbrey. But again, it was not primarily directed to practical seamen but reflected the global economic strategies of the Prussian state. The *Nouvel atlas* is, in fact, a single world map on twelve sheets, and if it found any interest among a maritime clientele it would have been due only to its use of the Mercator projection (Loeck 1992). The development of a true German charting tradition had to wait until the establishment of the Prussian Hydrographisches Bureau in 1861.

ALBRECHT SAUER

SEE ALSO: German States

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*Marine Charting by Great Britain*. Many factors converged after 1660 to transform Britain from a country with an emerging but disparate charting tradition into an important European marine charting center, which joined the French to rival the dominance of the Dutch in chartmaking. The demands of soaring trade interests combined with imperial acquisitions and aspirations required British merchants, ministers, and mariners to abandon their initial dependence on foreign sources and to come to terms with both an expanded known world and an ultimately bounded world during the Enlightenment. Internally, mapping the coastline of the British Isles also challenged the talents of local mariners and harbor pilots, who habitually relied on oral tradition and verbal directions to find safe harbor. Cartographic information about the world's new locales and their potential was of paramount importance to British overseas developments, whether commercial or imperial, exemplified by Sir John Narbrough's chart of the Strait of Magellan published in 1694. Yet the development and growth of marine charting also featured a persistent hesitancy to embrace new techniques and a shortsightedness with respect to establishing a centralized authority until the end of the eighteenth century. British marine charting acquired structure, systemization, and capital investment only with the efforts of Alexander Dalrymple and his successors at the British Admiralty Hydrographical Office after 1795.

The British maritime community initially built on the master-apprenticeship tradition established in the century after 1550 to produce manuscript charts. With time, charts were increasingly viewed less as a mariner's personal property and more as means to service the intersecting needs of the royal navy and mercantile marine. In terms of the artifact, marine charting evolved from the often single-sheet, portolan-style manuscript on vellum to printed collections of charts or sea atlases that had been vetted for accuracy. Manuscript and printed charts were used alongside one another until the transition to print was effectively complete by the end of the eighteenth century. Charts became steadily more domestic in their sources and compilation, progressively more concerned with large-scale pilotage than with small-scale oceanic charting, and finally began to reflect collections of institutionalized knowledge rather than the customized private collections of charts held by individuals. Thus, the transitions to print, domestic production, more rigorous precision, and institutionalization broadly describe the major changes in British marine charting during the Enlightenment.

By 1650, commercial and colonial exploits across the

globe had helped to establish an English cartographic tradition based in London. The restoration of Charles II (1660) brought renewed interest from the Crown in establishing institutions that would support native skills in navigation and improve chartmaking, such as the Royal Mathematical School at Christ's Hospital (1673), specifically to offer training in the application of mathematics to marine matters (Taylor 1954, 114–20), and the Royal Observatory (1675), tasked with creating the astronomical knowledge necessary for observing longitude at sea. The Royal Society (1662) also sought to remedy inadequacies in British charting; its members especially championed innovations pertaining to navigation, such as the invention and refinement of the octant and sextant, the analysis of magnetic variation, knowledge of currents and winds, and more exacting surveying techniques. Notable members Robert Hooke and Edmond Halley investigated the various problems of navigation through the early eighteenth century (Robinson 1962, 49–60).

Most domestic maritime chartmaking of this early period was produced by the Thames School, so named by Jeanette Black (1975, 15–22), which until 1670 primarily produced oceanic charts embracing the portolan style of marine charting. The Thames School has been defined by the location of most of the chartmakers, their affiliation with the Drapers' Company, and the general stylistic similarities of the men concerned (Campbell 1973; Smith 1978). Located along the Thames River in east London from 1590 until circa 1740, the chartmakers were largely, though not exclusively, copyists of Dutch and other foreign charts. Thirty-seven chartmakers are recorded as masters and apprentices in the ledgers of the Drapers' Company, relationships through which the style was transferred from the first exponent John Daniel to the last Drapers' Company chartmakers John Friend and Robert Friend (Smith 1978, 97). As the Thames School matured, so did its style and focus. At first the charts were drawn on the plane projection in colored inks on vellum with networks of interlocking rhumb lines and compass roses in the portolan style. In addition, the early Thames School charts were often mounted on hinged panels of wood for easy storage and use. After 1670 and the deaths of John Burston and Nicholas Comberford, the two dominant members of the early Thames School, the school's charts underwent some stylistic changes as seen most noticeably in the works of William Hack and John Thornton (fig. 514) (Smith 1978). The school gradually shifted to the production of hundreds of pilotage charts for smaller coastal areas, began to use paper as well as vellum, and started to abandon the traditional portolan style (Maeer 2006). Thornton began printing charts in *The English Pilot* (1671) and the *Atlas Maritimus* (1675) (Verner 1978, 149–50).

Thomas R. Smith (1978, 98–99) identified 556 extant works of this school, and more continue to be identified. Of Smith's corpus, 494 (89 percent) were produced during the later phase of the Thames School; Hack is credited with 331 works, an output that distorts any simple statistical analysis. The surviving charts can nonetheless be seen to mirror the geographical interests of their clients. For example, England's American mapping interests started in earnest after the establishment of colonies and viable trading. There are 6 surviving Thames School oceanic charts of the Americas dated before 1670; afterward, there are 98 charts of North America and the Caribbean, many of which are pilotage charts. A similar increase in charts relating to the East can be identified: 7 oceanic charts and Gabriel Tatton's atlas of 17 pilotage charts survive depicting the East prior to 1670, while well over 350 pilotage charts were created between 1670 and 1715. Specifically, many of Thornton's works were for the Hudson's Bay Company and East Indian trade; his publication of *The English Pilot: The Third Book* (1703) was dedicated to the court of managers of the East India Company (Cook 1985). The bulk of Hack's output comprised his three manuscript atlases of the East Asian navigation, each consisting of over 90 pilotage charts (Smith 1978, 100). Overall, the distribution of chart production by era and subject demonstrates that the English trade in marine charts was propelled by the dramatic expansion of the English shipping industry and a growing imperialism during the seventeenth century.

The significance of the Thames School becomes increasingly obvious as late seventeenth-century English ministers, merchants, and mariners used charts and maps as a means to understand their ever-expanding world. Not only did mariners and merchants use charts as navigational instruments, but members of the governing class, like Samuel Pepys of the Admiralty Board and William Blathwayt of the Lords of Trade, utilized them to inform imperial and commercial policies (Smith 1978, 92–94; Black, 1975, 20–21). Pepys sought out the work of Burston and Joel Gascoyne, both Thames School chartmakers (Pepys 1904–5, 4:343; 1926, 42, 237). Although the ministers and officials responsible for the creation and oversight of government policy for the colonies and England's overseas trade personally collected charts and maps, there was no sustained attempt to house, compile, or oversee cartographic knowledge for the benefit of the government until the late eighteenth century. Moreover, the piecemeal approach of manuscript production at the Thames School could not fulfill escalating English cartographic needs. The chartmakers could not disseminate charts quickly enough, and foreign, mainly Dutch, printed charts were continually sought to help meet the increasing demands



FIG. 514. JOHN THORNTON, EAST COAST OF ENGLAND FROM SPURN HEAD TO SOUTH FORELAND, 1667. Manuscript chart, scale ca. 1:400,000. Thames School charts remained in use until the early eighteenth century, despite their anachronistic portolan style.

Size of the original: 69 × 54 cm. © National Maritime Museum, Greenwich, London (G218:11/6). The Image Works.

of the English maritime community, although not for navigation in the East Indies. Pepys noted these faults and voiced his desires for improvements in English hydrography; he attempted to ameliorate these shortcomings by praising accuracy, deploring misleading work, and supporting the publication of English printed sea atlases (Wallis 1978, 18–19).

In the latter half of the seventeenth century, the English attempted to print sea atlases, or *waggoners*, as a means to offset their reliance upon Dutch sea atlases. In 1657, Joseph Moxon published six unrevised copies of Dutch charts in his *A Book of Sea Plats* and hoped to produce a purely English sea atlas for Charles II as his hydrographer in 1670. Although Moxon's endeavors failed, John Seller, a notable marine instrumentmaker and supplier, became the first to publish an English sea atlas of lasting influence, *The English Pilot*, the first book of which appeared in 1671. Although he promised a purely English sea atlas and was awarded a thirty-year royal privilege forbidding the importation of Dutch *waggoners*, Seller nonetheless had to incorporate Dutch plates and turn to other English chartsellers in order to complete his sea atlas. Eventually, *The English Pilot* comprised five parts in six books, each addressing a particular regional trading route. It was revised, maintained, and sporadically updated throughout the eighteenth century, ultimately by the firm of Mount and Page, which continued to incorporate outdated foreign charts, usually scrap Dutch or French copperplates that had been reworked into English translations (Verner 1978, 156). *The English Pilot* may have removed some of the British mariners' reliance on foreign sea atlases, but increased competition both at home and abroad reduced its attraction, and the production of manuscript charts for specific journeys continued until midcentury.

Criticism of Seller's *English Pilot* and the sorry state of British coastal surveys prompted Admiralty support for the production of Greenville Collins' *Great Britain's Coasting-Pilot* (1693) and Scottish parliamentary support for John Adair's *The Description of the Sea-Coast and Islands of Scotland* (1703). Commissioned by Charles II and granted Trinity House's assistance, Collins plotted Britain's coastline and headlands so as to provide more precise latitudes (fig. 515). Collins's work was lambasted from the outset because of his inferior surveying technique (Taylor 1954, 121). Despite its serious flaws, the *Coasting-Pilot* was printed at least twenty-four times with only minor corrections until 1792 (Adams and Waters 1995, 32–33). In it Collins called for Trinity House's role to be expanded to include the regular updating of charts, but his argument did not take hold. Adair, a notable Scottish surveyor and hydrographer, was able to publish his *Description*, covering the east coast of Scotland, even though plagued by

limited financial support from the Scottish Parliament coupled with an apparent disinterest in timely publication (Robinson 1962, 162); his work was surpassed only by that of Murdoch Mackenzie the Elder in the 1770s. Adair's atlas was only published once, and all of the difficulties surrounding its completion embodied the inherent problems facing marine charting and publication: limited funds, inferior surveying techniques, antiquated methodologies, and a lack of organizational structure that deterred accurate surveying, standardization, and adequate coverage of the British shoreline.

British hydrography in the colonies similarly suffered from the lack of rigorous application of any geometrical principles until marine charting started to become institutionalized in the later eighteenth century. Cyprian Southack, a Boston-based mariner and chartmaker of the early eighteenth century, first published *The New England Coasting Pilot* by subscription probably between 1729 and 1734. Its eight sheets, which could be joined to form a single regional chart, recorded hundreds of Southack's personal observations drawn from a lifetime of sailing along New England's shores. While Southack's annotations and navigational details were useful, he was a mariner first and marine surveyor second. Contemporary critics noted as much when they lamented the results of his antiquated surveying methods (LeGear 1954, 139, 141).

By the second quarter of the eighteenth century, the works of Thames School chartmakers were being eclipsed, at least locally, by the efforts of amateur hydrographers who applied the principles of land surveying to the coastline and who sought to publish their work to find a larger distribution. Such an approach is exemplified by the work of surveyor John Eyes and shipbuilder Samuel Fearon, who together surveyed the Lancashire coast in 1736–37. The resulting charts of the coast and Liverpool Bay were engraved by Emanuel Bowen in London and published in Liverpool in 1738 as *A Description of the Sea Coast of England and Wales* (Robinson 1962, 71–72). Lewis Morris, a Welsh surveyor and customs officer, surveyed the west coast of Wales from Whitehaven to Milford Haven from 1737 to 1739, and then resumed the survey from 1742–44 with Admiralty support. Using a perambulator, a theodolite equipped with a telescope, and a double sextant he produced eleven manuscript charts that formed the basis of a small atlas comprising twenty-five small plans (*Plans and Harbours of the Coast of Wales*, 1748), published by subscription, and *A Chart of the Coast of Wales in Saint George's Channel* (1748), all engraved by Bowen (Robinson 1962, 76–84). Military engineers also worked along the British coast, from the time of Charles II onward, producing large-scale manuscript surveys chiefly focused on harbors and soundings (Rob-

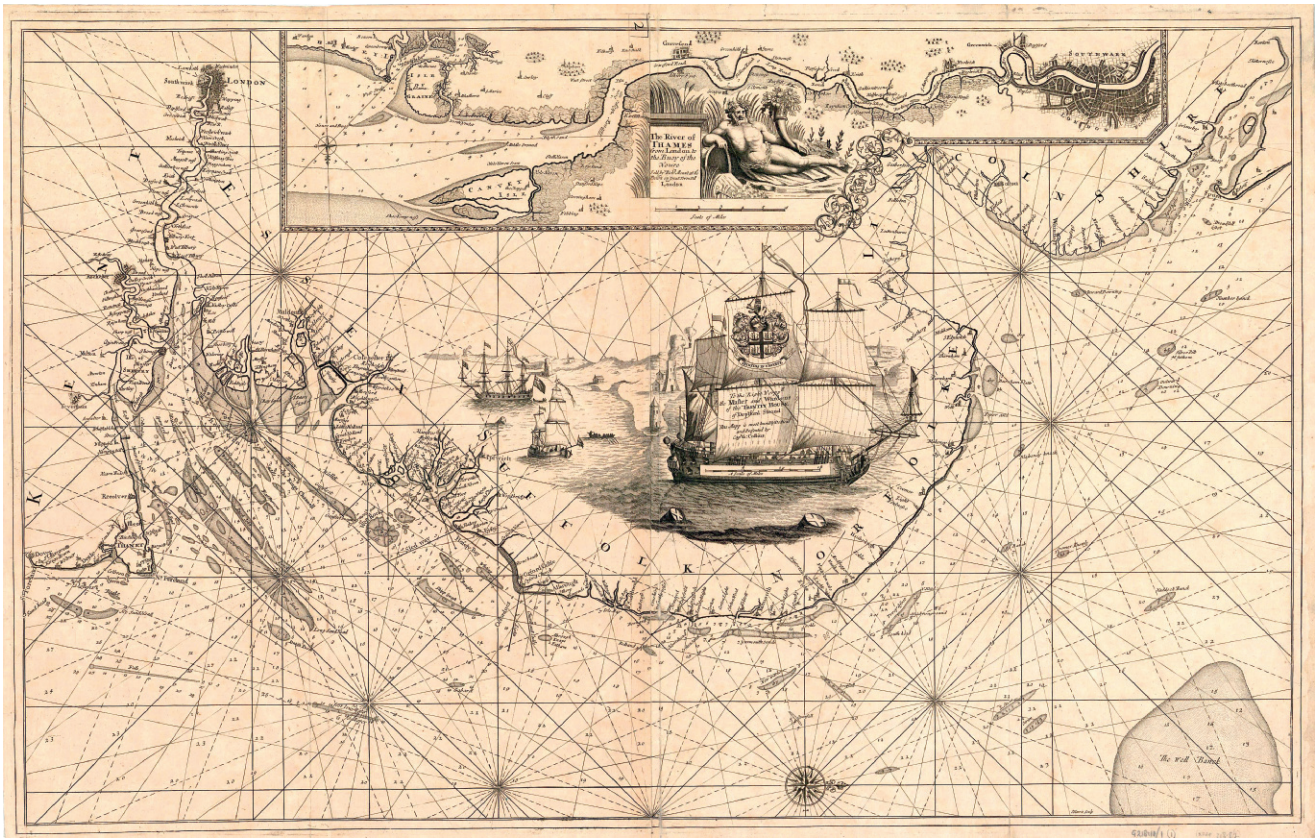


FIG. 515. GREENVILLE COLLINS, SEA CHART OF PART OF THE EAST COAST OF ENGLAND, FROM DOVER IN KENT TO SPURN HEAD AT THE MOUTH OF THE RIVER HUMBER, WITH AN INSET OF THE RIVER THAMES FROM ITS MOUTH TO LONDON (LONDON, 1693). Printed chart, scale 1:350,000. From book two of Collins's *Great Britain's Coasting-Pilot* (1693). The chart, which cov-

ers much of the same coastline as the earlier Thornton chart in figure 514, epitomizes the sometimes-haphazard construction and oversight of navigational knowledge that characterized marine charting in Great Britain until the late eighteenth century.

Size of the original: 67 × 96 cm. © National Maritime Museum, Greenwich, London (G218:11/1 [1]). The Image Works.

inson 1962, 175–77, provides a comprehensive list of harbor plans and charts by military engineers).

During the latter half of the eighteenth century, several surveyors undertook inshore surveys along the Atlantic coastline of North America. George Gauld charted the coasts of East and West Florida, the Florida Keys, Jamaica, and the north coast of the Gulf of Mexico for the British Admiralty from 1764 to 1781. Trained in mathematics at the University of Aberdeen, Gauld served as an on-board mathematics schoolmaster from 1757 to 1760 in the Royal Navy before he moved to Florida and participated in the West Florida Commons House of Assembly. Only one of his charts was published during his lifetime, a plan of Pensacola in *The Atlantic Neptune*, though he did send copies of his work to the American Philosophical Society. Many of his charts were eventually published after his death by Bernard Romans, William Faden, and Thomas Hutchins (Ware 1982, 236–41).

The application of local shore surveys and astronomical fixes was also accomplished by the several surveyors and hydrographers who mapped the North American coastline, notably Samuel Holland; their work was compiled by J. F. W. Des Barres into *The Atlantic Neptune* (1774–82). *The Atlantic Neptune's* four large volumes of charts and coastal views presented a hydrographic survey of the east coast of North America from the St. Lawrence River to the Gulf of Mexico. Despite initial flaws caused when the onset of the American Revolution led Des Barres to publish the charts, he continued to update and amend the work. *The Atlantic Neptune* remained the standard sea atlas for North American seamen for over fifty years.

The entrance of engravers and publishers from the London map trade into the chart trade began with the financial support and ultimate publication of all editions of *The English Pilot* by William Fisher, followed





onerous. Mackenzie began his survey in 1745 by establishing beacons on the islands and using a theodolite and an octant to measure the horizontal angles between them. He then took horizontal measurements from his vessel to the same beacons to fix the locations of soundings and navigational hazards by resection; this was the first use of marine triangulation. The resulting atlas was *Orcades: Or a Geographic and Hydrographic Survey of the Orkney and Lewis Islands in Eight Maps* (1750); the eight charts were engraved by Bowen. Stylistically, Mackenzie integrated coastal views as well as a comprehensive key and directions for coloring numerous distinctive geographic and hydrographic features (see figs. 80 and 759). The atlas was reprinted three times (1767, 1776, and 1791), and it was so well received that the Admiralty commissioned Mackenzie to survey the entire west coast of Britain. After Mackenzie's work from 1751 to 1769, his *Nautical Descriptions* were published in two volumes (1776) (fig. 516). He retired from surveying in 1771 and in 1774 was elected a fellow of the Royal Society, the same year that he published *A Treatise of Maritim Surveying*, in which he systematically described the most accurate methods for marine surveying, including the use of the station pointer, a three-armed instrument that allowed the user to fix a vessel's location from three or more onshore stations by resection (fig. 517) (Mackenzie 1774, 24; Robinson 1962, 64–67; Fisher 1991). His nephew, Lieutenant Murdoch Mackenzie the Younger took over from the elder in 1771 and accomplished much with his cousin, Graeme Spence, who succeeded him in 1788.

Having learned survey techniques from Holland in North America, Cook surveyed the coasts of Newfoundland and the Saint Lawrence River between 1758 and 1768, and Jefferys published these maps in 1769–70. Cook was then selected to observe the 1769 transit of Venus and to explore the South Pacific. By the time Cook sailed east in 1769, he was experienced in navigation and surveying and thus prepared to supervise charting in the distant Pacific. Cook's second (1772–75) and third (1776–79) voyages allowed him to survey a major part of the Pacific as far as 71°S, including New Zealand, the east coast of Australia, and numerous islands such as the Hawaiian archipelago. Cook's employment of John Harrison's chronometer, *The Nautical Almanac* for lunar distances, and data from onshore observations taken with a theodolite meant that his charts achieved a new and long-lasting standard of accuracy in terms of longitude and latitude.

The work of Mackenzie and Cook answered the growing demand for accuracy that was increasingly encouraged and rewarded by the government. Yet despite persistent calls from Samuel Pepys in the late-seventeenth century to Admiral Richard, Lord Howe, in 1765, no storehouse or institution for charts was established. This

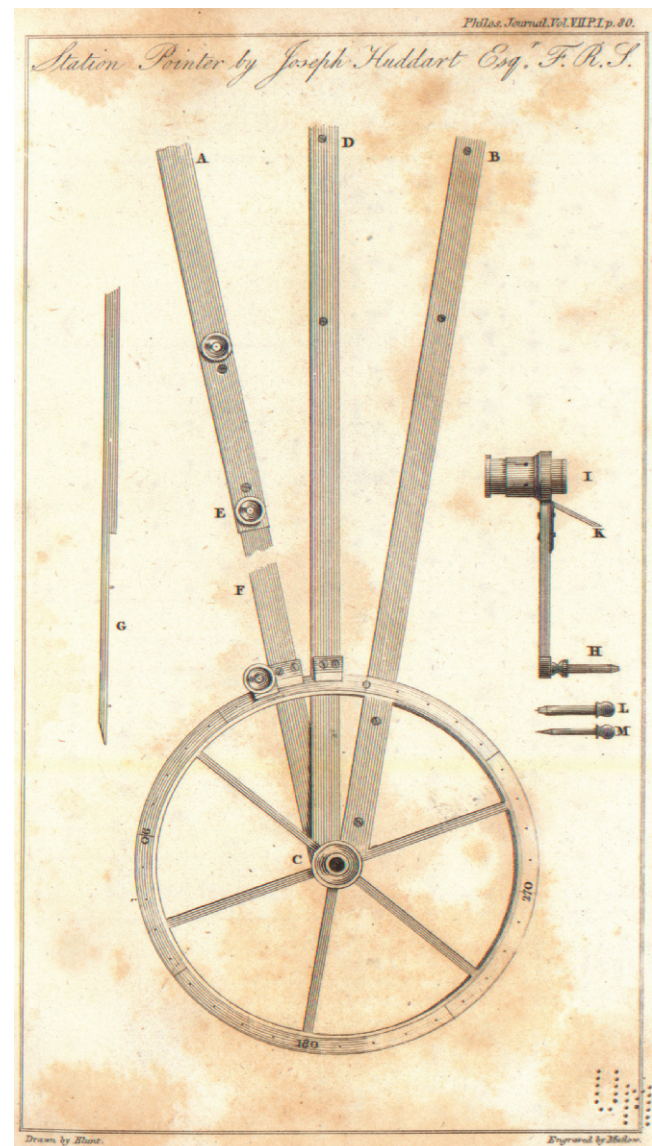


FIG. 517. JOSEPH HUDDART'S STATION POINTER, 1804. Accompanying Huddart's "Description and Use of the Station Pointer; an Instrument for Readily Ascertaining the Situation of the Observer after Having Determined the Angular Position of Three Known Objects," *Journal of Natural Philosophy, Chemistry, and the Arts* (by William Nicholson) 7 (1804): 1–5, pl. I (facing 80). Huddart's article provides a full description of the instrument's use as well as a diagram of how to fix location using the resection technique, essential for marine triangulation.

Size of the original: 20 × 10 cm. Image courtesy of the Harlan Hatcher Graduate Library, University of Michigan, Ann Arbor (Q 1 J86).

failing would eventually be corrected by Dalrymple, who instituted repositories of hydrographic information, first for the East India Company (1779) and then for the British Admiralty (1795). His duties as the first hydrographer to the Admiralty rapidly evolved from

organizing and officiating over the reliability of Admiralty charts to supplying limited runs of acceptable published charts to the Royal Navy under the auspices of in-house engravers and a rolling press, thus establishing a discrete Hydrographical Office for the British Admiralty. Dalrymple's attention to detail and his insistence on accuracy, classification, and organization, coupled with in-house publishing, epitomizes the culmination of British marine charting in the eighteenth century. All the components so long recognized but not achieved that had prevented the creation of a superior British charting organization and production were now in place.

In many respects, these last developments align with the ideas of the Enlightenment—the proclivity to categorize, organize, and scrutinize knowledge for rational ends—which were combined at the end of the century with state funding and organization under the Admiralty to produce and maintain high-quality chart production. Not until the nineteenth century was the process complete, with the dominant military/state mapping industries meeting national interests, leaving private mapping concerns confined to specialist products.

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SEE ALSO: Adair, John; *Atlantic Neptune, The*; Cook, James; Dalrymple, Alexander; *English Pilot, The*; Great Britain; Longitude and Latitude; Sounding of Depths and Marine Triangulation

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**Marine Charting by the Netherlands.** In the seventeenth century, Dutch publishers were known all over the world for their production of pilot guides and sea atlases. Amsterdam, the flourishing harbor town, was the hub of this activity, and its publishers supplied sea atlases, pilot guides, and loose charts in large quantities and in several languages (Koeman 1970; Schilder and Van Egmond 2007, 1398–1402). Dutch publishers retained their near-monopoly on chart production until after the Second Anglo-Dutch War (1665–67), when the English realized how dependent they were on the Dutch for the hydrography of their waters, and English publishers began to take up the task. John Seller produced the first English sea atlas, *The English Pilot*, in 1671 (comprised in part by reprinted Dutch charts), and Greenville Collins published an atlas with charts based on his own surveys in 1693. The French also developed their own maritime cartography. *Le Neptune françois*, published in 1693 under the aegis of the Académie des sciences, was followed by the establishment of an official hydrographical service, the Dépôt des cartes et plans de la Marine, established in 1720.

Around 1680, besides the Van Keulen firm, there were

four principal maritime publishers in Amsterdam. Most influential in the second half of the seventeenth century was Hendrik Doncker. In 1693 Doncker's business came to an end when Johannes I van Keulen bought his stock (De Vries et al. 2005, 14–15). Second was Jacob Robijn, who had a short association with Johannes I van Keulen in 1679, but beginning in 1680 published his own sea atlas and pilot guide, for which he bought the plates and rights of the *Zeespiegel* and *Zee-atlas* from the widow of Pieter Goos. Robijn must have died before 1717, when his *Zeespiegel* was being sold by Johannes Loots (Koeman 1970, 436–37). The third Van Keulen competitor was Casparus Lootsman, who had worked with his brother Jacob. Their *Zee-spiegel* was published in many editions in Dutch, English, and French, the last known edition appearing around 1717 under the imprint of a Lootsman nephew, Jacob Conijnenbergh (Koeman 1970, 231–47). The fourth competitor, Johannes Loots, began as an apprentice to Doncker, and after going into business for himself, he published in 1697 a pirated edition of the atlas of the Baltic by Petter Gedda (Koeman 1970, 411; Ehrensward 1977). From 1698, Loots participated in a project with two others to publish an atlas with two hundred charts on the Mercator projection. This project failed and in 1707 the partnership was dissolved. But the business was healthy, and after his death Loots's widow and her brother continued the shop, which remained in existence until 1795; the last owner was Hendrik Mooij, a cross-staff maker and bookseller (Koeman 1970, 410; Gernez 1954).

Apart from the maritime publishers mentioned, Pieter Mortier, son of a French immigrant and one of the richest booksellers in Amsterdam, published a pirated edition of *Le Neptune françois* in 1693, attributing it to Alexis-Hubert Jaillot (Koeman 1970, 423–31). Mortier had the French charts reengraved and added a supplement with charts of English origin, all lavishly illustrated by the artist Romeyn de Hooghe. The work was the most expensive atlas ever produced in the Netherlands at the time, but Mortier was primarily a publisher of terrestrial maps and therefore his influence on the development of maritime cartography was limited (Koeman 1970, 243–31; De Vries et al. 2005, 49–50).

Domestically, no publishers could compete with the Van Keulen firm, which flourished for nearly two hundred years. In the first half of the eighteenth century, the firm produced manuscript charts, navigation books, and instruments as well as atlases and pilot guides. The founder, Johannes I van Keulen, was a relative newcomer in the world of maritime publishers, booksellers, and instrumentmakers. His father, Gerrit (or Gerard) van Keulen, was a native of Deventer, a small town in the east of the Netherlands. A bookbinder and bookseller by profession, he moved with his wife and chil-

dren to Amsterdam between 1656 and 1657. In 1678 Johannes I became a member of the guild of booksellers, and around the same year he started his firm. He established himself as bookseller and *graadboogmaker* (protractor maker) in the neighborhood of the Damrak and called his shop "In de Gecroonde Lootsman" (at the sign of the crowned pilot).

In 1704, Gerard van Keulen, the oldest son of Johannes I, took charge of the firm. He was trained at the firm, and his name is mentioned on charts beginning in 1698. The firm prospered under his leadership, and after his death in 1726 his widow, Ludowina Konst, continued the business with their son Johannes II van Keulen. From 1743, Johannes II and other members of the family became the official chartmakers of the Verenigde Oost-Indische Compagnie (East India Company, or VOC) (Schilder and Kok 2010, 153–69). Johannes II was not only involved in publishing, but through a bequest from his wife's uncle, he came into the possession of an anchor foundry and some ship shares. After the death of Johannes II in 1755 his two eldest sons, Gerard and Cornelis, became owners of the firm. Gerard took the name of his mother's uncle and is known as Gerard Hulst van Keulen. His brother took his mother's name and is known as Cornelis Buijs van Keulen. After Cornelis died, his widow became the sole owner of the anchor foundry, and Gerard Hulst concentrated on the publishing house until his death in 1801. His widow in turn continued the firm as the *weduwe G. Hulst van Keulen* (widow of G. Hulst van Keulen) and it operated, under different names, until 1885 when the firm was dissolved and its inventory was auctioned.

*De groote nieuwe vermeerderde zee-atlas* (with charts only) and, especially, *De nieuwe groote lichtende zee-fakkel* (charts and text) made the reputation of the Van Keulen firm. The latter, an atlas and pilot guide, was published by Johannes I between 1681 and 1684 with elaborate frontispieces (see fig. 486). Volumes 1 and 2 were published in 1681, volume 3 in 1682, volume 4 in 1684, and volume 5 in 1683. These five volumes covered all the areas of interest to European sailors, with the exception of Asia. Charts of Asia belonged to the monopoly of the VOC, which supplied manuscript charts to its ships and prohibited the printing of detailed charts of the region. Only in 1753 were Dutch charts of Asia published, in the sixth volume of the *Zee-fakkel*, exactly fifty years after Englishman John Thornton had published his *The English Pilot, the Third Book, Describing . . . the Oriental Navigation*, the first pilot guide to the Asian waters.

The *Zee-fakkel* was republished throughout the eighteenth century. In composing the *Zee-fakkel*, Johannes I worked closely with Claes Jansz. Vooght, a mathematician, surveyor, and teacher of navigation who should un-

doubtedly be considered the main author. In preparing the second volume, Vooght was supported by Jan van Loon. Van Loon and his brother Gilles had produced their own sea atlas in 1661 (*Klaer lichtende noort-ster ofte zee atlas*) and had collaborated with the engraving of the charts of Johannes Janssonius and Robijn. The title pages of volumes 1–5 of the *Zee-fakkel* were engraved by the well-known artist Jan Luyken, who was also responsible for the cartouches. The *Zee-fakkel* was also published for the foreign market, with editions in French, Spanish (vols. 2–5), and in Italian (vol. 3 only). Gerard Hulst van Keulen greatly expanded the *Zee-fakkel*. For the first time, he included charts based on

the Mercator projection, his grandfather Gerard having in 1707 bought one hundred charts drawn on that projection from Loots. They were to have been included in an atlas that was never published.

The second major product of the Van Keulen firm, the *Zee-atlas*, actually predated the first volume of the *Zee-fakkel*, appearing under the imprint of Johannes I in Dutch and English editions in 1680. It was translated into English as *The Great and Newly Enlarged Sea Atlas*, with the frontispiece by Luyken. As with the publication of the volumes of the *Zee-fakkel*, the *Zee-atlas* also grew in size from 40 charts in 1680, to 116 in 1683, and 160 in 1695. Gerard reorganized the *Zee-atlas*, and, like the

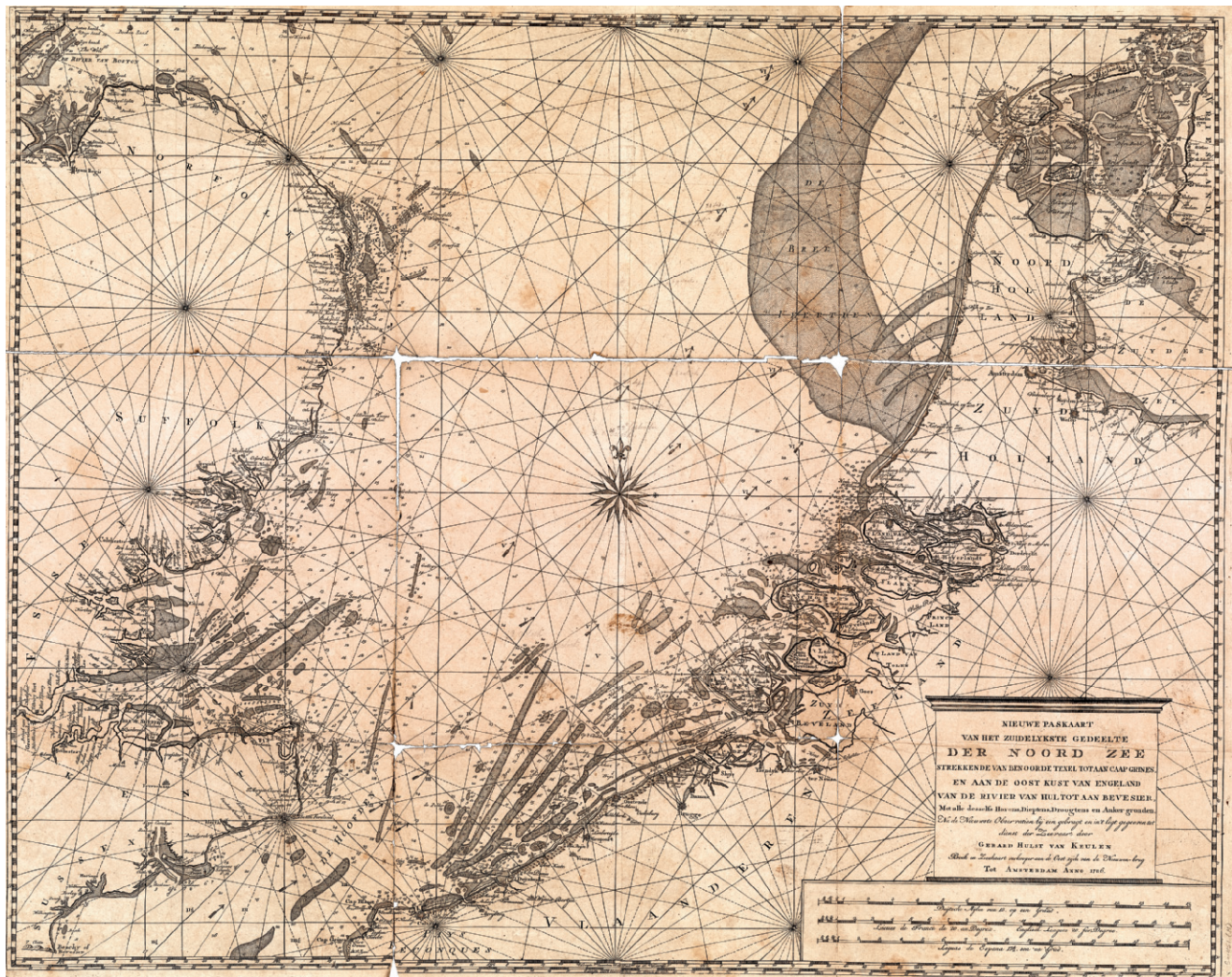


FIG. 518. GERARD HULST VAN KEULEN, *NIEUWE PASKAART VAN HET ZUIDELYKSTE GEDEELTE DER NOORD ZEE*, 1786. This chart, ca. 1:450,000, exemplifies the style of Van Keulen charts with rhumb lines, sand banks, and soundings. It clearly shows signs of wear along the fold lines. That this particular chart was used aboard ship is indi-

cated by the course dates penciled in, for example, just above the central compass rose.

Size of the original: 80 × 102 cm. Image courtesy of the Osher Map Library and Smith Center for Cartographic Education at the University of Southern Maine, Portland (SM-1786-4).



FIG. 519. GERARD VAN KEULEN, “DE STRAET VAN MAGALLANUS AEN ZUYD AMERICA,” AMSTERDAM, BETWEEN 1704 AND 1720. This chart, ca. 1:540,000, is bound into a copy of volume 5 of *De nieuwe groote ligtende zee-fakkell* (1738, map 41) and is a hybrid manuscript and printed

reproduction. The rhumb lines, latitude scales, and compass roses are printed from a copperplate, while the coastlines, place-names, and soundings are all in manuscript. Size of the original: 52 × 129 cm. Image courtesy of the collection Maritiem Museum, Rotterdam (Atlas37-V\_G).

*Zee-fakkell*, published it in five volumes. The Van Keulen firm made use of the seafaring community to gather facts concerning the seaways, and a constant stream of practical knowledge and data reached them in this way (fig. 518). They also adapted charts by foreign mapmakers, such as the Englishman Collins and the Swede Gedda, and in 1753 Johannes II bought the right to publish the charts of the Scot Murdoch Mackenzie the Elder.

A special category of charts supplied by the firm were hand-drawn charts with a preprinted compass rose, rhumb lines, and border (fig. 519). A part of the publisher’s archive is still extant, with most being held at the Leiden University library. Some of these charts are noted as *originele* in contrast to the numerous examples that are inscribed *kopie*. Why the Van Keulens sometimes opted to sell manuscript charts and not printed ones is not known, but there probably is a connection between cost and demand (Koeman 1970, 304). When the demand for charts of a certain region was low, it was not profitable to produce a printed chart of the area; the less expensive alternative was to produce a manuscript chart. During the eighteenth century, manuscript charts were also sought by collectors. For example, around 1715 the cardinal and booklover Domenico Salvio Passionei acquired eighty-five manuscript charts by Gerard van Keulen, a collection now in the Biblioteca Angelica, Rome (Guiso and Muratore 1992). Manuscript charts were also purchased by owners of printed Van Keulen atlases who wished to bind both products together.

The products of the Van Keulen firm were largely derivative. Their charts were compiled from earlier seventeenth-century examples and new isolated findings of sailors. This practice contrasted with charting in France, England, and Spain, where more sophisticated mathematical techniques began to be applied in the second half of the eighteenth century. Maritime surveying expeditions, both for regional discovery and to ascertain certain coordinates, were undertaken at public expense. In the Netherlands, relatively late, a scientific commission for fixing distance and improving charts, the *Commissie tot de zaaken het bepalen der lengte op zee, en de verbetering der zeekaarten betreffende*, was set up in 1787; its members comprised the professor of mathematics and physics Jan Hendrik van Swinden, mathematician Pieter Nieuwland, and Gerard Hulst van Keulen. The commission tackled the longitude problem and published from 1787 the *Almanach ten dienste der zeelieden*, following the lead of the English *The Nautical Almanac*. Another task of the committee was to select the best charts and to correct them on the basis of travel journals and other publications. Charts of particular foreign mapmakers were especially desirable, for example those of the Spanish hydrographer Vicente Tofiño de San Miguel, whose charts of Spanish waters were published by Gerard Hulst van Keulen (Mörzer Bruyns 2001, 65–73; Kok 1980a, 1980b; De Vries et al. 2005, 64–65).

Very late in the century the Dutch admiralty started a systematic survey of Dutch waters. Between 1796 and

1798 the naval officer Arnold Adriaan Buyskes worked on surveys of the Dutch coast, but his charts were never published and are known only in manuscript. It was the French who produced the first modern charts of the Dutch coast. The naval officer Charles-François Beautemps-Beaupré surveyed the Western Scheldt in 1799 using a modern triangulation method (Chapuis 1999, 754). The Dutch naval officer Julius Constantijn Rijk started a survey of the coast in 1812 and published a chart (of the Texel and Den Helder Channels) in 1816, based on the modern triangulation methods and with isobaths, as introduced by Beautemps-Beaupré, marking the beginning of a new episode in maritime charting in the Netherlands (De Meer 2012; Bruijn, Den Heijer, and Stapelkamp 1991, 19, 22–23).

SJOERD DE MEER

SEE ALSO: Netherlands, Republic of the United

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*Marine Charting by the Ottoman Empire*. A complete inventory of marine charts, whether navigational, operational, or commemorative, does not yet exist, and research is still required to reveal more maps in the archives and libraries of Turkey, of other states under former Ottoman sovereignty, and in archives of other foreign countries. Only when the full body of evidence is available will we fully understand the development and change in marine charting and sailing techniques of the long eighteenth century. What follows here is a summary of cartographic evidence supporting Ottoman awareness of the need for maps, small-scale marine map production and distribution in Ottoman society, and the use of maps to commemorate naval military encounters.

In the mid-seventeenth century, the Ottoman Empire's naval expedition to Crete (1645–69), a significant sea war, brought about a new era in which marine charts and geographical texts gained much importance. The reign of Mehmed IV especially may be regarded as the turning point when sea charts were included in the geography curriculum under the marked influence of Pîri Re'îs. According to the reports by the eminent traveler Evliyâ Çelebi, there were about fifteen artisans in eight workshops involved in mapping in Galata in the mid-seventeenth century (Evliyâ Çelebi 1896–1938, 1:548).

In the same period, the "Kitâb-ı bahriyye" (Book of maritime matters) by Pîri Re'îs was reproduced and enriched by new additions to the content of the book in a series of new copies. Furthermore, the maps in the "Kitâb-ı bahriyye" copied in the seventeenth century displayed typical features of the period such as drawings of castles and cities and various types of ships. (The best examples of such drawings are available in İstanbul Üniversitesi Kütüphanesi [İÜK], Türkçe Yazmalar 6605; İstanbul, Deniz Müzesi Arşivi, 988, and 989; and İstanbul, Topkapı Sarayı Müzesi Kütüphanesi [TSMK], R. 1633; Goodrich 2004, 6.99–6.101). Moreover, the drawings of galleons in these copies belong to the second half of the century and the following decades, when the Ottoman navy used such galleons in naval warfare.

The "Kitâb-ı bahriyye" of Pîri Re'îs was used as a model for a book titled "Kitâbu bahri'l-esved ve'l-ebiyâz" (attributed to a fictitious Seyyid Nuh) that delineated the ports and fortresses along the Black Sea and the Mediterranean shores in 204 portolan charts (Soucek 1992, 276–77, 291–92). Sea maps and geographical works written in that period included maps of the Black Sea, the Aegean Sea, and the Mediterranean Sea.

With an enormous enthusiasm for geography, Muştafâ ibn 'Abdullâh Kâtib Çelebi wrote the "Cihännümâ," aiming to fill gaps left by Muslim geographers and to display current geographical knowledge of Western geographers. The "Cihännümâ" demonstrates the progress

of Ottoman geographical mapping of water. The first of the two chapters concentrate exclusively on seas, rivers, and islands. Written in 1648, the book was revised in 1655. Kâtib Çelebi used the Mercator-Hondius *Atlas minor* (1611), translated by Mehmed İhlâsî, and other Western and Eastern works, as he attempted to transfer European geographical and mapping knowledge to an Ottoman audience. As he elaborated in “Tuḥfetü’l-kibâr fi esfâri’l-bihâr,” a narrative of previous naval wars during the military expedition to Crete, it was crucial to understand geographical knowledge and the significance of cartography because non-Muslims had already reached Indian ports; the Venetians had hindered the Ottoman navy by blocking the Dardanelles enabled by their skills in geography and marine charting. For these reasons, Ottomans began again to compose new sea charts. In the introduction of “Tuḥfetü’l-kibâr,” Kâtib Çelebi emphasized the importance of sea charts as guides for seamen and included three maps in his work. One of them illustrated a Mediterranean world that encompassed the Black Sea in the east and England in the west. The other two included the Aegean Sea islands and the Mediterranean coastal regions (TSMK R. 1192; similar maps in Istanbul, Süleymaniye Yazma Eser Kütüphanesi, Mihrişah Sultan 304, Lala İsmail 310, and Reşid Efendi 642; İÜK, Türkçe Yazmalar 6118; TSMK R. 1195 and Y. 67) (Kâtib Çelebi 2008).

By the late seventeenth century, new maps were produced by translating European geographical works and world maps, although none of these works incorporated large-scale navigational charts. Ebübekir ibn Behrâm ed-Dımaşkı, an Ottoman geographer, translated Willem Jansz. and Joan Blaeu’s eleven-volume *Atlas maior*, which had been submitted to Mehmed IV by the Dutch ambassador Justinus Colyer in Edirne with the title “Nuşretü’l-İslâm ve’s-sürür fi taḥrîri Aṭlas mayur.” In preparing this work, ed-Dımaşkı was inspired by Eastern sources for the maps, which included Anatolian and Arabian lands, as well as Ottoman seas. He completed the work between 1675 and 1685 in nine volumes and presented it to the sultan (TSMK B. 325 and B. 333 [see fig. 615]; *Atlas maior*, 1662, TSMK H. 2723; see *İstanbul* 1994, 148–51). An abridged version of ed-Dımaşkı’s work, “İhtişâr-ı tercüme-i Aṭlas mayur,” contains sixty-two maps (TSMK R. 1634). Other contemporary geographical works that featured information on chartmaking did not include maps: Esîri Ḥasan ibn Ḥüseyn’s “Mi’yârü’d-düvel ve Misbârü’l-milêl” (Süleymaniye, Hekimoğlu Ali Paşa 803) and İbrâhîm Hamdi’s “Aṭlas” (Süleymaniye, Esad Efendi 2044).

Foreign sources vouch for local map and chart production in the late seventeenth century. French traveler Jean-Baptiste Tavernier related that during his stay in

Istanbul (1631, 1668) he saw celestial and terrestrial globes in the treasury of the Topkapı Palace, and that Turkish mariners presented sea charts produced from personal observation to the sultan (Loupis 2000, 396–97). Antoine Galland, an official in the French embassy, stated that during his posting in Istanbul he met a Turkish chartmaker who had been invited by Charles-Henri-François Olier, marquis de Nointel, the French ambassador to the Sublime Porte (1670–79), to draw a map showing the Black Sea, the Bosphorus, and the Marmara Sea. Galland also asserted that the map expert Mehmed Çelebi showed him many maps, among which were those of Istanbul and the Bosphorus that he himself had drawn. In addition he claimed that Kapudan paşa (grand admiral of the navy) had sent two copies of these maps to the sultan and that he possessed similar Italian maps (Galland 1949–73, 1:151, 219; 2:38). These sources demonstrated that Ottoman sea charts functioned both practically, by providing information, and ceremonially.

Small-scale geographical mapping of large bodies of water was encouraged by the establishment of the state-sponsored printing house of İbrâhîm Müteferrika in 1727. Müteferrika’s earliest print productions were maps: that of the Sea of Marmara (1132/1719–20) and of the Black Sea (1137/1724–25). The Sea of Marmara was printed from a woodblock and displayed an Ottoman emblem (top left) and a script that says a larger map could be drawn if the grand vizier İbrâhîm Paşa so desired (bottom right) (Gencer 2010, 158–59). The map of the Black Sea, printed from copperplate with added color, originally titled *Baḥriyye-i Baḥr-i Siyâh*, includes the Sea of Marmara as well as the coasts of the Crimea and Sea of Azov; the entire Black Sea coast is shown in detail, including names of the residential places (see fig. 35). Müteferrika remarked in his work that this map aimed to enable the seamen to navigate better in these waters, and he pointed out that the map was drawn using calculations of latitude and longitude. In keeping with Renaissance traditions of illustrating different types of ships, the Black Sea map displayed galleons and galleys. In the publication of Kâtib Çelebi’s *Tuḥfetü’l-kibâr* in 1141/1729, Müteferrika included a world map, maps of the Black Sea and Mediterranean Sea, the Aegean Sea and the Aegean Islands, and the Adriatic Sea (Kut and Türe 1996, 22–25, 38–39). About fifty-two figures and maps found in *Kitâb-i Cihânnümâ* (published in 1145/1732) are Müteferrika’s own additions and rearrangements, half of them illustrating territories with coastal areas, rivers, and lakes. Some untitled maps belonged to Müteferrika while others were prepared by Ahmed el-Ḳırîmî and Mıgırdıc Ğalaṭavî (Beydilli 1997, 36–38).

Educational institutions established in the eighteenth

century incorporated the production and use of marine charts. In 1189/1775 the naval engineering school, *Hendesehâne* (École de Théorie), was established and map training was begun, requiring Ottoman sea charts to be published for educational purposes. Printing capability was expanded in 1211/1797 when tools from *Müteferrika*'s printing house, including a copperplate press, were transferred to the imperial army engineering school, *Mühendishâne-i Berrî-i hümayün*, where *Müderriş* 'Abdurrahmân Efendi, the head of the new *Mühendishâne* printing house, had a press built (Kaçar 1995–98, 2:82; Beydilli 1995, 100). In 1801 portolan maps of the Black Sea, the Mediterranean Sea, and the Sea of Marmara were engraved on copperplates and printed in *Mühendishâne* printing house (Beydilli 1995, 121–24, 153, 299). Copying foreign works persisted while technical skills improved. *Resmî Muştafâ Ağa* translated the *General Atlas* of English geographer William Faden in fifteen months, titling his work *Cedîd atlas tercümesi*, on which eight artists and a calligrapher worked. The atlas includes twenty-four colored maps, of which three are sea charts. The artistic and aesthetically high quality of *Cedîd atlas tercümesi*, printed in *Üsküdar* printing house (built in 1218/1803), set European standards for Ottoman printing (Beydilli 1995, 168–73), although the marine content is small.

Maps commemorating sea battles and sieges marked several Ottoman naval endeavors and form a distinct category related in form and kind to military mapping. Among these are maps concerning the Ottoman naval battles with Russia in the Black Sea, conflicts with the Austrian Empire along the Danube, the Spanish siege of Algiers (1783), and the restoration of Korfu (1798) and *İskenderiye* (Alexandria) (1799) from the French in the Mediterranean. The first map in this group concerns the Russian assault on the Crimea and siege of Azov during the 1736–39 Ottoman-Russian War. The Ottoman fleet, under the command of Kapudan paşa Canım Hoca Mehmed Paşa, conducted two naval landings on the Black Sea, in 1736 and 1737, resulting in successful operations against the Russians. A commemorative map shows the *Lori Burnu Muharebesi* (1737) (Istanbul, Topkapı Sarayı Müzesi Arşivi [TSMA], E. 9401 for the complete plan), depicting the Ottoman navy present in this operation and the siege, illustrated in color by el-*Hâcc Feyzullâh* for his “*Keyfiyyet-i Rûsiyye der sâl-i 1122*” (TSMK H. 1627). Another map shows the naval operations of the Ottoman navy, which arrived in the Black Sea to defend *Ochakiv* (Özi) and regain the *Kılburun Castle* from Russia in 1202/1788 (TSMA E. 9403/1 [see fig. 568]; yet another map pictures the Russian fleet in *Kherson* with castles along the coasts, TSMK H. 1850).

In 1151/1738, when the Habsburgs occupied the Ot-

toman island of *Adakale* (Orshova) on the Danube, the Ottoman navy sailed up the Danube via the Black Sea and the chief commander 'İvaż Mehmed Paşa's units began a joint sea operation. A commemorative plan of this naval operation was drawn in watercolor and presented by the grand vizier to Sultan Maḥmūd I. While its emphasis was more military than naval, it showed the deployment and course of the Ottoman fleet (TSMA E. 9439; Karamustafa 1992, 213–14, fig. 11.6). Another hand-colored map of the same period (Istanbul, Başbakanlık Osmanlı Arşivi [BOA], *Haritalar Tasnifi* 44), shows castles on the Danube and the Danube delta, probably produced for military purposes, as were other maps displaying military features concentrated on the *Dnieper* (Özi) River and the castles around it (BOA, *Haritalar Tasnifi* 91 and 92).

The Spanish naval siege of Algiers under the command of Antonio Barceló elicited cartographic plans that described the maneuvers and locations of specific vessels. One such plan was prepared by *Mühendis Aḥmed Râsim* and presented to *Abdülhamîd I* (TSMK H. 1851).

A watercolor map frames the allied naval operation of the Ottoman fleet and the Russians against the French, who had occupied Corfu in 1799 (fig. 520). It shows the old and new plans of the castle and also the occupied *Vido Island*. The plan illustrates the positions the navies took during the siege, giving information on each ship and its captains, with a description of the engagement written on the left and bottom margins of the map in Ottoman Turkish and Russian.

Throughout the century, foreign engineering and military talent contributed to commemorative naval mapping. Of particular note is the work of the French engineer *François Kauffer*, who was in the service of the sultan. Following the defeat of the French under Vice-Admiral *François-Paul Brueys d'Aigalliers* in Egypt by British Rear-Admiral *Horatio Nelson* at *Abū Qîr* (*Ebū Hür*), Kauffer depicted the battle of 1 August 1798 and included a narrative of it (TSMK H. 1849). As the French occupation of Egypt continued, the Ottoman fleet landed with a small English fleet at the port of *Abū Qîr* in 1799, an operation recorded on another map prepared by Kauffer, which shows the locations of the ships and the deployment of soldiers (TSMK H. 1847).

In 1801 Kauffer recorded the Ottoman naval operation in cooperation with the British against the French occupation in Alexandria with a series of four hand-colored maps. One large plan illustrates the siege of the port of Alexandria by Ottoman and British forces, showing the allied ships and the operation against *Rosetta* (fig. 521). Other plans in this group indicate operations conducted on the Nile River up to Cairo (TSMA E. 6200/22, 6200/29, and 6200/30). In the English copy of the plans figures of soldiers with the flags of the allied





countries and a coat of arms signify the alliance between the Kapudan paşa Küçük Hüseyn Paşa and General John Hely-Hutchinson (fig. 522). Other charts of the period show the ports of Alexandria and Abū Qīr with brief explanations of the figures (BOA Haritalar Tasnifi 657).

Evidence clearly exists for small-scale geographical maps of seas, rivers, and islands and for the use of maps to record naval endeavors. Further research is required to elucidate and understand the process of chartmaking for navigational purposes: the training and tools and the survey, measurement, and compilation techniques exer-

cised by Ottoman navigators and naval administrators in the long eighteenth century.

İDRIS BOSTAN

SEE ALSO: Ottoman Empire, Geographical Mapping and the Visualization of Space in the

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FIG. 521. THE OTTOMAN-ENGLISH JOINT FLEET ALONG THE COASTS OF ALEXANDRIA (İSKENDERİYE), ABŪ QĪR (EBŪ HŪR), AND ROSETTA (REŞİD), 1801. Hand-drawn manuscript plan by François Kauffer and Ottoman engineers, “Bizim donanmamız ve İngiltere donanması

mahlûtan Ebū Kır'da demirleyüp, bu iki takım donanmadan iki günde bir iki takım olarak yelken üzerinde volta ederek İskenderiyye ile ceng eylediklerinin aynı sûretidir.” Image courtesy of Topkapı Sarayı Müzesi Arşivi, Istanbul (E. 6200/32).



FIG. 522. [FRANÇOIS KAUFFER], "PLAN OF THE OPERATIONS OF THE OTTOMAN & BRITISH TROOPS IN EGYPT," 1801. An English copy of the siege map of Abū Qīr (fig. 521) showing the Ottoman-British Allied Navy against the French occupation in Egypt. Manuscript.

Size of the original: 49 × 75 cm. Image courtesy of Topkapı Sarayı Müzesi Arşivi, İstanbul (E. 6200/27).

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*Marine Charting by Portugal*. Unlike the charts and maps from the Renaissance, Portuguese marine cartography of the later seventeenth and eighteenth centuries has not yet been thoroughly studied (Alegria et al. 2007, 977–1002; Alegria and Garcia 1995, 31). This lack of scholarly attention results in part from the seemingly small number of surviving general nautical charts and

printed charts from this period (Teixeira da Mota 1976, 56). However, as catalogs of archival material in military and other archives emerge in Portugal, more charts may surface, as will maps in formats that might be construed as land surveys but contain nautical information.

Certain nautical appointments continued from earlier periods such as the *cosmógrafo-mor*, whose role could overlap with the *engenheiro-mor*, or terrestrial surveyor, as in the case of Luís Serrão Pimentel. The job of the *cosmógrafo-mor* was to examine and verify charts and instruments, instruct and train naval officers, and examine the skills of pilots; it was not to train cartographers. Some cartographic teaching was undertaken in the Aula da Esfera, a course on nautical mathematics and science taught at the Jesuit Colégio de Santo Antão, but this institution was not responsible for state-sponsored marine charting or mapmaking. As the office of the *cosmógrafo-mor* was hereditary and chartmaking was an empirically driven profession maintained within families, it is difficult to discern the training and background of producers of nautical materials. Certain developments may be traced, however, to the publication of Manoel de Azevedo Fortes's *O engenheiro portuguez* (1728–29), a training manual for surveyors, albeit land-based. Equally influential for marine charts was the work of the so-called *padres matemáticos* (mathematical fathers), the Jesuits Domenico Capassi and Diogo Soares in Brazil, whose rigorous measurements of longitude and surveys along both the coast and river networks provided much new data for marine chartmakers. Similarly, the work of military engineers along the rivers of Portugal exemplifies a high level of cartographic expertise and regard for surveying for navigation and defense (Dias 2010).

Some nautical texts dating from the later seventeenth and early eighteenth centuries mention Portuguese pilots using two types of maritime chart: Portuguese plane charts (*cartes plates* or *carta plana*), with degrees equally spaced, and foreign charts, with expanding degrees of latitude (i.e., Mercator charts) (Canas 2010). Locally produced cartography thus coexisted with imported knowledge. The oldest Portuguese map created using the Mercator projection was made by José da Costa Miranda in 1698 (Canas 2010, 371). During the first years of the eighteenth century, more maps were created using this projection, even though this innovative technique was introduced in Portugal in the sixteenth century, around the same time as it was in the rest of Europe. Although the “new” chart met with certain resistance among sailors, the textbooks of the *cosmógrafo-mor* and nautical manuals of the period included instructions for both plane charts and Mercator charts (e.g., Castelo Branco 1720; Pimentel 1969 [1699]). Costa Miranda's other work demonstrates the range of geographical spaces and scales used by Portuguese hydrographers: a

planisphere (1706) and a chart of the Atlantic (1688). His atlas of 1688 contained several charts representing small portions of the oceans, like the Mozambique Channel, as well as diagrams of ports that appeared on small-scale charts, such as the chart of the Indian Ocean (1681) (Cortêsão and Teixeira da Mota 1960–62, 5:51–55). All of the seas where the Portuguese sailed were represented on Portuguese maps at a variety of scales necessary for safe navigation throughout the seventeenth and eighteenth centuries—a situation substantiated by recent exhibitions and accompanying catalogs (*A Nova Lusitânia* [2001], *Cartografia e diplomacia no Brasil do século XVIII* [1997], *Lugares e regiões em mapas antigos* [1997]).

The Portuguese focused on the maritime regions where they most often sailed, although their cartographic renderings were not always original. Jacinto José Paganino, though not a naval officer, translated three *roteiros* (rutters) from foreign sources, published in 1783 and 1784, concerning routes to China, to the South Atlantic along the African coast, and to Brazil, which included detailed nautical charts. His *Roteiro do Neptuno oriental* was derived from Jean-Baptiste-Nicolas-Denis d'Après de Manneville's *Le Neptune oriental* and included charts by the British hydrographer Alexander Dalrymple. Curiously, Dalrymple notes “Portuguese Ms. [manuscript] chart” with “P. C.” as a source for some features on his *Chart of the China Sea* (ca. 1780; see fig. 505), demonstrating his confidence in Lusitanian efforts.

South American possessions attracted special attention from the Portuguese, especially when territorial disputes with Spain led to numerous cartographic projects. The Prata region, especially the area around the Colonia do Sacramento, a focal point in Spanish-Portuguese negotiations over access to the Río de la Plata, saw many charts develop such as the *Planta do Rio da Pratta* (1748, ca. 1:2,000,000) prepared by an army officer who served in the Colonia and printed by Silvestre Ferreira da Silva, and the *Plano do Rio da Prata tirado geometricamente*, created by Paganino and engraved by Francisco Domingos Milcent (1782), which included soundings and relied on the information provided by pilots who navigated the river. Such maps were distributed either in books, as in the case of the first map, or through commercial venues, as with the second. In addition to copying routes and texts produced by foreigners, Paganino and others also collected information from pilots who navigated the waters of various ports. Paganino included the *Plano do Rio Grande de S. Pedro situado em 32° de lat. sul* by José Correia Lisboa, the pilot of a corvette, in his *Roteiro occidental para a navegação da costa, e portos do Brasil* (1784).

The slave trade also had a significant impact on marine mapping. Portuguese colonies in the Americas

developed thanks to the labor of enslaved Africans transported by sea; several printed charts by Paganino described the African coasts, the region of the Gulf of Guinea and coasts further south, all areas significant in the slave trade (fig. 523). The *Carta reduzida da parte meridional do Oceano Atlantico ou Occidental des do equador athe 3° 8' 20'* [i.e., 38°20'] de latitude by José Fernandes Portugal (1802) represents the South Atlan-

tic between Africa and Brazil, with descriptions of slave trade ports, including Luanda, Benguela, and São Luís do Maranhão.

The number of Portuguese nautical maps in manuscript has led previous scholars to conclude that few nautical maps were printed. Yet it must be understood that production of nautical charting in the eighteenth century was, like other cartographic printing, dependent on foreign models and technical know-how (Garcia 2001). For example, Pedro Gendron published charts in 1754 and 1755 in Paris dedicated to Portuguese nobility that reproduced maps by German cartographer Johann Matthias Hase, and in 1757 in Paris Gendron published a chart of the port of Lisbon and surrounding coasts. At the end of the century, the engraver Gregório Francisco de Queirós reproduced charts by the Spanish hydrographer Vicente Tofiño de San Miguel of the region of Cádiz, evidence of Portuguese interest in navigating through the Levant but also of their reliance on foreign sources. From 1765 to 1784 some of the charts accompanying the *roteiros* published by Paganino were engraved by the Frenchman Milcent, who first established himself in Lisbon as an engraver of sheet music and used these skills to engrave and print maps and charts.

The creation of the Sociedade Real Marítima, Militar e Geográfica in 1798 allowed Portugal to improve its nautical charting, both at home and abroad. One of the society's goals was to review charts and *roteiros* to provide safer navigation, understanding that Portugal was not providing sufficiently accurate charts for its national interests; the sale of maps not approved by the society was prohibited. The society also sought to promote projects to further develop a national cartography of both land and sea. However, its brief existence, ending with the first French invasion in 1807, stymied the fulfillment of its objectives. Nonetheless, its members performed various studies and projects that contributed to the development of cartography. In 1790, Francisco António Ciera, the son of an Italian mathematician, Miguel António Ciera, who had come to Portugal to teach mathematics and astronomy, began a general triangulation of the kingdom that continued until 1803 (see fig. 271) and was taken up again decades later by Filipe Folque. Although the project remained incomplete, it served as the basis for marine projects, including the *Carta geral que comprehende os planos das principaes barras da costa de Portugal* (1811) by Marino Miguel Franzini, which presents diagrams of the principal ports of Portugal. This chart is the earliest Portuguese nautical chart based on geodetic principles and was intended to facilitate the mapping of the Portuguese coast.

ANTÓNIO COSTA CANAS

SEE ALSO: Portugal



FIG. 523. JACINTO JOSÉ PAGANINO, CARTA REDUZIDA DO CANAL DE MASAMBIQUE ENTRE A COSTA DE AFRICA E A ILHA DE S. LOURENÇO A THE A EQUINOCCIAL [S.l., 1784]. Engraved by Francisco Domingos Milcent, ca. 1:5,400,000, this map exemplifies the work of Paganino, a prolific chartmaker. It shows the channel between Mozambique and Madagascar with three inset plans of the ports of Mozambique and Sofala and the “Ilha da Area” (Tromelin Island).

Size of the original: 63.5 × 45.6 cm. Image courtesy of the Biblioteca Nacional de Portugal, Lisbon (C.C. 58 A).

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*Marine Charting by Russia*. Hydrographical descriptions of Russia date at least to the early modern period, when Russian sailors and fishermen (*pomor*) wrote down details about the rivers and sea coasts they traveled. The earliest known chart dates to 1594, when a Dutch seaman acquired a chart of the White Sea from a *pomor* near Kolguyev Island (Postnikov 2000, 79).

The reforms of Peter I in the early 1700s provided the main impetus for scientific marine charting in Russia as his Westernization of Russia brought European cartographic training across the Urals (Cracraft 2004, 40–96). At first, British cartographic ideas predominated in Russian hydrographic training, with Scotsman Henry

Farquharson and Stephen Gwyn and Richard Grice, young graduates of the Royal Mathematical School of Christ's Hospital, London, as the main instructors at the Moscow mathematics and navigation school, *Moskovskaya matematiko-navigatskaya shkola*, founded 1701. The curriculum at the Moscow school, modeled closely on that of the Royal Mathematical School, included a variety of mathematics, practical astronomy, practical navigation, technical drawing, elementary mapmaking, and methods for keeping a ship's log; students also were instructed in the techniques of hydrographical surveying (Cracraft 2004, 81–82; Postnikov 2000, 80). In this early instruction the textbooks were often published in Europe and read in the original languages as well as in Russian translation (for example, Jean Bouguer, *Traité complet de la navigation*, 1706, augmented by Semën Yemel'yanovich Gur'yev, *Navigatsionnyye ili morekhodnyye issledovaniya bezu*, 1790) (Postnikov 2000, 80, 91n8).

In 1715, the staff and curriculum of the *Moskovskaya matematiko-navigatskaya shkola* were transferred to St. Petersburg with the founding of the naval academy, *Morskaya akademiya*, and in 1752 it became the naval cadet corps, *Morskoy shlyakhetskiy kadetskiy korpus*. *Moskovskaya matematiko-navigatskaya shkola* graduate and hydrographer Fëdor Ivanovich Soymonov expanded the academy's teaching by founding navigation schools in Siberia (Okhotsk and Nerchinsk, 1754) and a school of geodesy in Tobol'sk (1758). *Morskaya akademiya* graduate Aleksey Ivanovich Nagayev taught navigation and mapping to the cadets.

To centralize the administration of all aspects of navy activities, Peter I created the *Admiralteystv kollegiya*, which in addition to all other matters (construction of ships and ports, regulation of navy officers' duties, and so on) supervised all cartographic activities at the *Morskaya akademiya* beginning in 1724. On 2 November 1777 (old calendar) the *Admiralteystv's* drawing office, which had come into existence in the 1760s, acquired a permanent staff responsible for compiling, engraving, and publishing charts and other navigational material (Komaritsyn 1997). The concentration of all these efforts in St. Petersburg allowed for careful oversight and control.

Peter I's promotion of hydrographic training allowed him to secure greater control over an ever-expanding Russian Empire, paying special attention to rivers and inland seas, particularly those with outlets. One of the first cartographic projects under him was the 1699 survey of the River Don by Cornelis Cruys. That survey, on which Peter I himself assisted, resulted in the *Nauw-keurige Afbeelding vande Rivier Don, of Tanais, de Azofsche Zee / Prilezhnoye opisaniye reki Donu ili Tanaisa Azovskovo morya*, printed in 1703 by Hendrik

Doncker in Amsterdam and annotated in Russian and Dutch. Later efforts focused on other river routes between the Baltic, St. Petersburg, and the Caspian and Black Seas. Hydrographers trained at the Morskaya akademiya were called upon to survey and chart these inland communication routes.

Peter I and his successors paid the most attention to the Baltic Sea, which adjoined the new capital, St. Petersburg. Tellingly, twenty-one of the twenty-nine Russian navigational atlases published in the eighteenth century were devoted to the Baltic. Soymonov added new Russian charts to Johannes I van Keulen's *De nieuwe groote lichtende zee-fakkel* and to the atlas of Werner von Rosenfeldt and Petter Gedda, published in 1696 in Swedish and later also in Dutch and English editions; Soymonov republished it as *Kniga razmernaya gradusnykh kart Ost-Zee ili Varyazhskogo morya* in 1714. Soymonov also compiled a new atlas of the Baltic Sea, *Svetil'nik morya* (1738), also called *Svetil'nik morskoy* or *Atlas Baltiskago morya*, comprising eight Swedish charts, six new Russian charts, and four charts from earlier Russian surveys of the Gulf of Finland (see fig. 763) and the Gulf of Riga (Kokkonen 1997, 54; Postnikov 2000, 81–82).

Russian hydrographer Nagayev led the most important stage in the charting of the Baltic. After his training in charting the inshore waters of the Gulf of Finland under Johann Ludwig von Pott Luberas in the 1730s, Nagayev carried out intensive surveys of the Baltic from 1748 to 1751. His work resulted in the *General'nyye i raznyye spetsial'nyye karty vsego Baltiyskogo morya* (1750). This atlas updated the Swedish atlas of Nils Strömcröna with Nagayev's own survey data.

Nagayev improved on this work with his *Atlas vsego Baltiyskogo morya* (1757), which added twenty-seven entirely new maps to the fifteen plates reused from the atlas of 1750 and two from the Soymonov atlas of 1714. The charts in the *Atlas vsego Baltiyskogo morya* comprised both special large-scale harbor charts for Baltic ports and island maps as well as smaller-scale navigational charts for the Gulf of Finland. They lack coordinates but show great attention to coastline detail and information on depths, rocks, and shoals. Though kept a state secret by naval authorities, the 1757 atlas was republished many times before the end of the century (Kokkonen 1997, 56–62).

The precise charting of the Caspian also served the Petrine program of Russian control over outlets to the sea at all compass points. Peter I ordered Aleksandr Bekovich-Cherkasskiy and Aleksandr Ivanovich Kozhin to chart the waters in 1715–18, followed by Soymonov and Karl von Verden in 1719–20. With assistance of Vasilii Alekseyevich Urusov, Soymonov and von Verden compiled their chart in Astrakhan, printed in St. Peters-

burg as *Kartina ploskaya morya Kaspiyskogo* (1720), which enjoyed considerable recognition in Western Europe, especially after Peter I sent a copy in 1721 to the Académie des sciences in Paris. Guillaume Delisle based his *Carte marine de la mer Caspiene* on Soymonov and von Verden's work; their map was also republished by Johann Baptist Homann in Nuremberg as the *Geographica nova ex Oriente gratiosissima duabus tabulis specialissimis contenta quarum una Mare Caspium* (Postnikov 2000, 81, 92).

Soymonov continued his surveys and studies of the Caspian during the Russo-Persian War of 1722–23 and during his seven years as Astrakhan's hydrographer. His publication of an untitled navigational atlas and sailing directions for the Caspian (1731) marked the beginning of specialized hydrographical publications in Russia (fig. 524). His subsequent work in the Baltic for the Admiralteystv kollegiya resulted in the 1738 *Svetil'nik morya* mentioned above—a revised translation from the Dutch of a Swedish atlas and sailing directions that included Russian surveys carried out in 1714–32. This atlas and his naval textbook ensured Soymonov's role as a key founder of Russian scientific hydrography.

The Russian charts on the Caspian and Baltic relied on European principles, and from them it is virtually impossible to identify links with earlier Russian cartographic traditions. However, Russian explorers in the Far East and Northern Pacific relied to a large extent on local information supplied by indigenous Siberians and drew upon earlier cartographic work such as that of Semën Ul'yanovich Remezov (Postnikov 2000, 83). The idea of a "Great Land" lying across the ocean, spoken of by the inhabitants of Chukchi, provided further impetus for scientific expedition, carried out in the First (1725–30) and Second (1732–42) Kamchatka Expeditions, led by Vitus Bering and Aleksey Il'ich Chirikov, and the voyages to the Bering Straits and northern Alaska by Mikhail Spiridonovich Gvozdev and Ivan Fëdorov (1732).

The Second Kamchatka Expedition discovered an abundant supply of furs in the Pacific Islands. Word spread, and over the next four decades hunter-traders (*promyshlenniki*) scoured the region and produced homespun nautical charts without geographical coordinates or a fixed scale or projection. Over time, expedition charts began to incorporate features in the Western European cartographic tradition, after the leaders of the expeditions had been trained formally in Siberian schools of navigation, the first of which opened in Okhotsk on Bering's order. Catherine II was the first to dispatch scientific expeditions charged with locating and describing the islands already visited by the fur traders. In 1768–69, an expedition led by Pëtr Kuz'mich Krenitsyn and Mikhail Dmitriyevich Levashov to the is-

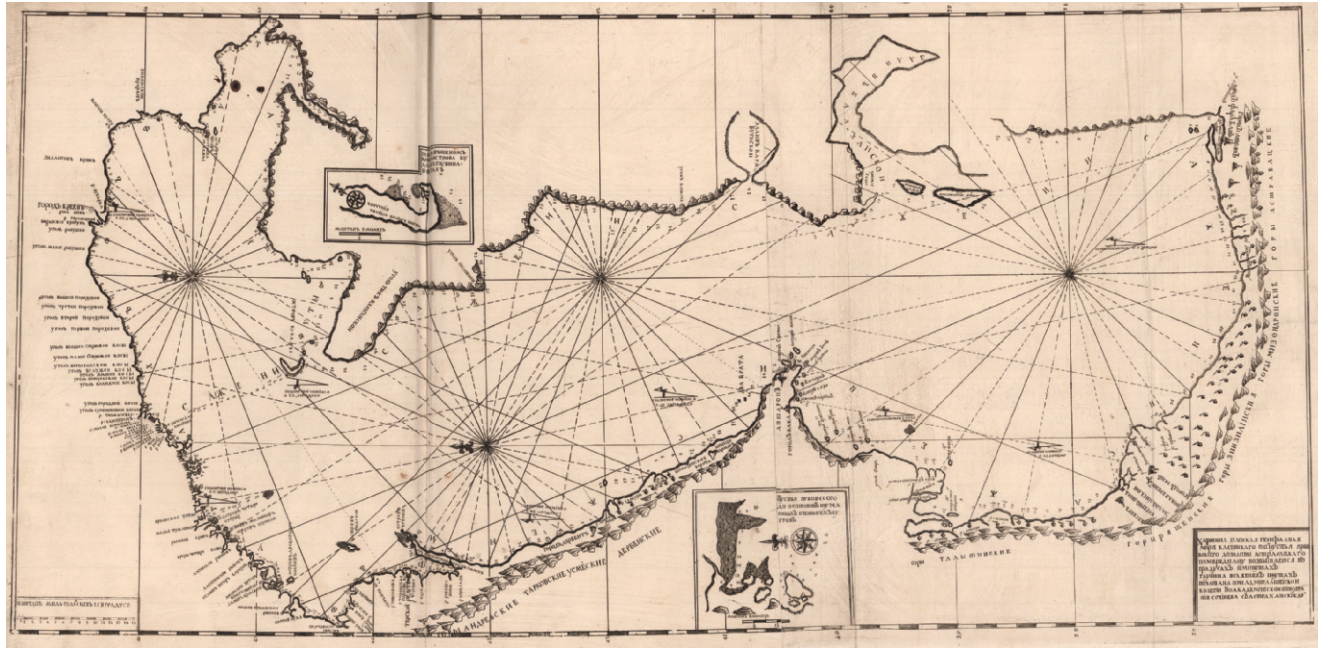


FIG. 524. FĚDOR IVANOVICH SOYMONOV, GENERAL CHART OF THE CASPIAN SEA. From Soymonov's 1731 untitled atlas of the Caspian Sea. Note that the map is oriented with north to the left.

Image courtesy of the Rossiyskiy gosudarstvennyy arkhiv voyenno-morskogo flota, St. Petersburg (at the back of F 1331/4/687).

lands of Unalaska and Umnak and the southern shores of Alaska resulted in the first hydrographic works conducted by educated Europeans in that part of the Bering Sea (fig. 525). On the expedition, the Admiralteystv kollegiya showed intense interest in the descriptions and charts compiled by the fur traders, sixteen of whom came along as guides. The accuracy of the indigenous information, when combined with geodetic measurements, was confirmed in charts drawn up by Nagayev, Timofey Ivanovich Shmalev, and Vasily Dmitriyevich Krasil'nikov, information that remained secret and unavailable even to Russian cartographers for many years. A 1781 chart drawn by Peter Simon Pallas (*Carte der Entdeckungen zwischen Sibirien und America*) finally showed the precedence of the Russian fur traders and explorers in the northern Pacific (see fig. 623) (Postnikov 1996, 63, 68–69, 71, 73).

Expeditions carried out in 1763–86 by Grigoriy Ivanovich Shelikhov, who founded Russian colonies in North America, and another led by Joseph Billings and Gavriil A. Sarychev in 1785–95 further proclaimed Russian rights to the northern Pacific. The undertone of propaganda is particularly obvious in Shelikhov's chart and subsequent publications by the Rossiysko-amerikanskaya kompaniya, founded in 1799. The results of the Billings-Sarychev expedition were illustrated in a 1794 chart of the northern Pacific drawn by Sarychev, whose

seven years in the area helped him compile and publish his book on the rules of marine surveying, *Pravila, prinadlezhashchie do morskoy geodezii* (1804), the first Russian manual on hydrographic surveying and charting. Republished with supplements throughout the nineteenth century, this work mandated that local toponyms be recorded, thus helping to preserve indigenous knowledge.

The interest in exploration did not distract monarchs like Catherine II from using hydrography toward the more traditional ends of military protection. The First Archipelago (Aegean) Expedition (1769–74), the first major strategic naval campaign conducted away from Russian shores, helped Russia emerge victorious in the Russo-Turkish War of 1768–74, which ended with the Treaty of Küçük Kaynarca. For the next three years (1775–77) the Russian fleet hovered in the area of the northern Aegean, the Dardanelles, and the Bosphorus, surreptitiously making survey measurements. Their work was compiled and published as the *Atlas arkhipelaga* (1788), comprising a small-scale general chart of the entire Aegean, six medium-scale regional charts, and fifty-one detailed, large-scale charts of potential anchorages such as gulfs, harbors, and channels. Russian officers combined their own survey data with information from printed French, English, Dutch, and Turkish charts. Greek recruits to the Russian navy assisted



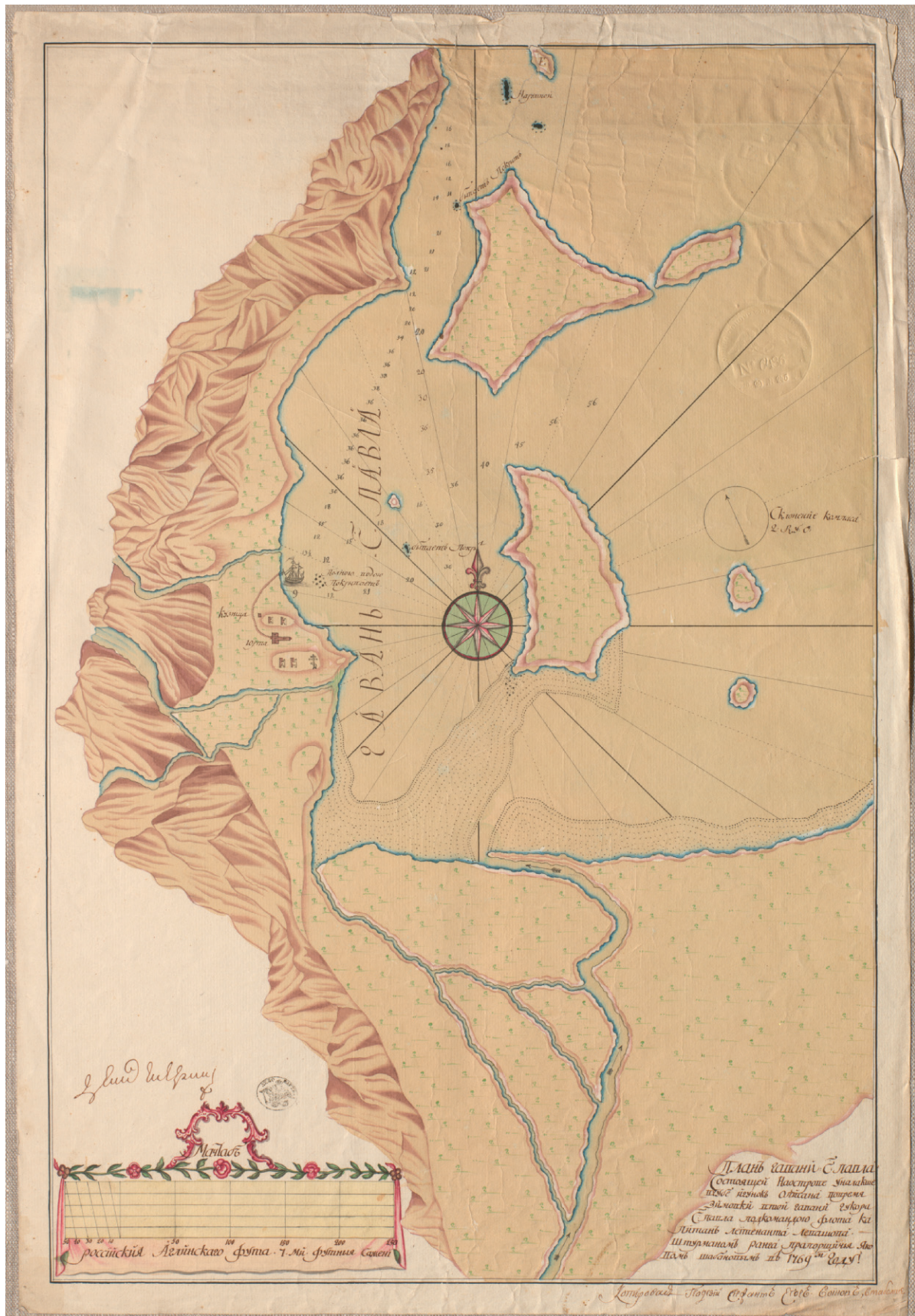


FIG. 525. YAKOV IVANOVICH SHABANOV, MANUSCRIPT PLAN OF ST. PAUL HARBOR (TODAY THE HEAD OF CAPTAIN'S BAY) ON THE ISLAND OF UNALASKA IN THE ALEUTIANS, 1769.

Size of the original: 59.5 × 40.0 cm. Image courtesy of the Rossiyskiy gosudarstvennyy voyenno-istoricheskiy arkhiv, Moscow (f. 846 VUA, op. 16, d. 23438).

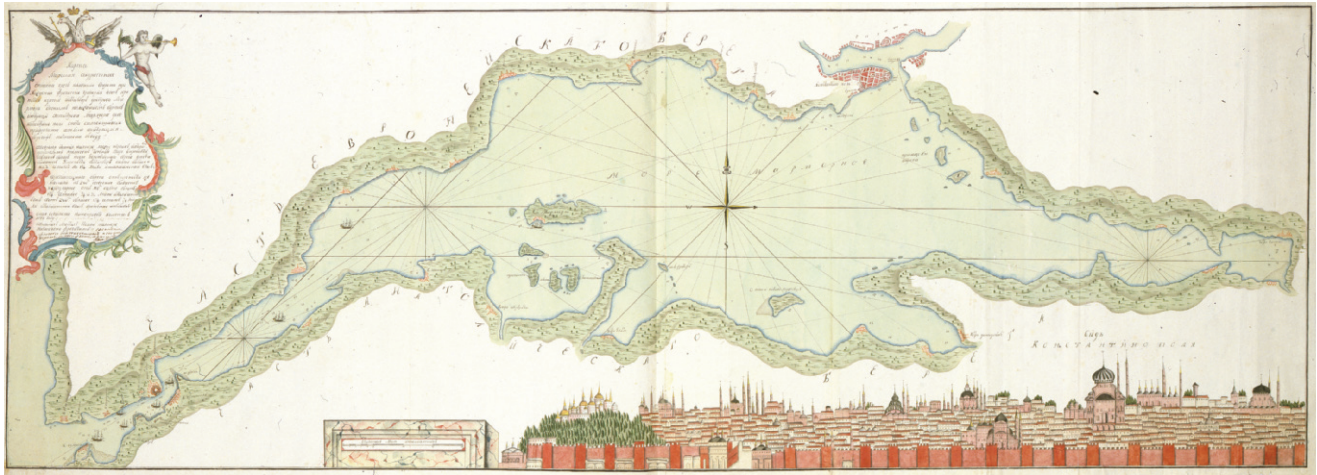


FIG. 526. PRESENTATION MANUSCRIPT COPY OF YEVTAFIY STEPANOVICH ODINTSOV'S CHART OF THE SEA OF MARMORA, WITH A VIEW OF CONSTANTINOPLE, 1788.

Size of the original: 50 × 140 cm. © State Historical Museum, Moscow (GO-1882/86).

with Greek geographical names (Bulatov and Zaytsev 1997). Although unexceptional technically, these maps were made under intense time constraints, and much of the work had to be done by stealthy reconnaissance (fig. 526) (Bulatov 2000; Postnikov 2000, 84–89). The work reflects the abilities and training of Russian naval officers to operate with scientific rigor under severe constraints.

ALEXEY V. POSTNIKOV

SEE ALSO: Nagayev, Aleksey Ivanovich; Russia; Sarychev, Gavriil Andreyevich; Soymonov, Fëdor Ivanovich

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**Marine Charting by Spain.** At the beginning of the eighteenth century, charts were still constructed using technical resources unchanged from the seventeenth century. Highly decorated charts, made by ship pilots drawn with the rhumb-line system, persisted. They were kept in manuscript as a general policy of secrecy limited their diffusion. Information was situated in latitude but not in longitude, which could not be securely established until the widespread adoption of nautical chronometers after 1774. The Mercator projection was not widely popular for Spanish charts until well into the eighteenth century; however, constant oceanic navigation to America and the Philippines encouraged permanent improvements to navigation and cartography.

Following the War of the Spanish Succession (1701–14), during the reign of Felipe V, institutions were created such as the Academia de Guardiamarinas de Cádiz (1717), the Seminario de Nobles de Madrid (1725), and the Academia de Artillería de Barcelona (1736). The first Ordenanzas de la Marina were published by royal order in 1717.

Naval officers and scientists Jorge Juan and Antonio de Ulloa, who participated in the expedition of Charles-Marie de La Condamine to measure the degree of the meridian at the equator (1735–43), accumulated scientific knowledge that allowed Spain to expedite research

in several scientific fields and warranted the creation of institutions to promote the study of nautical sciences in the navy. For example, the Real Observatorio de Cádiz (1753) institutionalized the practice and teaching of nautical astronomy for a select group of officers of the Armada who would then play a central role within numerous expeditions organized by the Crown. Also the Academia de Ingenieros de Marina was created in 1772 to instruct technical staff in the construction of ports and arsenals.

Yet real scientific and technical progress was not made until well into the second half of the eighteenth century, when the enlightened governments of the Bourbon dynasty grew conscious of the importance of science and technology as indispensable tools for strengthening the state and for the advancement of its elite class. In this context, the Armada became an instrument of the enlightened state, introducing the latest advances of navigation and nautical cartography into Spain.

In 1783, the Spanish government carried out the astronomical mapping of the coasts of Spain, charging the tasks to Vicente Tofiño de San Miguel, director of the Academia de Guardiamarinas de Cádiz, and resulting in the valuable *Atlas marítimo de España*, 1789. With this scientific precedent, and spurred on by geopolitical problems, the Spanish government organized numerous expeditions. Some were to protect the possessions in America and the Philippines vis-à-vis other countries and to vindicate discoveries made by Spaniards, particularly in the Pacific. Others pursued a strictly scientific goal. Yet all of these expeditions generated, to a greater or lesser extent, noteworthy cartography.

Between 1785 and 1789 two expeditions under the command of Antonio de Córdova went to the Strait of Magellan to make precise charts and test new instruments and methods of astronomical observation. These expeditions laid the organizational foundations for subsequent naval expeditions. While their methods coincided with those of other European countries, they differed in their goals, since the Spanish pursued a geopolitical goal of territorial affirmation over its colonies. Alejandro Malaspina followed with an effort (1789–94) that epitomized the national enterprises organized by an enlightened monarchy. Its mission was hydrographic reconnaissance along with reform and control of the colonies, an element missing in other European enterprises. The cartographic results were important because they made available charts on the Mercator projection of the Atlantic coast of South America from Montevideo around the entire Pacific coast of the South and North American continents, the Philippines, and other large islands in the Pacific Ocean (fig. 527).

Another hydrographic expedition, known as “la ex-

pedición hidrográfica del Atlas de la América septentrional,” left Cádiz in 1792 to chart territories in the Gulf of Mexico and the Antilles, areas of conflict for the Spanish monarchy (Martín-Merás 2008). The first division of *bergantines* (two-masted sailing ships) (1792–95) commanded by Cosme Damián de Churruca, made charts of the Lesser Antilles, Puerto Rico, and Trinidad. The second division (1795–1809), commanded by Joaquín Francisco Fidalgo, reconnoitered the southern coast of the Gulf of Mexico to Cartagena.

To process the mapping generated by these expeditions, to promote additional mapping, and to publish nautical charts, the Dirección de Hidrografía (1797–1908) was created as part of the navy; it became the official agency to receive and publish the charts generated by expeditions, as well as the work on port facilities by military engineers. Thus, following France’s example, the Dirección was established in Madrid as the first cartographic center in Spain. It undertook engraving and updating marine charts and preparing and publishing those needed for navigation and commerce.

In the process of scientific renewal, the government reached out to the highly qualified military echelon, rather than strengthening civilian institutions as other European countries had done—a phenomenon termed the “militarization of science.” This epoch of renovation and scientific advancement did not last as long as Spain could have required. Historical events, such as the Battle of Trafalgar, the invasion by Napoleonic troops, and the loss of most of its American possessions, drew Spain into a deep institutional crisis during the first half of the nineteenth century. Nevertheless, the Dirección de Hidrografía in Madrid and the Real Observatorio de Cádiz survived into the twentieth century—two scientific institutions, created by the short-lived Enlightenment movement.

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SEE ALSO: Spain; Tofiño de San Miguel y Vandewalle, Vicente

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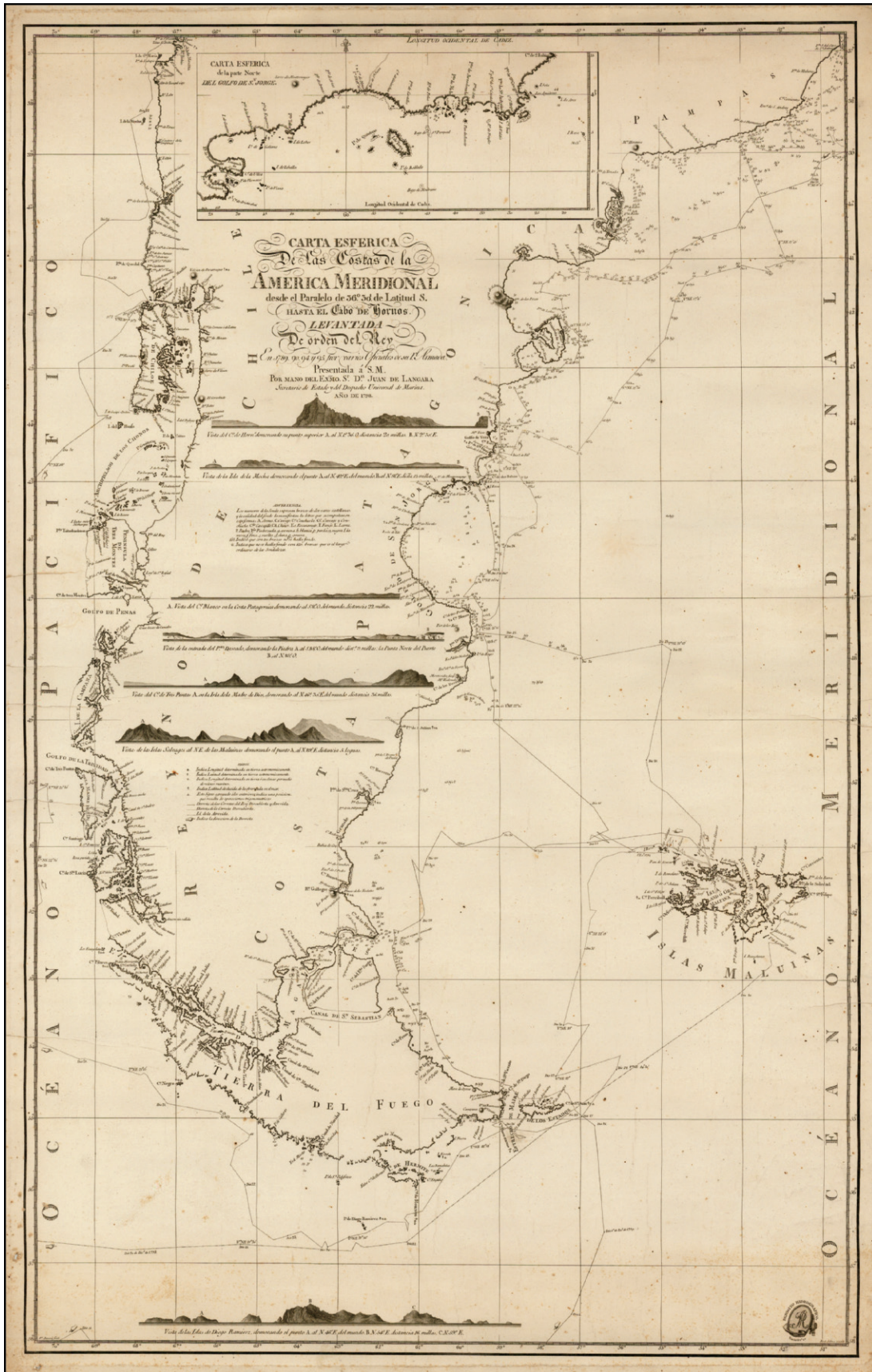


FIG. 527. CARTA ESFERICA DE LAS COSTAS DE LA AMERICA MERIDIONAL ([MADRID], 1798). This printed map was compiled from the surveys along the South American coast made by the royal corvettes, *Descubierta* and *Atrevida*,

part of the expedition of Alejandro Malaspinga, which greatly advanced the possibilities of navigation in this region. Size of the original: ca. 98 × 62 cm. Image courtesy of Barry Lawrence Ruderman Antique Maps, La Jolla.

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**Marine Charting by Sweden-Finland.** The Swedish hydrographical survey (Sjöfartsverket) originated in 1680, when Commodore Werner von Rosenfeldt was ordered to draw a “good chart of the whole Baltic Sea” (quoted in Dahlgren and Richter 1944, 34). The previous autumn he had already prepared for the navy’s relocation to what would become the town of Karlskrona and the center of Swedish marine charting by conducting soundings and setting buoys.

To be able to fulfil his task, von Rosenfeldt needed to become acquainted with land survey maps, and for this reason Petter Gedda was taken on as an assistant. In the summer of 1694 the preparatory work for an atlas was completed, and von Rosenfeldt and Gedda traveled to Amsterdam with the material to have it engraved and printed. As the Swedish Amiralitetet would not underwrite the project, and Gedda himself lacked resources, it was von Rosenfeldt who financed the publication. By 1696 the atlas, double folio in size, with ten charts, and with Gedda’s name as author, appeared in a Swedish edition with the title *General hydrographisk chart-book öfwer Östersjön, och Katte-Gatt*. At the same time Dutch and English editions were published and printed by Jacob Robijn.

In 1697 a pirated edition of the atlas was published in Amsterdam by Johannes Loots. In April 1698 von Rosenfeldt traveled to Holland and instituted legal proceedings against Loots. Back in Stockholm with the copperplates, von Rosenfeldt started to print a new edition with twelve charts. One copy of this edition was acquired by Peter I of Russia, who had it copied, and it was published in 1714 under von Rosenfeldt’s name with a Russian title.

The chief pilot in Karlskrona, Nils Strömcróna, was aware of the weaknesses of the “chart-book” and in 1739 published an atlas of ten sheets (*General och åtskillige speciale pass-chartor öfwer hela Öster-sjön med Sinu Finnico och Bothnico samt Skager-rack, Cattigat och Belt*). Strömcróna’s sea atlas included some notable improvements, the most significant of which appeared in his detail charts of the gulfs of Finland and Bothnia and the Fårö Sound.

In July 1756 Amiralitetet received orders from the

government to make reliable charts, marked in degrees, with all possible speed, and with the demand that the geographic grid be authorized by a professor of mathematics. Mårten Strömer was chosen for this task, and in 1760 Johan Gustaf Zegolström from the naval cadet school, Amiralitetets kadettskola, was appointed his assistant. For the next twenty-one years Zegolström would represent the continuity of the work of nautical surveying in Sweden (fig. 528). By 1768 the trigonometrical survey of the coastline from the Stockholm archipelago southward and then to the Norwegian border, as well as of the Pomeranian coast, had been completed. A similar charting of the Gulf of Bothnia was not finished until the 1820s.

The physicist Johan Carl Wilcke calculated the magnetic declination and inclination (dip) in the Baltic Sea, and in 1768 published *Försök til en magnetisk inclinations charta*, a world map showing magnetic inclination (see fig. 420). In 1770, he investigated the harbor at Landskrona in Skåne (Scania) for the purpose of expanding its citadel. He prepared a large map with isobaths (see fig. 362) and a 265-page report in which he propounded the idea that Skåne and Danish Zealand had once been connected (Ehrensward 1991).

Amiralitetet was released from the responsibility for all hydrographical work in 1772 when Rear Admiral Johan Nordenankar was commissioned director of charts. The work was done under the supervision of Zegolström and, after 1783, of naval major Eric af Klint. In 1790 the archive of nautical charts was destroyed by fire; many irreplaceable documents were lost, but the copperplates for the charts were rescued. Between 1785 and 1790 twelve charts were reprinted under Nordenankar’s name.

Until then the prevailing idea had been that nautical charts existed chiefly for military use. Under Nordenankar’s leadership, the improvement of sea charts became a high priority and his tenure marks the transition in Sweden to charts founded on geodetics and the liberation of hydrography from its heavy dependence on maps derived from land surveys.

In Finland, a pilot service (Lots- och fyrväsendet i Finland) was organized with several officers attached to the army fleet with its base at Sveaborg (Suomenlinna). This office did a good deal of military hydrographic and cartographic surveying of the South Finland archipelago. In 1785, its cartographic task was assumed by Rekognoseringkontoret (the reconnaissance office) under the leadership of Carl Nathanael af Klercker. In 1805 it was dissolved, and a series of charts of the coast from the Russian border to Porkkala was handed over to Sweden (now in Krigsarkivet, Stockholm).

After 1797 the Crown decided for economic reasons

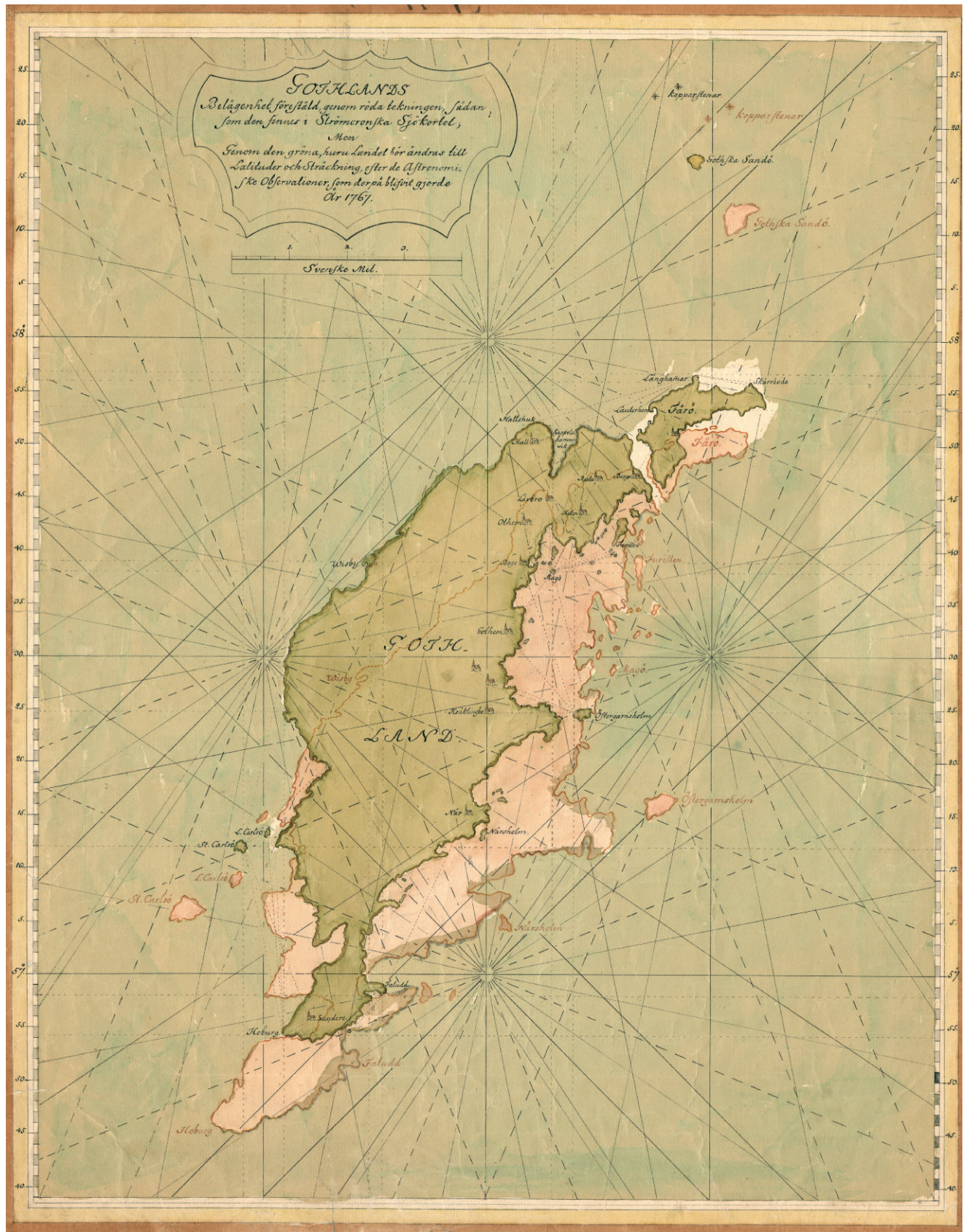


FIG. 528. JOHAN GUSTAF ZEGOLSTRÖM, "GOTLANDS BELÄGENHET FÖRESTÅLD, GENOM RÖDA TEKNINGEN . . .", 1767. The cartouche states: "The situation of Gotland drawn in red as it is shown on Strömcröna's sea-chart. But in green is shown how the land should be altered

with regard to its latitudes and extent, in accordance with the astronomical observations that were made there in the year 1767." Manuscript map, watercolor. Size of the original: 58.0 × 46.5 cm. Image courtesy of Krigsarkivet, Stockholm (SE/KrA/0515/B/17/005).

to discontinue the publication of nautical charts and cut down on all topographical and hydrographic activities. In this critical situation Eric af Klint's son Gustaf af Klint assumed responsibility for the map-issuing office. In 1798 he obtained the exclusive right to publish charts for a period of twenty years. This privilege was kept by the Klint family until 1848.

ULLA EHRENSVÄRD

SEE ALSO: Sweden-Finland

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**Marinoni, Johann Jakob.** Johann Jakob (Gian/Giovanni Giacomo) Marinoni was born in Udine, Italy, in 1676. After attending secondary school and studying mathematics in Udine, Marinoni moved to Vienna in 1696 and enrolled at the Faculty of Arts, University of Vienna. He worked as a mathematician at the city's imperial court and as a geometer in Lower Austria. In 1717, with Leander Anguissola, he founded the Militär-Ingenieurakademie in Vienna, where he taught and served as rector. Because of his emphasis on the theoretical basis of surveying as well as on practical techniques, Marinoni contributed substantially to the international standing of Austrian military cartography. Among other activities, he taught the future Empress Maria Theresa in mathematics. His most important cartographic works include the surveying and mapping of Vienna and its suburbs, the Duchy of Milan, and various imperial, aristocratic, and monastery properties. Marinoni was a member of the academies of London, St. Petersburg, Berlin, Bologna, Naples, Rovereto, and Olmütz (Olmouc). He died in Vienna in 1755 (Slezak 1976).

Marinoni's activities carried the science of surveying in the Habsburg Empire to new levels. Anguissola and Marinoni's map of Vienna, *Accuratissima Viennæ Austriae ichnographica delineatio* (1706), was commissioned by Emperor Joseph I to show the newly constructed Linienwall, Vienna's outer fortification line. This map provided the first-ever accurate geometric representation of Vienna's suburbs, which had begun to grow massively after the destruction wrought during the second Turkish siege (1683). In addition to showing all buildings, gardens, and terrain relief lines, the map also depicted fields by hatching, meadows by dotting, and vineyards with a particular vine symbol (Slezak 1976, 197–98; Dörflinger 2004, 102–3).

In 1718, Emperor Charles VI appointed a commission (the Giunta di Nuovo Censimento Milanese) to design a land-tax system for the Duchy of Milan, which had been added to the Empire in 1714. As one of the invited experts, Marinoni proposed a cadastral survey of the duchy that would rely on his own improved plane table rather than on the *squadro*, or surveyor's cross, favored by Italian land surveyors. Marinoni's plane table featured a board (larger than previously used) set on a circular spindle within a square frame: the spindle permitted the board to be rotated around its vertical axis for better orientation, the frame made it possible to shift the board in both horizontal directions to improve its centering. Field tests proved that Marinoni's plane table allowed surveyors to work almost twice as fast while producing more accurate results, especially in mountainous and difficult terrain (Lego [1968], 2,7,10). Marinoni eventually published an extensive monograph on surveying, *De re ichnographica* (1751), in which he described the construction and use of his plane table (see fig. 399).

Thanks to his excellent reputation, Marinoni was increasingly invited by influential persons to survey aristocratic estates, hunting grounds, and monastery holdings. The accurate survey data produced by the use of his plane table insured the high quality of these maps. In particular, his "Neuer Atlas des kayserl.<sup>en</sup> Wildban in Österreich unter der Ens" (1726–29) showing the imperial hunting grounds (fig. 529) is an important work of Austrian large-scale cartography and baroque design, evidenced by its ornate title cartouche and various depictions of hunting placed around the maps (Dörflinger 2004, 85; 1977, pl. 52).

PETRA SVATEK

- SEE ALSO: Instruments for Angle Measuring: Plane Table; Militär-Ingenieurakademie (Academy for Military Engineers; Austrian Monarchy); Military Cartography: Austrian Monarchy, with Topographical Surveying; Property Mapping: (1) Austrian Monarchy, (2) Italian States; Urban Mapping: Austrian Monarchy



FIG. 529. DETAIL FROM JOHANN JAKOB MARINONI'S "MAPPA UBER DIE ZUM KAYSERL.<sup>EN</sup> WILDBAN GEHÖRIGE IN EBERSDORFER FORST-MAISTER AMT . . . LIGENDE AUEN" (VIENNA, 1726). Manuscript map on one sheet; 1:21,600. This map is a part of the "Neuer Atlas des

kaysrerl.<sup>en</sup> Wildban in Österreich unter der Ens," the hunting atlas of Charles VI, which comprises thirty maps representing the imperial hunting preserves near Vienna. Image courtesy of the Bildarchiv, Österreichische Nationalbibliothek, Vienna (K I 98.480, Bd. 1, Tf. 2 Kar).

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**Marsigli, Luigi Ferdinando.** Luigi Ferdinando Marsigli (Marsili) was born and died in Bologna (20 July 1658–1 November 1730), one of the richest cities in Italy, where his maternal relatives were linked to the patrician families of Italy. His family thus enjoyed the wealth and connections necessary to provide for a good education, travel, and military service to the court of Vienna.

His diverse scientific knowledge grew from private education with renowned professors at the universities of Bologna, Rome, and Padua, and early membership in the private intellectual academies of Bologna: the Accademia del Davida, Accademia dell' Archiginnasio, and Accademia degli Inquieti. Alert to recent developments



in astronomy and natural history, Marsigli developed an appetite for mathematics and science in all forms. His year with the Venetian embassy in Constantinople (1679–80) introduced him to the Ottoman Empire and the natural phenomena of the Bosphorus, two fascinations that resulted in his passion for collecting (books, manuscripts, and maps) and cartography. His map of the currents of the Bosphorus illustrated his *Osservazioni intorno al Bosforo Tracio ovvero Canale di Costantinopoli* (1681), and maps and other illustrations enhance his *Stato militare dell'Imperio Ottomanno, incremento e decremento del medesimo* (1732), based on this visit.

In 1682 he crossed the Alps for Vienna, making notes, sketch maps, and drawings of defensive systems of castles along the way. Thanks to influential supporters close to the Austrian emperor, Leopold I, he was able to embark on a military career in the Austrian army during the Turkish War (1683–99), rising to the rank of general, a position in which he deployed his cartographic skills. In his first year of service at the Siege of Vienna (1683) he was captured by the Turks, sold as a slave, and finally ransomed in the spring of 1684, when he again reported for duty (Stoye 1994, 20–21). (In servitude he had prepared and served coffee to the Turkish troops, on the basis of which he wrote *Bevanda Asiatica* [1685].)

As inspector general of fortifications for the Habsburgs, his survey work reflected the growing dominance of the Austrian monarchy in the Balkans and the region of the lower Danube and its tributaries as the Ottoman Turks retreated. His special mission of 1689–91 to survey and report on the regions of Sylvania and Bosnia, as well as his later boundary surveys, provided him with the military, historical, and scientific material for his magnum opus, *Danubius Pannonico-Mysicus* (6 vols., 1726). While preparing this work he collaborated with Johann Christoph Müller from Nuremberg, whom he invited to Hungary in 1696 to aid with mapping. The scientific work of these two men became inseparably intertwined (fig. 530).

From 1699 to 1701, Marsigli oversaw the mapping of the 850-kilometer-long Austro-Turkish border following the terms of the Treaty of Karlowitz. He was required to map the area within a two-hour walk of either side of the border, as well as precisely record the border cartographically. Nearly four hundred manuscript maps and site plans, now divided between Bologna and Vienna, resulted from his efforts and include the well-known border map, “Mappa geographico-limitanea in qua imperiorum cæserei et ottomannici confinia in almæ pacis Carlovitzensis congressu decreta” (see fig. 101), and the set of thirty-nine large-scale sectional maps in forty-one sheets. His colleague Johann Christoph Müller used the many working drafts for later maps of the Danube and the Carpathian Basin.

During the War of the Spanish Succession, Marsigli, as second in command, was forced to surrender Breisach Castle on the Rhine to the French. Stripped of his rank and expelled from the Austrian army in 1704, he moved to Montpellier in France, where he studied marine life. His observations, published as *Histoire physique de la mer* (1725), included his *Carte du Golfe de Lion*, which used an isobath to show varying depths in the sea (see fig. 361). In 1708 Pope Clement XI recalled him to Italy to serve in the papal forces; by 1709 he was back in his native city of Bologna, where he concentrated on his vast private collections, the foundation for a library and museum. His valuable manuscripts—including several hundred maps and site plans he had collected, made, or commissioned—are preserved in 146 volumes at the Biblioteca Universitaria of Bologna. In 1712, he founded the Accademia della Scienze dell'Istituto di Bologna, modeled on the academies of London, Paris, and Montpellier, of which he was a member. Bologna's observatory was built thanks to his initiative.

Marsigli revised the cartography of the Carpathian Basin by using the most modern methods and technical instruments available. In correspondence with Jean-Dominique Cassini (I) and Georg Christoph Eimmart, Nuremberg astronomer, engraver, and instrumentmaker, he learned to use astronomical observations to determine location. Müller helped in this practical application by using a quadrant, a telescope, a precise clock, and astronomical charts acquired by Marsigli for observation. They both used a compass to record the bends in the rivers, a barometer to determine the height of mountains, and a type of quadrant for measuring the speed of the river currents. The observations of water currents (for the Dardanelles, Bosphorus, and Danube) recorded on maps and site plans offered new visualizations of complex sea passages.

He conscientiously and methodically used maps for different thematic purposes. In addition to those mentioned above, he created maps for hydrography (*Mappa potamographica*, 1726), archaeology (*Theatrum antiquitatum romanarum*, 1726), mining (*Mappa mineralographica fodinas in Hungariâ*, 1726 [see fig. 777]), botany (“Theatrum regionum, in quibus fungos, etc.,” 1701), commerce (“Mappa geographica, facta in usum commerciorum,” 1699), and communications (“Mappa geograph: facta in usum officialium,” 1700). Because of his steady creation of maps for specific purposes, Marsigli is rightly considered a pioneer in thematic cartography.

ANTAL ANDRÁS DEÁK

SEE ALSO: Academies of Science: Italian States; Boundary Surveying: Austrian Monarchy; Cassini Family: Cassini (I), Jean-Dominique; Heights and Depths, Mapping of: (1) Isobath, (2) Bathymetric Map; Karlowitz, Treaty of (1699); Müller, Johann Christoph; Thematic Map: Geological Map

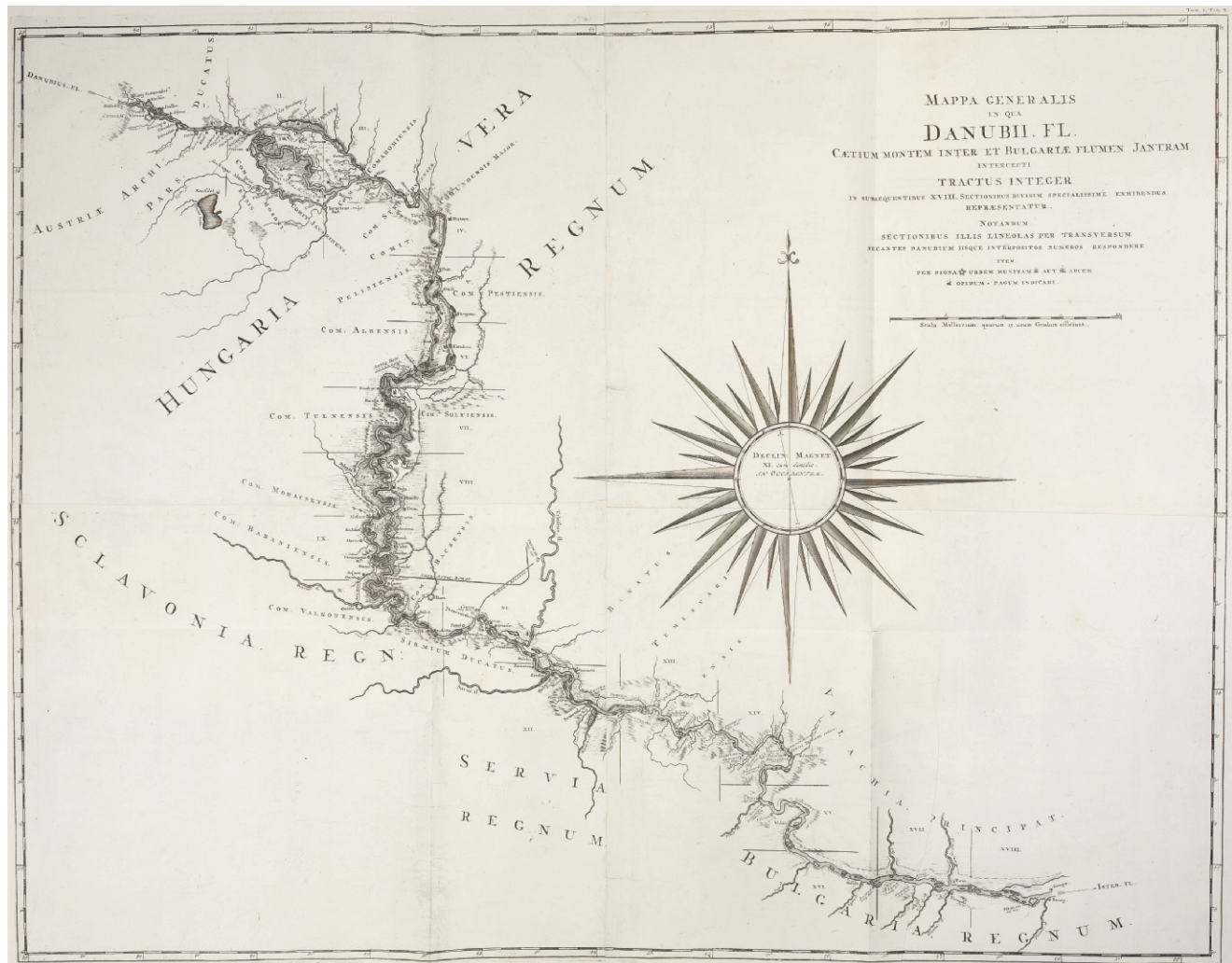


FIG. 530. JOHANN CHRISTOPH MÜLLER, *MAPPA GENERALIS IN QUA DANUBII FL., FROM DANUBIUS PANNONICO-MYSICUS* (1726). Under Marsigli's supervision, Müller mapped the Danube between Kahlenberg (Austria) and the Yantra River (Bulgaria). This general map marks the eighteen sections discussed in the book. Astronomical observations were used to rectify the traditionally poor representation of the Carpathian Basin. The compass rose indicates magnetic

declination as observed in Hungary. Copperplate engraving in Luigi Ferdinando Marsigli, *Danubius Pannonico-Mysicus, observationibus geographicis, astronomicis, hydrographicis, historicis, physicis perlustratus*, 6 vols. (The Hague: P. Gosse, R. Chr. Alberts, P. de Hondt, 1726), vol. 1, pl. 1 (foldout). Courtesy of Special Collections, Kenneth Spencer Research Library, University of Kansas Libraries, Lawrence.

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**Mason-Dixon Line.** The geodetic work of Charles Mason and Jeremiah Dixon, defining and establishing the borders between Pennsylvania, Maryland, and Delaware, marks the beginning of Britain's geodetic endeavors during the Enlightenment. In establishing the bound-

aries under the direction of colonial commissioners, Mason and Dixon were implementing the ruling of the Court of Chancery in 1750 that settled the long-running dispute between the Penns and the Baltimores over the position and definition of their mutual borders.

John Bird of London constructed the optical instruments. These included a six-foot zenith sector for measuring latitude, a thirty-inch transit and equal altitude instrument for alignments and azimuths, and an eighteen-inch Hadley quadrant. Isaac Jackson of Philadelphia constructed the astronomical regulator needed for precise timekeeping.

Mason and Dixon arrived in Philadelphia on 15 November 1763. Work began with the determination of the latitude of the official origin, the southernmost point of the city of Philadelphia at the north wall of a house on Cedar Street (now South Street) (Danson 2016, 85–86). The latitude of this point was replicated thirty miles west at John Harlan's farm (Stargazers Farm, Embreeville). The following year, Mason and Dixon ran the legally required fifteen-mile distance due south to a field in Mill Creek Hundred. Here they set up the "post mark'd West" marking the beginning of the West Line (Mason-Dixon Line) (Danson 2016, 107, fig. 19). They next established the Tangent Line running from the Delaware Middle Point marker on the transpeninsula line to where it grazed the twelve-mile radius circular border centered on New Castle. Mason's astronomical expertise combined with Dixon's land survey skills resulted in a perfectly straight line.

In 1765, Mason and Dixon ran the West Line as far as the Susquehanna River. This was achieved in a series of great circle chords, which, when adjusted with offsets, produced a line of constant latitude. The North Line of the Delaware boundary was then completed from the Tangent Point to the West Line before resuming the West Line until winter forced a halt. In 1766, the West Line was run as far as the Allegheny Divide; to go further west required consent of the Iroquois Six Nations under the strictures of the Royal Proclamation of 1763. General Sir William Johnson, British Agent for Indian Affairs, secured permission, and work resumed in June 1767, when representatives of the Six Nations of the Iroquois (Haudenosaunee), accompanied by Captain Hugh Crawford, joined the team.

On 9 October 1767, the survey party reached the Catawba warpath near Dunkard Creek, which the Iroquois representatives refused to cross (see fig. 112). This marked the end of Mason and Dixon's survey; they were just thirty miles short of the Ohio border. On returning to Philadelphia, they produced a map of the lines, which was engraved by James Smither and Henry Dawkins, and two hundred copies were printed by Robert Kennedy. The Mason-Dixon Line is marked at one-mile in-



FIG. 531. A MAP OF THAT PART OF AMERICA WHERE A DEGREE OF LATITUDE WAS MEASURED FOR THE ROYAL SOCIETY BY CHA: MASON & JERE: DIXON, 1768. In addition to determining the long east-west boundary between Pennsylvania and Maryland, Mason and Dixon also determined the short north-south boundary through the Delmarva Peninsula. They first laid out a series of lines, from N to A on the map, and defined their limits by astronomical observations. They then resurveyed the lines, measuring their length directly using sturdy wooden frames (20 ft. long by 4 ft. high), lifted into horizontal positions, that were regularly checked against a brass yard standard; the unwieldy instrument allowed the surveyors to measure across felled trees and other uneven ground. Finally, they reduced the measured lengths to the true meridian through A. From Charles Mason and Jeremiah Dixon, "Observations for Determining the Length of a Degree of Latitude in the Provinces of Maryland and Pennsylvania, in North America," *Philosophical Transactions* 58 (1768): 274–328, pl. 14 (facing 325).

Size of the original: 17.3 × 10.2 cm. Image courtesy of the Department of Special Collections, Memorial Library, University of Wisconsin–Madison.

tervals by stone blocks quarried in Portland, England, and carved with the Penn and Baltimore arms.

Mason and Dixon were Britain's first geodetic surveyors, and their boundaries in America were the first established and dependent upon precise geodetic principles. The distance from Harlan's Farm to the Middle Point marker, undertaken for the Royal Society, became the first meridian arc measured by British observers (fig. 531). The technical and mathematical principles established by Mason and Dixon laid the foundation for American and British geodetic surveying throughout the Enlightenment.

EDWIN DANSON

SEE ALSO: Boundary Surveying: British America; Geodetic Surveying: Great Britain

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**Masse Family.** Claude Masse (1651–1737) was born in Combloux in the Savoy region. His father, a shopkeeper, gave him a good education, and he entered the service of one of Jean-Baptiste Colbert's engineers, François de Ferry, as a draftsman. Masse followed Ferry to La Rochelle in 1679, where the latter had been named director general of the town's fortifications. Alongside Ferry, Masse carried out works and projects of recognized quality. The fear of an English invasion pushed Colbert to undertake the mapping of the Atlantic coast from south of the Loire to the Arcachon basin. In 1688, Masse, at age thirty-six, received the commission for this enormous project, which would occupy him until he was seventy-three. He married Marie Papin in 1698, and two of their five children became engineers: François Félix (1706–1757) and Claude Félix (1712–1786).

Claude Masse was a model of uprightness. Never overly concerned about his career, he did not obtain his *brevet d'ingénieur ordinaire* until 1702. This cartographer did not write about cartography, but passed on its rules by example. His "Mémoire ou traite de fortification en abrégé," a manuscript for the instruction of the young, was begun in 1687 during his free time and expanded for his sons until 1726. The work displays a pedagogy in which images play a key role. Masse innovated and anticipated the idea of regular cartographic cover-

age of France (foreshadowing the *Carte de France*) by dividing territory into identical "squares," oriented north, on sheets that could be assembled into a larger map. On each side of the square were two spaces for the scale (1:3,600 or 1:7,200), the title, and, if necessary, for detailed inset plans. These "squares," surveyed at 1:14,400 and then enlarged to accommodate the reduction of scale to 1:28,800, provided a veritable portrait of the landscape, showing the outlines of buildings, enclosures, all linear boundaries, and shaded relief (see figs. 814 and 820). His general maps at 1:97,800 functioned both as index maps and as a synthesis of the smaller-scale maps by maintaining the proportion of objects with cartographic generalization (see fig. 815). The memoir accompanying each map is a model of geographical analysis (physical, human, ethnographical, historical).

Masse finished work on the coastal project in 1724. He was immediately sent to Lille to survey France's northern border. François Félix worked by his father's side, as he had from age fifteen, and obtained his *brevet d'ingénieur ordinaire* in 1726. Claude Félix, from the age of twelve, did the same and obtained his *brevet* in 1731. They surveyed and mapped Flanders and Hainaut under the guidance of their father, who died in 1737 at the age of eighty-six.

François Félix then entered into active duty in the Corps du Génie (lieutenant in 1739), but from 1746 to 1749 he resumed the survey of the Dutch border as *ingénieur en chef*. Given the rank of captain in 1747, he completely abandoned cartography; he drowned during the campaign in Germany in 1757.

His brother Claude Félix surveyed the Luxemburg border until 1744, then entered into active duty in the Corps du Génie. Distinguished in combat, he attained the rank of captain in 1747, when he was severely wounded, which earned him the honor of Knight of the Order of Saint Louis in 1748. From 1749–50, he taught topography at the École du Génie de Mézières. In 1753 he returned to the region where he was born as *ingénieur en chef* of Oléron. Pensioned in 1777, he retired in La Rochelle, where he died in 1786.

The precision of the maps of the Masse sons is not equal to those of their father; they suffer from a lack of rigor in their method. Witnesses to a changing society, the sons abandoned the austere and unrewarding job of engineer in favor of the army, where social advancement was guaranteed.

CATHERINE BOUSQUET-BRESSOLIER

SEE ALSO: Military Cartography: France

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phie des côtes du Ponant (1688 à 1724).” *Cahiers Nantais*, no. 59: 57–73.

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Faille, René, and Nelly Lacrocq. 1979. *Les ingénieurs géographes: Claude, François et Claude-Félix Masse*. La Rochelle: Rupella.

**Mayer, Tobias.** Tobias Mayer’s career exemplifies the social mobility that could be achieved by those who devoted themselves to the nexus of astronomy, mathematics, and mapmaking that was mathematical cosmography. Born on 17 February 1723 in Marbach am Neckar, the son of a wheelwright, Mayer was professor of mathematics in Göttingen when he died on 23 February 1762 (Roth 1985). Mayer grew up in Esslingen am Neckar; orphaned before he was fourteen, he received little formal education. The town council’s charity did finally send the brilliant teenager to the Latin school, but he was completely self-taught in art, architecture, and mathematics. Indeed, he supported himself by teaching geometry and surveying, especially as applied to gunnery. His passion for the artillery and fortifications led him in 1739 to draw the first plan of Esslingen, independently published by Gabriel Bodenehr in Augsburg in 1741 (Forbes 1980, 26, pl. 4). In 1741, still only eighteen, he published his first book on geometry, which he specifically intended to be an introductory text geared to the needs of other autodidacts.

Mayer prepared a number of graphics to illustrate mathematical concepts, which he published as his *Mathematischer Atlas* (1745). Its sixty plates—again intended to help the autodidact—explained concepts in both pure and applied mathematics, including geometry, trigonometry, astronomy, geography, fortifications, and gunnery. Within the section on geography, Mayer provided an introduction to map projections and map drawing, explaining the process of constructing the graticule of meridians and parallels within which places could be sited according to their coordinates. His further instructions referred to the different steps in map construction and to the symbolization of data (Roth 2000, 25).

In 1746, almost certainly as a result of his *Mathematischer Atlas*, Mayer was hired by Homann Heirs in Nuremberg to improve the mathematical exactness of the publishing house’s maps. During his five years with the Homann Heirs, Mayer drew some thirty regional maps (listed and described by Hüttermann in Mayer 2009). For each, he collected, reexamined, and recalculated the latitudes and longitudes of the key locations on which geographical features were based. In particular, he constructed a new geographical frame



FIG. 532. DETAIL FROM TOBIAS MAYER’S *GERMANIAE ATQVE IN EA LOCORVM PRINCIPALIORVM MAPPA CRITICA* (NUREMBERG: HOMANN HEIRS, 1750). Mayer contrasted the locations of key places (e.g., Cassel, Nuremberg, Frankfurt) and boundaries according to existing maps of Germany by the Homann Heirs (red) and Guillaume Delisle (yellow) with recently determined latitudes and longitudes (green).

Size of the entire original: 44 × 52 cm; size of detail: ca. 10 × 13 cm. Image courtesy of the Universität Bern, Zentralbibliothek, Sammlung Ryhiner (Ryh 4302 60).

for the Homann Heirs’ maps of Germany and its parts that compared the positions of places and boundaries with his own corrected data (fig. 532). The map thus indicated the problems faced in geographical editing, clearly demonstrating the inexactness of contemporary maps and that the major problem lay with the determination of longitude rather than latitude.

Mayer believed that the solution to determining longitude lay in the observation of the moon. To this end, he began a long series of lunar observations. In addition to several treatises, Mayer prepared a map of the moon during the August 1748 lunar eclipse, complete with regularized nomenclature and coordinate system, copies of which were bound in Johann Gabriel Doppelmayr’s posthumous edition of *Atlas coelestis* in 1752 (Forbes 1980, 43), and also a large manuscript lunar map from many detailed observations undertaken in 1748–50. This last was eventually published in Georg Christoph Lichtenberg’s edition of Mayer’s *Opera inedita* (1775; see fig. 158).

It was this astronomical work and his mathematical talents that led to Mayer’s 1751 appointment as professor and director of the new observatory at Göttingen (founded 1748). He recorded the itinerary of his route to Göttingen, which would be the first of a proposed series of road maps published by the Homann Heirs, but only one other ever appeared in print (Hüttermann

2002). In Göttingen, Mayer concentrated on the longitude problem. In particular, he developed highly accurate tables of the moon's motion that could serve as the basis of the method of calculating longitude from lunar distances. This work was acknowledged when, in 1765, he was posthumously awarded part of the prize of the British Board of Longitude.

Other projects, notably his lunar globe, were less successful. He first worked on this globe in Nuremberg, in parallel with his moon maps, thinking it to be more exact and useful as a replica of the moon. This work was interrupted by his move to Göttingen, but he was able to return to it around 1760. Yet by the time of his death he had completed only eight of the twelve gores and only six had been engraved.

ARMIN HÜTTERMANN

SEE ALSO: Celestial Mapping: Enlightenment; Geographical Mapping: (1) Enlightenment, (2) German States; Globe: Lunar Globe; Homann Family; Longitude and Latitude

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## Measures, Linear.

LINEAR MEASURES IN THE ENLIGHTENMENT  
ITINERARY AND GEOGRAPHICAL MEASURES  
MARINE MEASURES  
SURVEYING MEASURES  
REFORM OF LINEAR MEASURES

**Linear Measures in the Enlightenment.** Linear measures developed within discrete arenas of human endeavor. Those based on the human body, notably cubits, feet or pieds, inches or pouces, and smaller measures such as the ligne, all related to building and making things. Yards, ells, and aunes were measures for cloth manufacture based on the width of the loom and the body; perches, furlongs, and arpents for arable agriculture; paces, miles, and leagues for travel (Kula 1986). Each measure varied from district to district, although within each district some were fixed by physical standards, such as the wooden yardsticks and toises used respectively in

England and France; for these measures, the same word referred both to the standard and to the abstract unit. Furthermore, starting in the thirteenth century, monarchs created and distributed standards made from brass or iron, which were divided and multiplied to define and regularize other linear measures. The use of these particular formulations was enshrined in decrees and statutes. Within a functional group of measures, these statute divisions and multiples tended to be regular, as when the toise was defined as six pieds (feet), the pied as twelve pouces (inches), and the pouce as twelve lignes (lines). By comparison, relating measures from different functional groups produced the haphazard relationships that are characteristic of premetric units (e.g., 5½ yards to a rod, 40 rods to a furlong, 8 furlongs to a mile).

However, medieval and early modern polities proved ineffective in imposing the use of their standards, and local usages proliferated. Eighteenth-century commentators generally grouped these variants into three categories: large or great, common, and small or short. The following entries examine the variety of measures used in the three main areas of cartographic work—land surveying, itinerary and geographical work, and marine charting—together with their reform. The extensive work by economic historians and geodesists in establishing modern equivalents for the many early units of measure is manifested in a variety of online resources, especially the official site of the Bureau international des poids et mesures (BIPM), to which reference should be made for precise details of all the different variants within each national context.

Customary measures were so ingrained in daily life that it required substantial political and economic upheaval to even begin to overturn them. Despite the multiple proposals made after 1650 for rational systems of weights and measures, it was not until the French Revolution that the metric system was conceived and imposed as a means to reform France's entire economy (Zupko 1990). Even so, there was sufficient resistance that the new system would be largely suspended in 1812 (Alder 1995; Heilbron 1990). The metric system was not widely adopted across Europe until the 1840s, when increasing industrialization and state-run education fundamentally reconfigured European societies. Consideration of the full implications for cartography of metric measures, and of the reactionary imperial system adopted by Great Britain, therefore awaits volume 5 of *The History of Cartography*.

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SEE ALSO: Modes of Cartographic Practice

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**Itinerary and Geographical Measures.** Itinerary measures—the units used to express road distances—were variously called miles or leagues in early modern Europe. The wide variety of particular measures stemmed from the manner in which inherited Roman measures were complicated by both local customary practices and attempts at standardization. Roman measures had been based on the pace (*passus*), the length covered by a soldier in two marching steps (5 Roman feet or 1.48 m). The longer Roman itinerary units were the stade (*stadium*) of 125 paces (185 m), which would be equated to the furlong; the mile (*mille passus*) of 8 stades or 1,000 paces (5,000 feet or 1,480 m), used to define mile markers on Roman roads; the league (*leuga*) of 1,500 paces (2,220 m), or the distance walked in an hour; and, sometimes, the *schoenus* of 4,000 paces (5,920 m) (Zupko 1977, 6–7).

In northern Europe, the usual itinerary measure was the mile, which was subject to substantial variation. In England, a 1593 act defined the statute mile as 8 furlongs or 1,760 yards (1,609 m), distinct from the older, customary mile of 1,500 paces (about 1.3 statute miles); a shorter mile could also be used of 1,000 paces (1,524 m). Elsewhere in the British Isles, the length of the mile varied according to the local yard or furlong: 1,814 meters in Scotland; 2,048 meters in Ireland. Some English itineraries used the league of 3 miles (5,280 statute yards; 4,827 m), although again there was variation based on which miles were used (from 2,290 to 4,570 m) (Zupko 1985, 248–51).

On the continent, the *Meile* was much longer than the several British miles and inevitably varied across the German states. Among the shorter German *Landmeile* was the Danish mile of 24,000 Prussian feet (7,532 m), which would be adopted as the Prussian standard in 1816; at the longer end was the *Sachsen Meile* of 32,000 feet (9,062 m). Through the eighteenth century, Germans also used the *Wegstunde*, or one hour's travel, taken to be about half a *Meile* (or about 3,700 m). In the Netherlands, the *mijl* was again idealized as one hour's walk and again varied between the provinces but approximated 5,000 meters.

In France and southern Europe, a variety of paces, miles, and leagues were used for itineraries. In France, the crown identified three distinct paces: the *pas mili-*

*taire* of 2 *pieds* (0.65 m); the *pas commun* of 2½ *pieds* (0.812 m); and the *pas géométrique* of 5 *pieds* (1.624 m). The *mille* (or *mile*) generally used during the Enlightenment was the Parisian standard of 5,000 *pieds* (1,624 m). However, the commonly used itinerary measure of the *lieue* (league) varied widely from 2,216 to 4,411 meters, with an odd assortment of submultiples (Zupko 1978, 95–96). There were no common standards in the Italian states until unification and metrification in the later nineteenth century, but several units were extensively used for road applications across the hundreds of communes and republics: the *braccio* commonly varied from 0.4 to 0.8 meters; the *passo* (pace), from 0.7 to 2.0 meters; the *trabucco*, from 2.6 to 3.25 meters. The *miglio* (mile) was generally the same as the Roman (i.e., 1,000 paces or 5,000 feet [1,481 m]), but it varied regionally, with numerous internal submultiples, up to 2,519 meters; and the *lega* (league) varied as well from 3,900 to 5,600 meters (Zupko 1981). The multiplicity of units continued in the Iberian peninsula, where the Portuguese *milha* (mile) was 1.28 English miles (2,060 m), the *legoa* (league) was generally 3.84 miles (6,170 m), and the Spanish *legua* was either 3.46 miles (5,570 m) or 4.21 miles (6,780 m).

Such variability in measures required geographers to provide conversion factors, which they generally copied from one another. They reduced other units to those of their own tradition, or referred them all to the universal standard provided by the size of the earth, or both. Nicolas de Fer (1706, 52–54), for example, listed a variety of itinerary measures in terms of the Parisian *pas géométrique*, which he also related, based on the recent calculations by members of the *Académie des sciences*, to the length of one degree of a great circle. Geographers also made such comparisons explicit on their maps (fig. 533), and Jean-Baptiste Bourguignon d'Anville made a particular study of itinerary measures throughout the world as known to him (d'Anville 1769). There was, however, still some variation in these attempts to standardize measures. In particular, while many geographers in Britain adopted the figure of 62.5 statute English miles to a degree, some continued to use the older Renaissance formula of 60 (common) English miles. As long as the geodesists debated the size and shape of the earth, reductions to the universal standard remained conventional.

RONALD EDWARD ZUPKO

SEE ALSO: Geographical Mapping; Transportation and Cartography: (1) Road Map, (2) Route Map; Traverse: Itinerary Traverse

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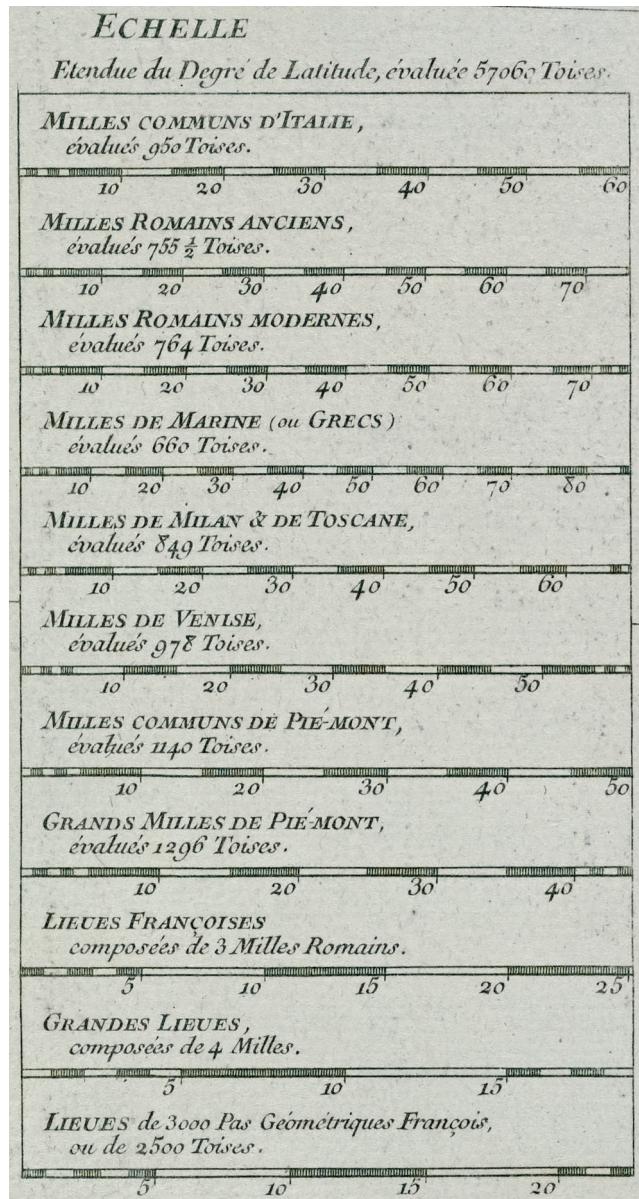


FIG. 533. MULTIPLE SCALE BARS. Jean-Baptiste Bourguignon d'Anville indicated the multiple measures that had informed his four-sheet *L'Italie* (Paris, 1749) with a series of scales in an unusual arrangement. Rather than the usual format of a series of scales of different lengths, each indicating a whole number of the respective measure, d'Anville made all the scales the same length, that of a degree of the great circle, defined at the top in toises, each of 1.2 pas géométrique. D'Anville further expressed each local measure as so many toises. Image courtesy of the Osher Map Library and Smith Center for Cartographic Education at the University of Southern Maine, Portland (SM-1753-5).

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**Marine Measures.** Marine measures were related to navigation as a science of positions and routes primarily concern angles, distance, speed, and depth. In the eighteenth century, angles were observed in circular measures of degrees ( $360^\circ$ ), minutes ( $1^\circ = 60'$ ), and seconds ( $1' = 60''$ ), even though usually the division on charts remained essentially that of thirty-two rhumbs, each of  $11^\circ 15'$ . For a long time, the most widespread unit of distance was the marine league, which equaled one-twentieth of a degree (sometimes called the marine league of France and England). Since antiquity the league, whether maritime or terrestrial (in France alone, at least three variations of it were used for land measurements), had approximated the distance that a ship or a man could traverse in one hour. A posteriori, the marine league of one-twentieth of a degree would equal three nautical miles or 5,556 meters.

The measurements of both angles and distances were affected by the rival theories related to the figure of the earth. Christiaan Huygens and Isaac Newton considered the earth a flattened spheroid. Measurements by the Cassini family along a meridian in France between 1684 and 1718 suggested that the earth was an elongated spheroid. The activities and expeditions sponsored by the Académie des sciences during the eighteenth century confirmed the hypothesis of the flattened spheroid by showing that the length of a degree of latitude increased toward the poles (Chapuis 1999, 90–91). As yet, the overwhelming majority of seamen were unaware of the question of the figure of the earth during a period when the contentious issue of the division of the log line spawned innumerable fantasies (Chapuis 1999, 48–49). However, elite navigators had an essential piece of information at their disposal, the increase of the value of a degree from the equator to the poles. France, at the forefront of geodesy in the mid-eighteenth century and located midway between the equator and the pole, was well-placed to make its mean latitude of  $45^\circ$  the standard reference for the value of a degree of latitude (Chapuis 1999, 91–92). Nevertheless, the expression mille marin (nautical mile), equal to a minute of latitude, rarely appeared on contemporary charts or in works



of navigation, which continued to employ the marine league of one-twentieth of a degree (nautical mile: See-meile [German], nautische mijl [Dutch], sømil [Danish], milla marina [Spanish], miglio nautico [Italian], milha marítima [Portuguese]).

In France, after the adoption of the metric system during the Revolution, the term mille marin became widespread. It assumed its definitive significance thanks to Charles-Pierre Claret de Fleurieu, who clearly articulated its definition in his 1799–1800 treatise applying the metric system to hydrography. The nautical mile corresponded to one minute of arc of a great circle on a sphere coaxial with the earth, or to one minute of latitude: 1,852 meters at 45° latitude. Since it was now accepted that the planet is flattened at the poles, it was henceforth acknowledged that a minute of latitude had a value between 1,842.78 meters at the equator and 1,861.55 meters at 85°. However, it was the median value of 1,852 meters (6,076.12 feet) at 45° latitude that became the official unit of distance at sea in France, and it would be established as the international nautical mile at the International Hydrographic Conference of 1929 (Chapuis 1999, 726). The definition of the nautical mile considered it a constant anywhere on the surface of the earth. Yet, of course the representation of a minute of latitude varied on charts and maps on the Mercator projection as a function of latitude.

Great Britain lies at a mean latitude slightly further north than that of France and therefore adopted a nautical mile that equaled 1,853 meters (6,080 feet)—though it was expressed in meters only much later. Great Britain would not definitively abandon imperial units until 1968, when charts were converted to the metric system (Chapuis 1999, 726).

For estimating short distances by sight, sailors were hesitant to adopt the metric unit that was ill-adapted to navigation, even in France (Chapuis 1999, 741–42). For a long time, they preferred to use the cable to estimate such short distances (a cable equaled, in round terms, 100 toises or 195 m; in England, 1 cable was 100 fathoms).

The measurement associated with speed was the knot, which was estimated with the log deployed from the stern of a ship and was equivalent to one nautical mile traversed in an hour. At the end of the eighteenth century, Fleurieu provided a very clear definition of it (Fleurieu 1797–1800, 4:107–8).

Depth was measured in terms of the brasse marine (fathom) originally defined as the span of two outstretched arms, equal to five royal feet in France or to a modern 1.624 meters (Fleurieu 1797–1800, 4:111). In the French language of the eighteenth century, the depth of water was commonly designated by the term

brassage. The English fathom equaled 5 pieds and 7 pouces in France or 6 English feet, that is 1.8288 meters (Chapuis 1999, 713).

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SEE ALSO: Marine Charting; Navigation and Cartography; Sounding of Depths and Marine Triangulation; Traverse: Marine Traverse

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**Surveying Measures.** The basic measure for property throughout Western Europe was derived, in size and name, from the wooden rods used to measure land. In the Romance languages, its name was derived from the Latin *pertica*, for a pole or long staff; comprised of ten Roman feet (2.96 m) the *pertica* was also known as a *decempeda*. Thus in French, the measure was known as the *perche*, in English as the *perch*, and in Italian as the *pertica* or *pertiche*. Among the Germanic languages it was variously known as a *rod* (English), *roede* (Dutch), *Ruthe* (German), or *rode* (in Scandinavia). Other local names can be found: in England the perch could also be called a *gad*, *goad*, *lug*, or *pole*; in Italy, the *pertica* was used interchangeably with the *canna*, *cavezzo*, *ghebbo*, *passo*, and *trabucco*, all of which had different submultiples.

In the British Isles the statute rod contained 16½ feet or 5½ yards (5.029 m), but a wide variety of customary and locally regulated measures were used, ranging from 9 to 28 feet (2.743 to 8.534 m). The smaller rods were generally used for agricultural land measures; those larger than 16½ feet were used by woodsmen and town craftsmen for clearing, deforesting, draining, fencing, hedging, and walling operations. The Irish standard rod was 7 yards or 21 feet (6.401 m); there was local variation as well. The Scottish fall contained 6 ells or 6.2 English yards (5.669 m); originally it was that amount of land that fell under a fallen rod, hence a linear fall.

In France, seventeenth-century reforms had established three standard perches—the *perche de Paris* of 3 toises or 18 pieds (5.847 m); the *perche de l'arpent commun* of 20 pieds (6.497 m); and the *perche de l'arpent d'ordonnance*, or *perche royale*, of 3⅔ toises or 22 pieds (7.146 m)—but even so there persisted hundreds of lo-

cal variants ranging from 2.569 to 8.121 meters with a motley assortment of submultiples. In northern Europe, the *ruthe/rode/roede* again varied widely from 2.86 meters to as much as 10.0 meters. The Spanish *vara*, or short rod, was standardized in 1801 as 0.836 meters but only after a variety of local *varas* had been adopted throughout Spanish America. Italians used hundreds of different lengths for the *pertica*, ranging from 1.565 to 6.165 meters. They also used the *canna* for textiles, agricultural land divisions, surveying, architectural determinations, construction, and forestry, with hundreds of variations ranging from 0.624 to 7.851 meters; the *cavezzo* used in northern and north-central Italy usually consisted of 6 *piedi* (feet) and varied from 2.057 to 3.863 meters; the Venetian *ghebbo* was a small *pertica* of 4½ *piedi* (1.565 m); the *passo* was used throughout Italy and varied from 0.670 to 2.021 meters; and the *trabucco* of Sardinia and northern Italy was usually 6 *piedi*, varying from 2.611 to 3.243 meters.

Longer measures were also used, reflecting traditional agricultural practices. The British furlong was generically the length of a plowed strip of land within an open field. When regularized, the English furlong comprised 40 statute rods, or one-eighth of a mile (201.170 m); the Scottish furlong was 40 falls, or 240 ells, and equaled 744 English feet (226.771 m), while the Irish furlong was 840 feet (256.032 m), or 280 yards, or 40 *perches* of 21 feet each, equal to one-eighth of an Irish mile of 6,720 feet. Similarly, in France, the *arpent* was a measure of both length and area; the linear *arpent* comprised ten *perches* and so varied by district.

Finally, in Britain, the widespread adoption of Edmund Gunter's measuring chain promoted the use of a new measure, the chain of 100 links, totaling four rods, which in turn promoted the acceptance of statute measures. The principle of the measuring chain was that ten square chains equaled one acre, making calculations for area very straightforward if the surveyor knew decimal arithmetic. In England, the chain was therefore four statute rods or 66 feet (20.12 m) in length, but the measure varied in other parts of Britain in accordance with different statute measures; in Scotland, the chain was 22.677 meters, in Ireland 25.6 meters.

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SEE ALSO: Heights and Distances, Geometric Determination of; Instruments for Distance Measuring; Property Mapping; Topographical Surveying

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**Reform of Linear Measures.** The regulation of weights and measures—which entails both the provision of physical standards and the enforcement of their use—was less central to the formation of the early modern European state than might be supposed. While such regulation appears to have been a key mechanism for sustaining the centralization of authority starting as early as the thirteenth century, states were in practice unable to combat the proliferation of local customary units (Zupko 1990, 1–24, summarizes the social and economic forces at play). By the mid-seventeenth century, literally hundreds of thousands of different units were in use in Western Europe alone. Coupled with ineffective metrological policing and defective physical standards, this sheer diversity meant that all segments of society suffered. Merchants, scientists, and manufacturers close to the central authorities, as well as the bureaucracies themselves, were especially confounded, and diversity became a problem that they had to resolve (Ashworth 2004). The result was the Enlightenment's massive restructuring of weights and measures. Most attempts at reform occurred in the competing and increasingly centralized states of Great Britain and France but through different processes.

Metrological reform in Great Britain was a process of refinement. The Stuart monarchs concentrated the production of physical standards in the Exchequer, where significant reforms were introduced. In particular, the standard yard made in 1671 for the London Clockmakers' Company introduced a crucial innovation that thereafter became standard: to protect against the wear of the standard's ends, the brass rod was made longer than the measure, which was now defined by the separation of two fine pins (Zupko 1990, 44–45). The acceptance of statute measures was, however, carried on within the public sphere as scientists and manufacturers promoted new techniques and new instruments that were made in London by reference to the new physical standards. Thus, the increasing use after 1650 of perambulators, matched by the increase in turnpikes and road improvements, led to familiarity with the statute mile; the ubiquity of the Gunter's chain in land surveying led to the acceptance of the statute rod. It was the semiofficial Royal Society that in 1742 commissioned two new standard yards in an effort to reconcile British and French measures; both were also inscribed with a

half-toise of 3 pieds du roi, and one was retained by the Académie des sciences. Eventually, a scathing report by a 1758 parliamentary committee led not to wholesale reform but to the creation of a new standard yard. Based on the Royal Society's 1742 standard, the new standard was also defined in terms of the length of a seconds pendulum beating in a vacuum at the latitude of London; this independent measure permitted the standard to be re-created should it ever be lost (as it would be in the Great Fire that ravaged Westminster Palace in 1834). In all of this reform, the goal was to refine, perpetuate, and promote the use of long-established statute measures (Zupko 1990, 70–73).

Metrological reform in France had a similar concern with refining standards but with more radical solutions proposed. French reformers turned to nature to define measures that were free of the personal authority of the monarchs and ministers who had decreed them and that did not promote the interest of a particular province or state (Crosland 1972). The immediate stimulus for reform was the revelation that, in addition to the existence of hundreds of local variations of the toise, the standard Parisian toise was itself of uncertain length. Set into the steps of the Grand Châtelet (and so generally called the toise du Châtelet), the rudimentary medieval iron standard was damaged in 1667 when a pillar shifted; although the restored standard was found to be five lignes shorter than its original length—which had been preserved in a copy standard, the toise de l'Écritoire (1.959 m)—Jean-Baptiste Colbert in 1668 decreed that the toise de Châtelet indeed remained the official standard (1.949 m) (Zupko 1990, 114–15). Gabriel Mouton (before 1670) and Jean Picard (in 1671) accordingly advocated the independent determination of the length of the toise du Châtelet by comparing it against both the newly developed seconds pendulum and also against the size of the earth (to this end Picard would undertake his own survey of part of the Paris meridian). They also proposed the use of these determinations as the basis of entirely new decimal systems of measures. Mouton's depended on the length of a minute of arc of a great circle, based on the work of Giovanni Battista Riccioli (1 milliaria = 1,855.3 m), Picard's on the length (rayon astronomique, or astronomical radius) of an as yet undefined pendulum. Other geodesists subsequently proposed similar standards to be universal and invariable. In 1720 Jacques Cassini (II) advanced a pied géométrique equal to  $\frac{1}{6000}$  of a minute of arc of a great circle, and in 1747 Charles-Marie de La Condamine proposed the length of a seconds pendulum at the equator (Zupko 1990, 123–35). But none of these reforms was taken up. The increasingly decrepit toise du Châtelet was finally replaced as the official standard in 1766 by the toise de Pérou, a copy of the toise du

Châtelet that had been made in 1735 for the geodetic expedition to the equator.

The debate between reformed measures based on the seconds pendulum, which while practical was nonetheless dogged by the political issue of just where to situate the pendulum, and those based on the size of the earth, which while universal was less practical, was eventually won by the promulgation after the French Revolution of the metric system. Whereas Charles-Marie de Talleyrand-Périgord began in 1790 to promote new measures based on the length of a seconds pendulum at 45° latitude, a measure also advocated by Thomas Jefferson in the United States, Sir John Riggs Miller argued for a seconds pendulum at the latitude of London. The *philosophes* generally rejected such a unit because it required the further, and arbitrary, definition of a second of time (Zupko 1990, 71–105). In the decree of 1 August 1793 that established a preliminary metric system, the mètre would be one ten-millionth of a quadrant of a meridian; based on already completed geodetic work, it was provisionally defined as 3 pieds, 11.442 lignes of the toise de Pérou, on which standard the new unit was necessarily based. The subsequent law of 7 April 1795 set up the framework for new geodetic surveys to establish the definitive mètre, finally determined to be 3 pieds, 11.296 lignes. Three new standard mètres were constructed from platinum, secondary standards of iron were distributed to each *département*, and all older measures were officially abolished on 10 December 1799 (Zupko 1990, 135–69). Yet, despite the effort and cost, such revolutionary reform could not readily supplant customary measures, which persisted in widespread use until 1840.

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SEE ALSO: Commission topographique of 1802; Meter, Survey for the; Science and Cartography

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**Medals, Maps on.** In the years between 1650 and 1800, medals enjoyed great prestige and importance as a medium of information in educated European society. Gold, silver, and bronze examples were highly prized, extensively studied, and collected. Coins and medals in

white metal and other cheap metals circulated widely in all strata of society. Opinion makers were thought to be influenced by them. A medal's durability and the combination of succinct text and striking design made them a major commemorative and propaganda medium side-by-side with printed pamphlets. French medals were almost exclusively officially commissioned, and private individuals continued occasionally to commission their own medals, particularly in Italy. Elsewhere, medals were the work of commercial producers, who advertised their wares through published catalogs and who sometimes held positions as medalists to minor German rulers. They moved in the same world as continental map publishers and like them attended the Frankfurt and Leipzig fairs. A leading German commercial medalist, Christian Wermuth, was a close friend of the German-born Dutch map publisher Petrus II Schenk.

Although globes had appeared on Roman coins and maps and bird's-eye views on European coins and medals from the mid-sixteenth century, the growing familiarity of geographical shapes to all literate members of society made them valued elements in the coin and medal designers' repertory, particularly in the Dutch- and German-speaking world and Russia. The role of maps on coins and medals was primarily emotive and symbolic rather than informative. The maps were usually simple and derivative (their manuscript and printed sources can sometimes be identified) and the geographical reality was sometimes distorted to enhance the propaganda potential. Occasionally, however, medalists created miniature relief maps of superb quality, such as Johann Höhn the Younger's silver medal commemorating the recapture of Haupt on the Vistula by Prince Jerzy Lubomirski in 1659 (fig. 534) or Lewis Pingo's depiction of the Bay of Gibraltar on the medal commemorating the British victory in the French and Spanish siege in 1783.

Maps on medals served commemorative and propaganda purposes. Whether depicting individual towns, like Lille, Strasbourg, or Dunkirk, or regions like Flanders, Alsace, Hungary, Italy, Poland, Ukraine, or Crimea, they enabled the viewer to locate the site of battles and sieges, newly built town defenses, newly acquired territories, harbor works, or the locations of peace conferences. More dynamically, they dramatized and hinted at the significance of important events, be they the accession of George I to the British throne in 1714, with Georg Wilhelm Vestner's depiction of the Saxon horse jumping over a map of northern Europe from Germany to Britain, or the outbreak of European war following the death of Emperor Charles VI without a male heir in 1740, in a cheap and anonymous Dutch medal showing European rulers gathered around a table looking greedily at a map of the Austrian dominions (fig. 535).

Globes found a wide variety of uses on coins and med-



FIG. 534. SILVER COMMEMORATIVE MEDAL, 1659, BY JOHANN HÖHN THE YOUNGER. The well-executed struck medal, probably based on a draft by a military engineer, indicates orientation, physical relief, river currents, and siegeworks; everything except Lubomirski's camp is shown in plan. The medal was more durable as a memorial for eternity than a printed map, which would hardly have shown more. Diameter of the original: 7.3 cm. © The Trustees of the British Museum, London (M.1853).

als. They were regularly depicted as symbols of learning and equally as often as symbols of power. The appearance of a globe on Neapolitan silver coins of 1684 and, as dual hemispheres, on eight-real (pieces of eight) coins struck in Mexico City and Potosi, Bolivia, between 1732 and 1779 reminded the viewer of the global claims of the Spanish monarchy. Similarly, the symbol of Louis XIV of France from the early 1660s was the sun dominating the earth, which represented Louis's fellow rulers. By contrast a single country alone could be shown on the globe. Between 1720 and 1760 the exiled Stuarts demonstrated their continuing claim to and yearning for the British throne through medals depicting allegorical figures looking at or in close vicinity to a globe containing only a depiction of Great Britain.

Such was the popularity and influence of medals that a cartographic design could provoke a medallic propaganda war with successive medals using the same cartographic image to make opposing points. The war provoked by Louis XIV's symbol continued for nearly fifty years and found expression in a series of medals with globes (some of them up-to-date despite their size) ending only with a commercial German medal by Martin



FIG. 535. ANONYMOUS MEDAL SATIRIZING AUSTRIA'S OPPONENTS IN THE WAR OF THE AUSTRIAN SUCCESSION. Amsterdam?, undated (ca. 1741). Diameter of the original: 4.5 cm. Image courtesy of Peter Barber.

Brunner, issued at the moment when the Allies invaded France in 1710, showing the globe of the earth eclipsing the sun. It was only after 1815 that medals predominantly became collectors' items.

PETER BARBER

SEE ALSO: Decoration, Maps as; Globe: Cultural and Social Significance of Globes; Household Artifacts, Maps on

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**Memoirs, Cartographic.** A great variety of documents fall under the heading of cartographic memoirs. These written documents may be called memoir (*mémoire*), report (*rapport*, *compte-rendu*, *Bericht*), essay (*dissertation*, *dissertazione*, *essai*, *Aufsatz*, *Versuch*), analysis (*analyse*, *Erforschung*), explanation (*éclaircissements*, *Auf/Erklärung*), or account (*relation*, *Aufzeichnung*). Though each of these terms introduces nuances

in the form and content of the memoir, they share the common purpose of synthetic writings: they enlighten the reader by providing an organized description, supporting a proposal, or backing up a hypothesis.

All such written documents—manuscript or printed, a few pages or hundreds—clarify, complement, and organize the information on the graphic map. They may also contain critical analyses of sources. Memoirs require the same consideration for reading and interpretation as maps: their authors wrote with a specific goal and a preconceived audience. To understand and interpret the content of a memoir, it is therefore necessary to appreciate the social position and the status (lay, military, ecclesiastic) of the people involved: those who ordered it, those who wrote it, and those who received it. One must also consider the aim of the memoir: to provide complementary information (whether military or historical), to serve as a memory aid, to establish a basis for taxation, to provide a vade mecum for particular terrain, or simply to give an account of the work done.

Reading and interpreting a cartographic memoir must take all these elements into account. While it is easy to locate printed memoirs, gaining access to manuscript memoirs poses difficult problems. From a practical point of view, finding the memoir related to a manuscript map may be a nearly impossible task. Political and administrative vicissitudes, the breakup of states, and territorial partition have led to the disbanding of archives and a dramatic dispersal of their contents among different conservation sites. In such circumstances, a deep knowledge of the history of depositories in different countries is required, and sometimes it is impossible to compare side by side two documents intended initially to complement one another.

The first memoirs accompanied by drawn maps date back to the fifteenth century. These are juridical documents intended to settle private territorial disputes; the map was attached to the memoir to support its claim. However, between 1570 and 1580 in England, estate maps laid out strictly by surveyors supplanted traditional written descriptions (Kain 2007). The map increased in importance and memoirs were freed from their juridical objective. By the middle of the seventeenth century, the word "memoir" already possessed the meaning it has today in several languages.

Given this background, one may distinguish between authors of memoirs who worked *au cabinet* and those who worked in the field. The *cabinet* geographers constructed maps using data they assembled, compared, and compiled without going in the field. In France, such geographers were often members of the Académie des sciences, whose institutional publication supported the validity of the cartographic work of its members and whose memoirs were published in the *Recueil de*

*l'Académie*. The papers, memoirs, and correspondence from some workshops have survived, such as those of the Delisles, which provide a clear picture of the working methods of the *géographes de cabinet*. Claude Delisle and his son Guillaume meticulously read written travel accounts and studied astronomical observations, then translated their findings into sketches that acted as scratch pads on which they worked out distances, landscapes, and information about foreign peoples. The Delisles benefited from their network of correspondents, firmly anchored in the personal bonds they enjoyed with authorities in key posts and with scholars. This network provided foreign documents, including copies of manuscript or printed maps whose outlines were carefully studied and critiqued in their memoirs (Lagarde 1995; Dawson 2000; Pelletier 2002). The Delisles even accompanied their correspondence with memoirs to defend and promote the cartographic corrections they desired (Dawson 2000, 141).

To a lesser degree, Great Britain witnessed the use of the memoir in the work of Scotsman John Cowley, whose *An Explanation of the Map of North Britain with an Apology of the Same* (1734), discussed differences in coastal renderings among six maps of North Britain (Withers 2002, 50–52). Similarly, the published work of John Green (Bradock Mead) analyzed sources for his maps. But the unanimous model memoir for the *cabinet* geographers remained the work of Jean-Baptiste Bourguignon d'Anville (Archier 1986). He based his historical and geographic memoirs on his correspondence with a network of eminent and well-placed informants. His many published memoirs supported the validity of his maps, increasing his reputation as one of the best and most reliable geographers of his period. Though rarely translated, his memoirs were diffused throughout French-speaking Enlightenment Europe. They demonstrate the care he took in establishing and correcting toponyms, as well as the detailed seriousness of his compilations and his critical method of incorporating the most recent geodetic measurements. His historical memoirs, especially those concerning ancient metrology, remain a milestone in classical geography.

In southern Germany, d'Anville's contemporary, the Lutheran theologian Eberhard David Hauber, merits particular mention for his 1724 historical essay on cartography and the criticism of maps (Hauber 1988). This early work on the history of cartography outlines a project of five parts: a history of maps, construction and survey of maps in different countries, marine and river maps, a survey of historical and biblical maps, and a survey of thematic maps. He also provided a chronological and critical cartobibliography of Swabia and Württemberg.

Apart from the example of Hauber, the production

of erudite, analytical, precise memoirs by *cabinet* geographers seems to have been principally a French phenomenon. They addressed themselves to a public of connoisseurs and the curious. Academies of science throughout Europe, including those in Berlin, St. Petersburg, Uppsala, Stockholm, Madrid, and Turin, aided in their diffusion.

The memoirs of the first modern hydrographers may be placed alongside those of the *cabinet* geographers. The work of the Scotsmen Murdoch Mackenzie the Elder (*A Treatise of Maritim Surveying*, 1774) and Alexander Dalrymple (*Essay on the Most Commodious Methods of Marine Surveying*, written 1765, published 1771) largely surpass in importance the memoirs of the first *ingénieur hydrographe de la Marine*, Jacques-Nicolas Bellin (Chapuis 1999, 111–28) by virtue of their impact on the methodology of hydrographic plotting.

In addition to the memoirs of the *cabinet*, there are the written reports of the on-site cartographers, the land surveyors or military engineer-geographers who surveyed the terrain and prepared detailed maps at large or medium scale, covering a limited portion of territory. The purposes of their missions varied, but they also used the memoir as a supporting document.

Sweden had instituted cadastral maps early (1628) following the example of the English estate maps. In Holland, geometers made them for the administration of dikes (*waterschappen*) (Koeman and Van Egmond 2007, 1254–55, 1263–68). Dike associations of the lower Ems River and of Esens ordered maps divided by parcel, accompanied by registers of possessions, completed respectively by Jean de Honart in 1669–73 and Jean-Baptiste Regemont in 1670–79. However, Eric-Philippe de Ploennies surveyed the first true cadastral maps of the Lahn (1:7,200) between 1711 and 1722 on behalf of Count Frederick William Adolf of Nassau-Siegen. The maps were accompanied by topographic memoirs (*Markbeschreibungen*) in addition to registers of possessions. This practice spread rapidly across Europe: Pomerania (1692), Denmark, the states of the German Empire, Italy (Stein 2007), and France. In 1740, Gian Tomaso Monte drew up the “Regole da tenersi dalli Misuratori e Geometri nelle Misure Generali,” which accompanied an ideal map (*Topografico ideale di parte del territorio*), an accomplished example of what the new cadastre of Savoy, decreed by Carlo Emanuele III in 1739, aspired to be (Palmucci 2002, 53–54). In the last third of the eighteenth century, the multiplication of rules, instructions, and memoirs shows how difficult it was to harmonize all the methods in use for such large projects.

There also exist numerous examples of memoirs written by soldiers that developed general or specific points not appearing on the map, thus aiding their use: “A

map and its accompanying memoir mutually enlighten each other,” wrote Dupain de Montesson (1774, 190). Their content differed little from country to country, for they all described what was necessary for the conduct of an army or the protection of territory. Publication codified their composition. Dupain de Montesson (1774, 187–90) instructed that such a memoir should provide information (1) “on the general makeup of the country”—whether flat or mountainous, easy or difficult to traverse, dry or arid; (2) “on the direction and nature of roads”—their grade, condition, surface condition; (3) “on the rivers, streams, canals, the nature of their bottoms and banks”—whether easy or difficult to cross; (4) “on the cities, their setting, their type”; and (5) “on the land where one could camp, and in the case of a maritime country, places accessible to the coast where one could disembark.” As an example, Dupain de Montesson cites a memoir compiled during the Seven Years’ War fulfilling a directive to military geographical engineers in 1761 (1774, 190–205); it included a table summarizing the resources of the country. The facsimile publication of the *Kriegskarte* by Anton von Zach and the accompanying memoirs prepared by Austrian, French, and Italian engineers at the end of the eighteenth century (Rossi 2005, 2007) allows one to assess the content of an individual memoir and its relationship to the map.

In peacetime, military engineers often undertook civil tasks, including surveys for large-scale maps, and wrote accompanying memoirs with well-developed historical and geographical components. The education of a gentleman in the seventeenth century had already incorporated this exercise, which relied upon observation and analysis, qualities their teachers had sought to cultivate. In Jesuit colleges all over Europe and in a number of *Gymnasia* in northern countries, this exercise helped test the comprehension and capacity of students while sharpening their analytical sense of terrain, a valuable trait for future officers. In France, Claude Masse, trained in the field, wrote for his large-scale maps (1:28,800) memoirs that were models of geographic analysis, as valuable for their historical and anthropological content as for their economic and strategic interest. The tradition of such memoirs lasted throughout the eighteenth century in Europe. The twelve volumes of “Mémoires historiques, chronologiques et économiques” by Joseph Jean François de Ferraris refer to each of the 275 sheets of the manuscript *carte de cabinet* of the Austrian Low Countries. They vibrantly depict the history, economy, and activities of inhabitants of the region and admirably exemplify the memoir tradition (Bruwier 1978).

In commercial and Protestant northern Europe, it was often individuals, following the example of military engineers, who mapped countries or states (at medium

or large scale) on behalf of princes and left explanatory memoirs. The pastor Johann Majer, for example, prepared memoirs for the duke of Wittenberg in 1679 and 1691 in order to demonstrate his mastery of mathematical methods and instruments (Oehme 1961, 44–45). Protestant scholarly circles played an important role. Andreas Böhm, a methodically minded professor of mathematics at Gießen who was a former student of the philosopher-mathematician Christian Wolff, published a comprehensive volume on methods of land surveying and their applications: *Gründliche Anleitung zur Meßkunst auf dem Felde: Samt zweyen Anhängen vom Wasserwägen und von der unterirdischen Meß- oder Marktscheidekunst* (1759). Intended for the practical training of engineers and surveyors, such instruction manuals appeared everywhere after 1750 in order to make up for gaps in official training. They sharpened students’ critical skills and inculcated working methods. Other instructions in manuscript form, for the personal use of the engineer, laid out the process for the elaboration of maps and made the conditions and methods for surveys clear.

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SEE ALSO: Anville, Jean-Baptiste Bourguignon d’; Ferraris Survey of the Austrian Netherlands; Geographical Mapping; Green, John; Public Sphere, Cartography and the

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**Meridians, Local and Prime.** Despite the importance of lines of longitude to cartographic practice, meridians have received only limited historical consideration (but see Withers 2017). The lack of attention is especially pronounced in terms of how meridians were understood and represented during the Enlightenment. Early accounts (e.g., Mayer 1878) stressed the Renaissance proliferation of prime meridians, the further proliferation of new meridians in the nineteenth century, and thus the need for a single, universal meridian. With the 1884 adoption of the Greenwich meridian as the universal standard for time, historians simply added two new elements to the established narrative: first, celebration of this belated triumph of cartographic rationality and, second, complaint that this rationality was promptly undermined when some countries declined to adopt Greenwich as the universal meridian (e.g., Haag 1913; Perrin 1927; Brown 1949, 282–83, 295–99; Washburn 1984; Stams 1986; Forstner 2005, 21–32). Moreover, historians have routinely confused prime meridians with different kinds of local meridian (Waff 2001). This entry therefore considers, in turn, the local meridians of astronomers and surveyors, the prime meridians of chart-makers and geographers, and the ways in which these different concepts began to blur in practice late in the eighteenth century (it draws significantly on essays in Malin, Roy, and Beer 1985).

A variety of astronomical and surveying tasks required a physically demarcated *local* meridian. The French language properly distinguishes between the conceptual *méridien*, an imaginary line of constant longitude circumscribing the earth from pole to pole, and the local *méridienne*, a specific portion of a meridian through a specific location that is given real, physical

existence (Gotteland 2008, 1:19–20). Many eighteenth-century texts explained the several possible methods for determining the direction of a meridian—i.e., the directions of true north and south—as the first step in physically demarcating the line (e.g., Cassini 1720, 22–33; Long 1742–85, 1:107–10; Patterson 1786).

Traditional horizontal sundials created the simplest local meridians: the time-telling edge (the "style") of the sundial's gnomon must be physically aligned with the meridian. Such a short local meridian, rarely longer than fifty centimeters, is suitable for monitoring the sun's diurnal movement. Much longer meridian lines were marked out to keep track of the sun's annual motion, both to help determine religious feasts and fasts (especially Easter) and to convert solar time to stellar or clock time. In 1655, Jean-Dominique Cassini (I) built the *meridiana* in the cathedral of San Petronio, Bologna, specifically to measure key parameters of the sun's motion. A small hole in the roof of the nave turned the church into a giant camera obscura: the measurement of the bright spot cast by the sun along a calibrated iron rod (66.8 m) set along the meridian line in the church floor permitted Cassini I and his colleagues to determine, among several factors, the precise tilt of the earth's axis. Other *meridiane* were constructed and used in Catholic cathedrals and science academies, mostly in Italy. Although the adoption of telescopes and precise angle measurement made *meridiane* obsolete as solar observatories by 1750, many *meridiane* remained in use into the early nineteenth century to correct clocks (Heilbron 1999, 91–92, 107, 61–63, 135–37; Gotteland 2008).

Astronomers constructed special monuments to demarcate the local meridian through each of their observatories. Basic astronomical practice entailed the observation and timing of the passage (transit) of the sun, moon, stars, and planets across the observer's meridian. Transits of stars and the noon sun were essential for the determination of latitude and local time; in addition to regulating clocks, local time was essential for determining longitude. More generally, repeated transit observations were necessary to refine the mathematical models for the orbits of each heavenly body, to trace the motion of the stars, and so to improve astronomical tables and star catalogs. Carefully aligning their telescopes to the local meridian, whether in the field or at fixed observatories, astronomers used the monuments to check that their instruments had not become misaligned and, if they had, to realign them properly.

The determination of longitude was a dominant concern for eighteenth-century astronomers. Just as latitude could be determined with the aid of tables of the sun's declination, so the astronomical solution to determining longitude depended on tables of the movements either of Jupiter's moons (eclipses of the Jovian satellites) or



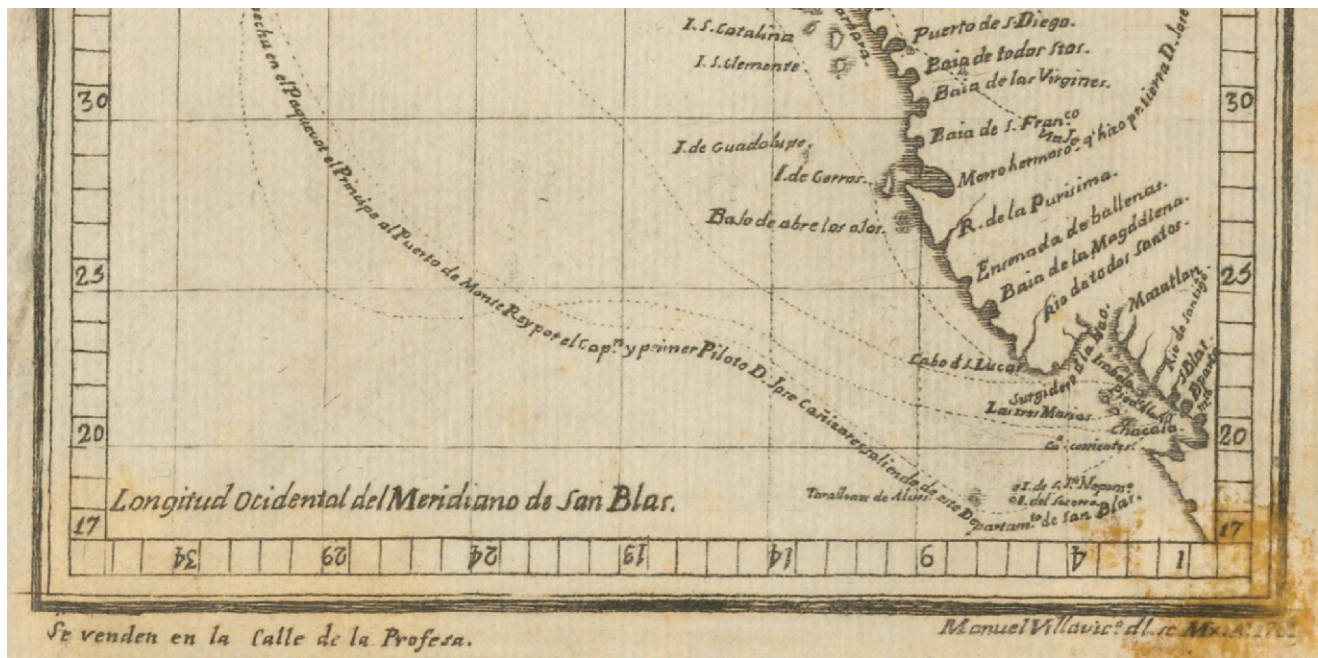


FIG. 536. DETAIL FROM JOSE DE CAÑIZARES, *CARTA GEOGRAPHICA Q'CONTIENE LA COSTA OCIDENTAL DE LA CALIFORNIA* (MEXICO CITY, 1781). This detail of the southern portion of the map shows the statement of local longitude as well as some of the lines of ships' routes by which local differences in longitude were calculated.

Size of the entire original: 17 × 12 cm; size of detail: ca. 6 × 12 cm. Image courtesy of the John Carter Brown Library at Brown University, Providence.

of the earth's own moon (lunar distances). Funded by the French and British states, the necessary tables were prepared, respectively, in the observatories at Paris and Greenwich and published in *La connoissance des temps* (from 1690) and *The Nautical Almanac* (from 1767). By comparing their own timed measurements of Jupiter's satellites or of the moon to the motions predicted in the almanacs, field observers could determine their own longitudes east or west of the observatories. Thus the precise locations of the main telescopes in the Paris and Greenwich observatories each defined an *observed* meridian. Observed meridians began to proliferate late in the eighteenth century when other European states recalculated the astronomical tables. In particular, the Amsterdam Admiralty began publishing astronomical tables recalculated for the meridian of Tenerife in 1788, and the Cadiz observatory (founded 1753) began in 1792 to republish *The Nautical Almanac* as the *Almanaque náutico, y efemérides astronómicas*, having recalculated it to its own meridian.

Surveyors used local meridians in a variety of ways according to the nature of their work. In mapping particular properties and places, surveyors generally worked without regard to the meridian; if they used a compass, they worked with magnetic north. But if the subject was of sufficient importance—a colonial boundary, a

new town, or a plan of a major urban center—then the surveyor might align the work with true north by first determining the local meridian through a central point.

In extensive surveys featuring one or more measured itineraries, surveyors (and geographers) could calculate longitudinal differences from the measured distances and bearings, as long as latitudes were also determined. In this situation, some reference point, generally the point of origin, was used to define a local zero mark for longitude. For example, a number of maps of the southern British colonies in North America were based in part on the 1728 survey of the east-west boundary line between Virginia and Carolina and accordingly calculated longitudes from the line's origin at Currituck Inlet; also, a Spanish map of the coast of Baja California and New Spain, published in Mexico City in 1786, indicated "Longitud occidental del Meridiano de San Blas," Spain's main naval center on the Pacific coast (fig. 536).

Detailed topographical surveys of small areas similarly did not need to be tied to the global system of latitude and longitude. The early survey maps of English counties, for example, used prominent local features as the zero mark for their only approximately drawn graticules. Only after 1750 did the county surveyors begin to show longitudes from the prime meridian of London (below), but in doing so they still simply superimposed



meridian through one of the islands in the Azores—Corvo, Pico, or São Miguel—where the coincidence of true and magnetic north, as observed in about 1500, appeared to define a natural prime meridian. Others had used one of the Cape Verde Islands or even Cape Verde itself. Others had adopted prime meridians through the Canaries, whether La Palma, Ferro (Fer, Hierro), or Tenerife. Still others simply ran the prime meridian through the middle of the archipelagos.

Although use of all of these different meridians continued well into the eighteenth century, there was after 1650 a clear trend toward standardization (see censuses by Kleinn 1985; Forstner 2005, esp. 31–32). Willem Jansz. Blaeu had championed the high peak (Pico de Teide) of Tenerife as a zero mark. As he had explained on his 1617 globe, changes in magnetic declination had negated all claims for the precedence of any natural prime meridian, so geographers might as well adopt the highest point of the primary island in the archipelago used by the ancients as the prime meridian (Van der Krogt 1993, 509–14). By 1700, Dutch and German mapmakers and chartmakers mostly followed Blaeu's lead. Conversely, in 1634, Louis XIII decreed that the westernmost island of the Canaries, Ferro, marked the prime meridian for the purposes of the French state: west of that line and north of the Tropic of Cancer, French ships were free to attack Spanish and Portuguese vessels. The adoption of Ferro as the default French prime meridian was made feasible when Guillaume Delisle began to use a precise value of  $20^\circ$  for the longitudinal difference between Ferro and Paris (fig. 538) (Delisle 1700). Delisle's approximation persisted because the variable quality of field observations for the island's longitude gave widely varying results (Lagarde 1979, 297–99). Spanish and Italian geographers used both Tenerife and Ferro, depending on whether they copied French or Dutch sources.

The differences between these Atlantic prime meridians were too slight to be reconciled by contemporary technology, and eighteenth-century geographers were generally vague about which particular meridian they used. The identity of the prime meridian was obvious on world maps. Geographers did not identify the prime meridian on regional maps. Only when a prime meridian fell within the frame of a map—i.e., on continental maps of Europe, Africa, or the Americas—was it ever specifically identified. Even then, the labels were generally as uninformative as “Premier Meridien” (on Delisle's *L'Afrique*, 1700). Only rarely did maps bear location-specific labels such as “Meridianus primus per Insul Tenerifam” (Johann Baptist Homann, *Totius Africae nova representatio*, [1716]) or “Premier meridien fixé à l'Isle de Fer par la declaration de Louis XIII en 1634” (Gilles Robert Vaugondy, *L'Europe*, 1749). Moreover, when geographers adhering to one conventional prime meridian

copied maps based on another, they simply renumbered the longitudes for each meridian. In doing so they used an appropriate and rounded conversion value of  $2^\circ$  as the difference between Ferro and Tenerife.

The use of prime meridians grew complicated when assertions of cultural autonomy led geographers in Europe's margins both to adopt locally significant prime meridians and then to identify those prime meridians prominently on all of their maps. British geographers began after 1670 to break with continental practice by adopting the meridian of London (specified overprecisely as the dome of the new St. Paul's Cathedral). The transition extended into the early 1700s when, for example, Herman Moll gave longitudes on some maps from both Ferro and London (separated by a neat  $19^\circ$ ). The innovation apparently stemmed from two nationalistic factors: the active rejection of Dutch cartographic models and a desire for mathematical rationality promoted by the public reception of Newtonian science. The latter prompted the few eighteenth-century arguments that the adoption of a standard prime meridian (i.e., one through London) would make the critical compilation of maps easier and would improve readers' ability to evaluate maps critically and without confusion (e.g., Green 1717, 149–50; Senex 1721, 6). In ad-



FIG. 538. DETAIL FROM GUILLAUME DELISLE, *MAPPE-MONDE DRESSÉE SUR LES OBSERVATIONS DE M<sup>RS</sup>. DE L'ACADEMIE ROYALE DES SCIENCES* (PARIS, 1700). The division of the hemispheres along the prime meridian of Ferro is shown. Note that Paris lies precisely on the meridian of  $20^\circ$ E. For the full map, see figure 201. Size of the entire original:  $42.5 \times 65.6$  cm; size of detail: ca.  $14.0 \times 15.5$  cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [84 B]).

dition, the early eighteenth-century public craze to solve the longitude problem led British geographers to count longitudes from  $0^{\circ}$  to  $180^{\circ}$  to both east and west of the prime meridian, as if they had all been determined by observation. British localism was recapitulated in the colonies, beginning with Lewis Evans's structuring of his 1749 and 1755 maps of Pennsylvania on the meridians of both London and Philadelphia and continuing after the Revolution with the adoption of another prime meridian through New York.

The same localism is evident in the Swedish use of a prime meridian through the observatory at Uppsala, as in the regional map *Svea ock Göta riken med Finland ock Norland* (1747, see fig. 324). For his uncompleted atlas of the Russian empire (1724–34), Ivan Kirilovich Kirilov used for his prime meridian the Baltic islands of Dagö (Hiiumaa) and Ösel (Saaremaa), the empire's westernmost limits. On the other hand, the European émigrés who dominated the Russian Akademiya nauk, especially Joseph-Nicolas Delisle (Appleby 2001), set the style for Russian geographical mapping more generally to use Ferro.

The multiplicity of prime meridians was not an issue for mariners. Few mariners actually used longitude and few pre-1800 charts included graduations for longitude. Dutch sea charts used prime meridians from islands in each of the Atlantic archipelagos, although Tenerife increasingly became the standard after 1700. In the seventeenth century, if British mariners calculated longitude from their logs, they did so from the Lizard, the southern tip of Cornwall. After 1700, however, they increasingly reduced their work to the meridian of London. French chartmakers generally used Ferro in line with the 1634 royal decree although, as observations for longitude increased around the European and Atlantic seacoasts, after 1700 they began to add longitude scales counted from Paris. The lack of standardization was emphasized after 1753, when multiple scales for longitude were added to the maps of the second edition of *Le Neptune françois*, to permit comparisons between Dutch, British, and French charts (fig. 539) (Chapuis 1999, 106–10).

Only after 1770 did naval authorities push the use of the new longitudinal technologies, even as they undertook new hydrographic surveys to update the charts

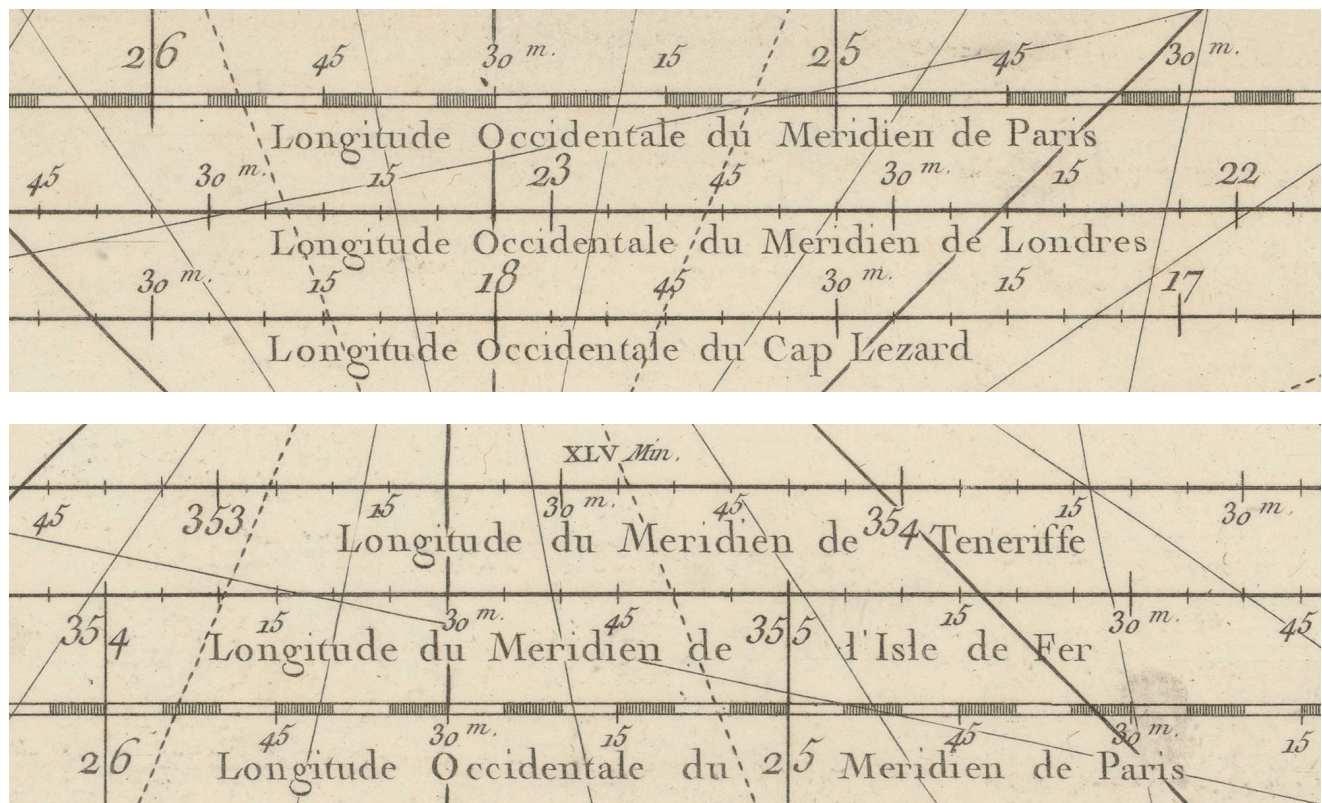


FIG. 539. DETAILS OF THE UPPER AND LOWER MARGINAL GRADUATIONS ON JACQUES-NICOLAS BELLIN, *CARTE RÉDUITE DES ISLES AÇORES* (PARIS, 1755). Longitudes from several prime meridians are given: Paris, London, and the Lizard (upper); Paris (by time), Tenerife, Ferro, and Paris (degrees) (lower). Note that Ferro and Paris are precisely

$20^{\circ}$  apart. From Bellin's *Hydrographie française*, 2 vols. (Paris: Dépôt général de la Marine, 1737–72), vol. 1, map no. 51. Size of the entire original:  $60 \times 94$  cm; size of each detail: ca.  $5 \times 17$  cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [8484 B]).

according to the new standards. The result was the promotion of new prime meridians as chronometers determined longitudes with respect to ports of origin and astronomical observations with respect to observatories. The acquisition of several chronometers by the Spanish after 1774 and their use on the Malaspina Expedition (1789–94) combined with the promulgation of a Spanish almanac to establish the Cadiz observatory as the prime meridian on Spanish charts. The first British charts to be based on the Greenwich meridian were the newly surveyed sheets of *The Atlantic Neptune* (1774–82), soon followed by the charts produced from James Cook's voyages; starting in 1779, the charts of the East India Company were progressively realigned to the Greenwich meridian (Cook 2006). The French promoted the Paris Observatory and after 1800 dropped Ferro from their charts completely. The progressive incorporation of the results of the new era of marine exploration, with longitudes determined from observed meridians, into general geographical circulation would spell the end of the Atlantic prime meridians.

The cartographic use of meridians was in significant flux by the end of the eighteenth century. The increasingly widespread application of new longitude technologies—whether measured by chronometer, observed astronomically, or calculated trigonometrically—emphasized the role of the national observatories as defining the zero markers of local meridians, whether observed or surveyed. The surge in the number of places with longitudes that had been properly determined inevitably led those observed and surveyed meridians to be used as marine and geographical prime meridians. This inflation was, in turn, fostered by the modern era of nationalism, as commentators argued that the adoption of a unique prime meridian was as essential an attribute of nationhood as currency and a flag. Although eighteenth-century geographers had expressed their displeasure at the idea of running a prime meridian through a country, it became by 1800 a mark of national unity to have low values of longitude running to the east and west of a locally situated prime meridian (Edney 1994). The result was the semantic expansion of “prime meridian”: in the modern world, the prime meridian is at once geographic and marine, observed and surveyed. Historians have understandably, though improperly, sought the origins of early prime meridians in local meridians. In this respect, the conventional, and never strictly arbitrary, choice of a prime meridian serves as a marker of distinct phases of cartographic practice between the Renaissance (various Atlantic islands), Enlightenment (Tenerife, Ferro, London), and the nineteenth century (Greenwich, Paris, Cadiz).

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SEE ALSO: Geodetic Surveying; Geographical Mapping: Enlightenment; Greenwich Observatory (Great Britain); Instruments, Astro-

nomical; Longitude and Latitude; North, Magnetic and True; Paris Observatory (France)

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**Metaphor, Map as.** What is a map if not a metaphor? As Christian Jacob put it, “Seeing the world from above is a timeless fantasy that geographical maps make actual by way of metaphor” (2006, 1). Strictly, a metaphor is a figure of speech in which a descriptive word or phrase is made to refer to an object or action different from, but analogous to, that to which it is literally applicable. If we see the map as an accurate representation—either of the whole earth or of part of it—then we ascribe to it the metaphor of “the map as mirror,” a faithful yet stylized mimetic representation of the real world. In another sense, those historians of cartography engaged in deconstructing the map have spoken of “the map as text,” a social document inscribed with different meanings and amenable to different readings (Harley 1989). If maps are not simply transmitters of previously existing facts but are the result of constructing and ordering knowledge in ways that did not exist before the act of cartographic representation, then any map is a metaphorical and rhetorical construct that refers to, creates, and transforms experience but never simply reflects it (MacEachren 1995). Even the geometry of cartographic representation, expressed in projections, lines, names, and symbols, is a metaphor of presumed certainty, of visual authority, of unproblematic viewing, and of reading: “Recourse to metaphor and to imaginary projection on the forms of the map helps to bypass the aporia of cartographical mimesis by making them recognizable, nameable, and memorizable” (Jacob 2006, 317).

In the Enlightenment, the connections between charts, plans, and maps and metaphor, and between mapping and allegory for themes within the human experience, were apparent in several ways. From the late seventeenth century, notably in France and in relation to bourgeois or courtly culture, the *Carte de Tendre* was a significant allegorical map with later variants, in which feelings like love, or life experiences such as marriage, were spatially represented. The phrase *savoir la carte*, to know the map, had proverbial meaning, referring to those persons who understood the interests of the court or the manners of society. Other such terms were also known: *trafiquer sur la carte*, to traffic on the map or

give advice on a topic about which one knew little, or *perdre la carte*, to “lose the map” or become upset (Peters 2004, 24). In eighteenth-century English usage, the term “map” included the idea of a tract of land spread out, and, as the poet William Cowper had it in his poem “Hope,” the idea of a life’s course: “He draws upon life’s map a zig-zag line, / That shows how far ‘tis safe to follow sin” (Cowper 1782, 171). And just as maps resulted from travel, or could aid sedentary readers to travel the world as it were, allegorical maps portrayed the journey through life. Allegory was metaphor extended. As Hugh Blair, a leading Enlightenment rhetorician noted, “If the resemblance, on which the figure is founded, be long dwelt upon, and carried into all its minute circumstances, we make an allegory instead of a metaphor” (Blair 1783, 1:313). The metaphor of the map and of mapping was widely used in relation to the ordering of knowledge, notably in relation to that leading prospectus of the Enlightenment, the *Encyclopédie* of Denis Diderot and Jean Le Rond d’Alembert, and to the placing of the peoples of the world in terms of contemporary schema for social and historical classification. Maps were also used—sometimes in association with medical referents—to present the female form as a landscape, the object not of territorial but of sexual possession. In short, maps were metaphors for bodies of knowledge, knowledge of the body, and for charting through allegory the relationships between human bodies.

The mapping metaphor appealed to Enlightenment natural philosophers because it spoke to their concerns to establish intellectual and moral order over the world’s manifest complexity and to describe the progress of scientific inquiry. In the work of the Swedish naturalist Carl von Linné, for example, metaphors of the *mappa naturæ*, the map of nature, informed his work on natural systems and geographical diversity, what is now considered bioclimatic zones. For Enlightenment encyclopedists especially, authors and publishers who sought to present in ordered and relational form the fast-increasing knowledge of the age, mapping was a common metaphor. For Diderot and d’Alembert, the *Encyclopédie* was to be understood “as a kind of *mappemonde* that would clearly demonstrate the interconnections of the arts and sciences, by tracing out a rigorous ‘topography’ of knowledge. Each article was a fragment of a vast three-dimensional ‘atlas’ of human endeavour, and the borders of each individual state, each specific locale, pointed to new regions and new frontiers of discovery” (Bates 2002, 1). This use of map imagery—“at once explicitly rhetorical and epistemological” (Bates 2002, 2)—did not mean either that the categories of knowledge themselves or the relationships between them were fixed immutably. Although contemporaries held to the view that mapping was about systematiza-

tion and stability in picturing the world—the view that “Enlightenment cartography, in both its epistemology and its practice, sweeps away local knowledge, particular itineraries, traditional points of reference, redrawing the world according to a comprehensive and rational system of mathematically controlled points” (Bates 2002, 7–8)—they recognized too that the *Encyclopédie* provided an abstract and a multiple, rather than a mimetic, view of knowledge. For d’Alembert, the best map was not the most “accurate” but the one “which reveals the most relationships” (1751, xv; and quoted in Bates 2002, 14).

Writing in June 1777 to William Robertson, the Edinburgh historian and university principal, to congratulate him on the publication of *History of America*, Edmund Burke considered Enlightenment audiences would find in such works that “the Great Map of Mankind is unrolled at once” (quoted in Marshall and Williams 1982, 1). Burke was making metaphorical reference to one of the principal results of Enlightenment geographical exploration, namely that different human cultures were revealed and considered to be at different stages of moral and social development. While islands and distant continents figured in the emerging world map of the Enlightenment and as part of nascent social theory in that period, they also provided a basis for the metaphorical, even satirical, representation of the human condition and attributes in the worlds of science and of literature.

One notable usage of such cartographic representation is the 1654 *Carte de Tendre*, map of tenderness, created by Madeleine de Scudéry in volume one of her ten-volume heroic novel *Clélie, histoire romaine* (1654–60) (see fig. 54). Far from being somehow aberrant within the context of cartography as only accurate mimesis, Scudéry’s map “generated a remarkable vogue for allegorical cartography that began in the 1650s, lasted throughout the rest of the century, and intersected with several of the period’s most important cultural conflicts” (Peters 2004, 23). Such maps were successful because of an increased engagement with geography in polite society, because maps were then being much used as political markers in territorial disputes, and because in poetry and in novels maps provided a figurative language “as instruments of persuasion, as forms of narration rather than as only science.” Scudéry’s map may be read allegorically as an example of women’s civilizing influence on the behavior of men: as Peters further notes, “the rivers and towns of the *pays de tendre* map of course an abstract, poetic topography of courtesy and courtship” (Peters 2004, 33, 34).

For Franz Reitinger, “Cartographical allegory functioned according to the simple principle of replacing a map’s toponyms with commonplaces of practical reasoning. On one hand, it reduced figurative action to the

level of abstract relationship, where personal qualities continued to exist as pure notions. On the other hand, it encouraged thinking in relative terms by visualizing moral, social and political values that went beyond an individual’s horizon of perception” (1999, 107). If in the work of Scudéry and others allegorical mapping was a kind of “*géographie galante* in which the formal language of geography was transferred into the mundane world and used as a means of expression to gain social prestige” (Reitinger 1999, 107), others used allegorical cartography to construe a less gallant view of social relationships. The otherwise innocuous *A Map or Chart of the Road of Love, and Harbour of Marriage* (see fig. 56), for example, was later tipped into a copy of the erotic book *A Voyage to Lethe* (1741), Lethe being both place and the female body laid out for the “survey” of “Captain Samuel Cock.” Works such as this and Thomas Stretzer’s *A New Description of Merryland* (1741), in which “Merryland” was the female body, were part of a genre of Enlightenment erotica that was evident in certain sorts of geography and allegorical cartography, in medicine, in literature, and in landscape gardening, where “pleasure grounds” were laid open for inspection and delight (Harvey 2004, 181–85). Allegorical maps echoed other cartographic styles as well as literary genres and cultural landscapes. The German mapmaker Matthäus Seutter produced a “love map” in 1730 in the style of contemporary military maps, with the male’s fortress besieged by female forces (see fig. 55), while a 1777 map of *Das Reich der Liebe* by Johann Gottlob Immanuel Breitkopf depicted the Land of Unhappy Love (Land der Taurenden Liebe) and the Desert of Melancholy (Wüste der Schwermuth) among other places in an allegorized topography of emotion (Hill 1978, 58). Also in 1730, Seutter produced a map of Schlaraffenland, an imaginary land of idleness and vice (fig. 540). Laid out according to cartographic convention, Seutter’s map (to be read with the aid of an accompanying text) depicted a fictive landscape of piety and of corruption. His was a moral cartography, an allegory about one’s place in the world.

Given their prevalence, their function, and their role in the symbolic representation of human qualities, it is perhaps inappropriate to regard such allegorical cartographies in the Enlightenment (or, indeed, for other periods) as “cartographical curiosities,” as does Gillian Hill (1978). To do so uncritically is to establish a standard by which we interpret and read other “less curious” maps when, as Jacob has noted, all maps are metaphorical but are so in different ways. If in the early Enlightenment, Reitinger notes, “cartographical satire [was] used to claim the right to tell the truth in jest” (1999, 125), allegorical or, more properly, metaphorical cartography was not limited to that alone. The significance of the *Carte*

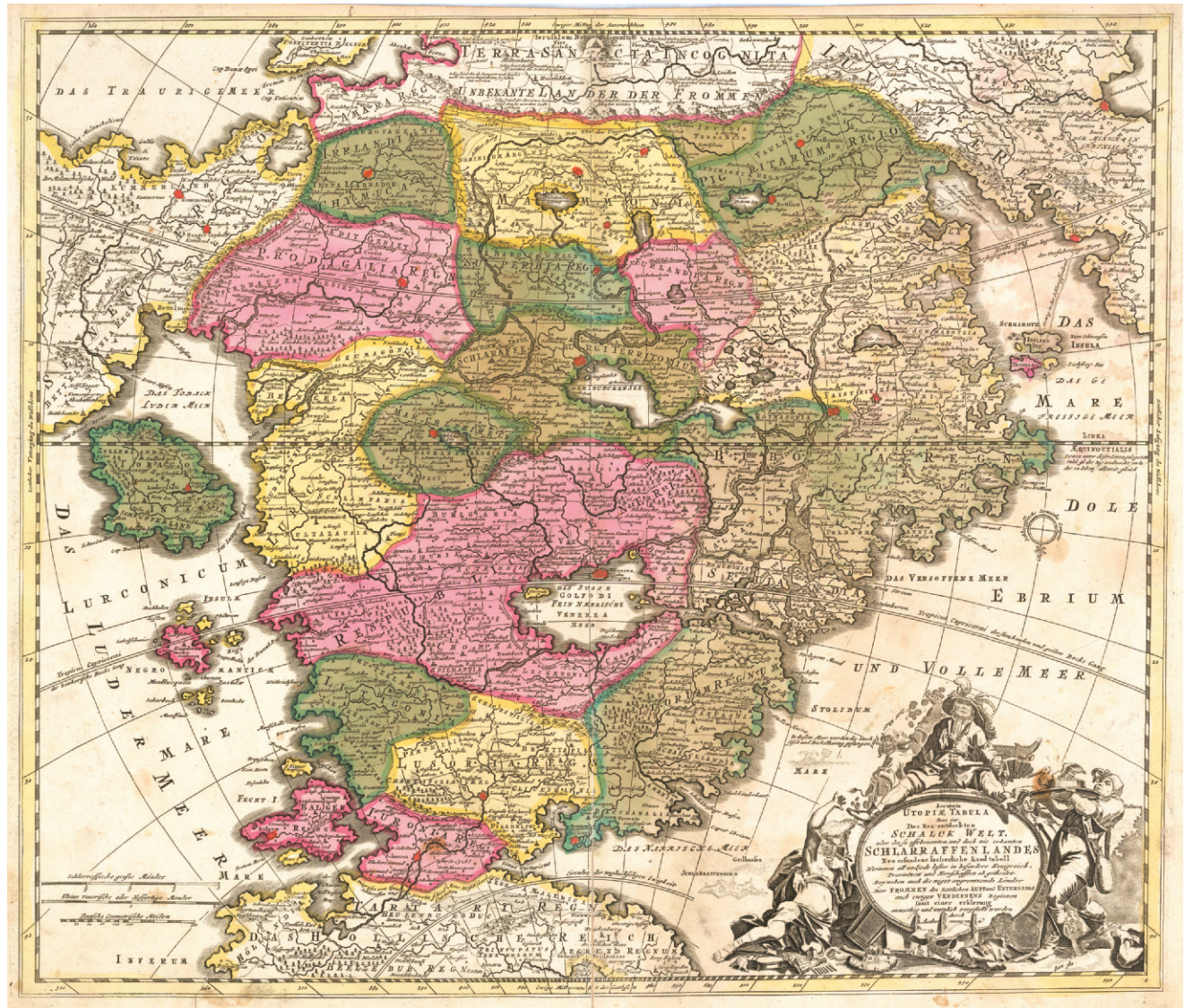


FIG. 540. ACCURATA UTOPIÆ TABULA. DAS IST DER NEU ENTDECKTEN SCHALCK WELT, ODER DES SO OFFTBENANTEN, UND DOCH NIE ERKANTEN SCHLARRAFFENLANDES (AUGSBURG: [MATTHÄUS SEUTTER], 1730).

Size of the original: ca. 48 × 56 cm. Image courtesy of Barry Lawrence Ruderman Antique Maps, La Jolla.

*de Tendre* and its later variants lay in the metaphorical assertion of power—of women over men, tenderness over brutalism—in the depictive power of narrative imagery rather than of words alone and in the association between figurative language and cartographic convention. For these reasons, it is possible to agree with Jeffrey N. Peters when he asserts that “it may be that the very notion of allegorical cartography is redundant, the product of a foundational chiasmus: maps are always allegorical; allegory is always cartographic” (Peters 2004, 33). Yet we must also be cautious. For in the Enlightenment, many people read maps not as metaphors but as

more or less accurate documents about an ontologically real world. The metaphor of the map and of mapping was used widely in the Enlightenment precisely because the idea and the ideal of the map appealed to a world seeking to give order—scientific, textual, political, and moral—to its systems of knowledge and of governance. In botany, geology, and, not least, in geography—where, for example, children’s geographies and geographical games allegorized the journey of life—maps symbolized progress, spatial pattern, and the proper place of things. In some forms of literature as in some forms of mapping, metaphorical cartography was a rhetorical trope that al-



lowed human relationships to be codified, and visually to be a basis for and expression of social conduct.

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SEE ALSO: Allegorical and Satirical Maps; Encyclopedias; Enlightenment, Cartography and the; Games, Cartographic

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**Meter, Survey for the.** When Louis XVI convoked the États Généraux of 1789, several *bailliages* (bailiwicks) demanded a unified system of measurement to rectify the disparate metrology of the Ancien Régime. On 8 May 1790, the Assemblée Constituante named a Commission d'étude des poids et mesures composed of Jean-Charles Borda, Joseph-Louis Lagrange, Pierre-Simon de Laplace, Gaspard Monge, and Jean-Antoine-Nicolas Caritat de Condorcet. The commission's report of 19 March 1791 proposed deriving a measure taken from nature. After fixing the arc of the meridian between Dunkirk and Barcelona, scientists would observe the length of the arc of a pendulum beating one second at 45° of latitude and at sea level. Such an "oscillation" of the pendulum would equal the ten-millionth part of the terrestrial meridian (Alder 2002, 84–86; 2005, 110–12). The new units would rest on a universal, not anthropometric, frame

of reference. The Assemblée Constituante adopted the report on 26 March 1791. After the defection of Jean-Dominique Cassini (IV) and Adrien-Marie Legendre, the Académie des sciences named as commissioners for the measurement of the meridian two students of the celebrated astronomer Joseph-Jérôme Lefrançois de Lalande, Pierre-François-André Méchain and Jean-Baptiste-Joseph Delambre (Levallois 1988, 61–74). Étienne Lenoir prepared new repeating circles devised by Borda (fig. 541), which were not ready until May 1792.

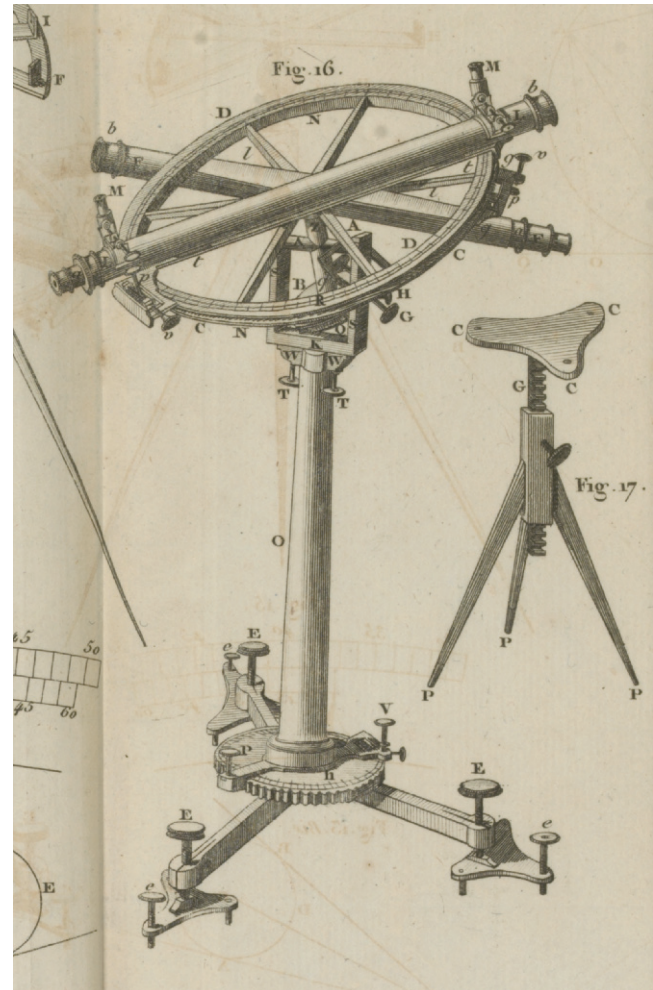


FIG. 541. REPEATING CIRCLE BY BORDA. This instrument was an adaptation of the older quadrants used by French geodesists in that, in measuring the horizontal angle between two targets, the instrument's graduated arc and telescopes were aligned so that its plane included the two targets (see fig. 265). Rather than a single measurement of the angle, however, the observer made repeated observations around a fully graduated circle (here of 32 cm diameter), taking the mean to achieve a high degree of accuracy. From Verkaven 1811, pl. 2, fig. 16. Size of the full plate: ca. 16.5 × 27.5 cm; size of detail: ca. 14 × 9.5 cm. Science, Industry & Business Library, New York Public Library, Astor, Lenox, and Tilden Foundations.

Méchain had been received into the Académie des sciences in 1782. Hydrographer at the Dépôt de la Marine, he had participated in joining the French and English triangulations in 1787. He was to measure the portion of the meridian between Barcelona and Rodez. Delambre, an associate of the Académie des sciences since 1792, undertook the larger work of measuring the meridian between Rodez and Dunkirk. These two connecting chains of triangulation were supposed to reuse the stations of the meridian from the *Carte de France* in 1740, but this proved difficult: trees had grown; towers and belfries had crumbled. Seven astronomical stations used for latitude (Dunkirk, Paris, Evaux, Carcassonne, Perpignan, Mont-Jouy, and Barcelona) allowed study of the variation in the curvature of the meridian.

The political troubles in France and their unexpected reversals complicated everything. Delambre's measurements elicited suspicion if not animosity. He was arrested several times and his supplies confiscated. To proceed, he needed a decree from the Assemblée législative. Méchain's mission in collaboration with Spain advanced until the outbreak of war with France (March 1793). After the insurrection of 10 August 1792, the new government of the Convention nationale, dominated by the Jacobins, abolished the monarchy. Disturbances erupted in all the provinces, the king was executed, and war broke out in both the interior and on the borders. At first Méchain remained in Spain; he then took refuge in Italy. In France, executive power was transferred to the Comité de Salut Public, which legislated by decree. The Reign of Terror (2 June 1793 to 28 July 1794) claimed many scientists both on the scaffold (e.g., Antoine-Laurent de Lavoisier) and in prison (e.g., Condorcet). Having adopted the metric system on 1 August 1793, the Convention suppressed the Académies on 8 August, and in December the Comité de Salut Public stopped work on the meridian project. Finally, on 25 October 1795, the Institut national des sciences et des arts was created, in which the former divisions of the Académie des sciences were restored. The Directoire was instituted the next day. Etienne-Nicolas Calon, who had worked on the *Carte de France* and was director of the Dépôt de la guerre et de la géographie from April 1793, recalled Delambre and Méchain to recommence work on the meridian from July 1795.

The chain included ninety-four first-order triangles measured using Borda's repeating circle between 1793 and 1794 by Delambre from Dunkirk to the Loire and by Méchain from Barcelona to Perpignan (Verkaven 1811, 77–94). Méchain made an error in the observation of Mizar ( $\zeta$  ursae majoris), which created erroneous positions for Barcelona and Mont-Jouy. Stricken by guilt, he delayed returning to Paris. Following the Terror, Delambre continued his triangulation from the Loire to

Rodez from 1795 to December 1797. Continuing to delay, Méchain finally linked up in Rodez in November 1798. The Melun baseline had been measured between May and June and that of Perpignan in September; it remained to make the calculations. Delambre innovated by formulating the degree to which stations were off center and by taking spherical excess into account. The calculations were submitted on 2 February 1799 to an international commission of scientists, convoked in June; they were approved in spite of Méchain's error. The value of the meter was settled at 443.296 lignes. The earth's curvature had proved to be irregular. In June 1799, the instrumentmaker Etienne Lenoir presented to the government the platinum meter, the standard measure, with great ceremony. However, it was another matter entirely to put the new measures into use. The French public rejected the metric system entirely. Its acceptance would take more than a century.

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SEE ALSO: Academies of Science: Académie des sciences (Academy of Sciences; France); Geodesy and the Size and Shape of the Earth; Geodetic Surveying: (1) Enlightenment, (2) France; Measures, Linear: Reform of Linear Measures

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**Mikoviny, Samuel.** Samuel Mikoviny (Sámuel Mikoviny; Samuel Mikovini) was born around 1698 in the village Lehota-Ábelová (Slovakia), then in the Kingdom of Hungary. His father was a Lutheran minister who belonged to the lesser nobility. This social status in the Habsburg-ruled feudal country made his son sign his maps proudly as “nobilis Hungarus.” In the Hungarian kingdom he belonged to a multiethnic group of intellectuals, mainly Lutherans, who all considered themselves to be *hungarus* and worked for the development of the country in the period of Habsburg re-Catholicization.

In 1718, Mikoviny enrolled at the Lutheran college in Pozsony (Bratislava, Slovakia). He was a student of Matthias Bél, a Lutheran minister and the director of the school. Returning from the University of Halle in Saxony, where he followed the Pietist educational principles of August Hermann Francke, Bél introduced the

new subject of geography. His major project was the historical-geographical description of the Kingdom of Hungary, reestablished after centuries of Turkish wars. Both Bél and Mikoviny were followers of the Pietists, a religious-cultural movement that presaged the nineteenth-century Enlightenment in Hungary.

Most likely Bél not only encouraged but also supported the talented Mikoviny to continue his studies at the University of Altdorf from 1721, where he studied astronomy and mathematics with Johann Heinrich Müller, the brother of the mapmaker Johann Christoph Müller. In 1722 Mikoviny was an apprentice in Johann Georg I Puschner's printing workshop and stayed in the house of the publisher Peter Conrad Monath in Nuremberg. Mikoviny's first engravings were published in 1723 in the *Hungariae antiquae et novae prodromus*, a portion of Bél's later multivolume work. Mikoviny's smaller views of Nuremberg and the university town Altdorf were also published by Monath. In 1723 Mikoviny moved to Jena to pursue mathematical studies. Before his return to Pozsony, the administrative center of Hungary, he probably took private lessons from the mathematician and astronomer Johann Jakob Marinoni in Vienna.

From 1726 to 1735 he was the engineer of the county of Pozsony, engaged in hydrographic surveys, water regulation, and flood control. In 1728 he started making astronomical observations for the calculation of geographical coordinates that he needed for the county maps to be included in Bél's monograph, *Notitia Hungariae novae historico geographica*, from 1735. Eleven maps, representing nine counties, were printed and included in the four volumes of Bél's work between 1735 and 1742, but many county maps remained in manuscript because the book series was interrupted.

In 1735 Mikoviny was appointed *court geometra*, the first professor of the mining school at Banská Štiavnica (Schemnitz, Selmečbánya) to teach mathematical and engineering subjects as well as surveying and mapping. His equally important commission was to survey and map the country during summer months.

Mikoviny's duties involved a wide range of engineering and surveying tasks. To ensure water was available for the silver mines in Banská Štiavnica, he constructed a sophisticated system of canals, ponds, drainages, and water reserves (a World Heritage Site since 1995). From 1744 to 1745, during the War of the Austrian Succession, he served in the Habsburg army as a military engineer in Silesia. In this capacity, his practical achievements were remarkable; he constructed hydraulic machines, built bridges and roads, regulated rivers, built canals, and even excavated ancient and Roman sites. From 1747 he was appointed as the only engineer of the Magyar Kamara (royal Hungarian chamber). He worked almost

continuously during his life and died while on his way home from performing regulation work on the River Váh in the spring of 1750.

Mikoviny's greatest contribution to the development of cartography in the region was his practical mapping activity based on theoretical principles that he published in the form of a public letter written to Bél in 1732. In this *Epistola*, Mikoviny introduced mapmaking as a *scientific* practice. To end the period of "geographical apathy" (1732, 4) he suggested employing four fundamental measurement methods of mapmaking: astronomical, geometric, magnetic, and hydrographic. The *Epistola* was among the first theoretical publications on topographical and geodetic surveying and mapping that emphasized the importance of astronomical determination of longitude and latitude and triangulation. Astronomical and geometrical measurements, usually emphasized in his maps' titles (e.g., "*astronomico-geometrico concinnata*"), were combined to give greater geodetic accuracy and mathematical control. These scientific principles guided Mikoviny's surveys in the field, and at the same time, they gave a rigid mathematical-geometrical structure to the information he collected. He integrated the fundamental methods, previously used in discrete mapping modes, into an evolving topographic paradigm (fig. 542).

He also dealt with the problem of graphic representation, that is, map drawing. According to Mikoviny, maps should represent the natural characteristics of the landscape. Topographic relief—as if seen from above and projected onto a plane—should be represented by hachures. He suggested excluding all impractical decorations from maps, replacing them with elegant clear drawing, pleasing to the reader. Mikoviny's maps were constructed as images of the landscape: the astronomical and geometrical measurements controlled observation, and the maps represented empirical and rational knowledge in graphic form. His contemporaries realized the importance of his theoretical treatise, and he was elected a member of the Königlich Preußische Sozietät der Wissenschaften in about 1733. He was later considered to be among the most important cartographers of the eighteenth century (Robert de Vaugondy 1757, 611).

Mikoviny's work was a forerunner to the later topographic surveys in the Habsburg Empire. In 1746 he proposed to Empress Maria Theresa a topographical survey of Hungary to support the military, state economics, communication, administration, and commerce. He wanted to start the survey of the Kingdom of Hungary "from almost the beginning" (quoted in Deák 1987, 113), meaning a systematic survey of the whole country, instead of by individual counties or regions.

Mikoviny's pioneering work represented the theory



FIG. 542. SAMUEL MIKOVINY, *VESTIGIUM OPERATIONIS ASTRONOMICOGEOMETRICAE*. Engraved by the author (“auctor sculps.”) and tipped into (“Tab. Ad pag. 20”) his *Epistola* (Bratislava, 1732). The map illustrates the combination of astronomic-geometric methods for mapmaking. To measure the considerable (ca. 150 km) distance between Pozsony (A at bottom left) and Neosolium (Nové Zámky, Slovakia; D at top right), Mikoviny used triangulation, as

shown, then checked its accuracy with astronomical measurements of longitude and latitude using the zero meridian of Pozsony, marked along the framing grid. The graphic scale in *Hexapedae Parisienses* reflects similar methods established in France. Copperplate engraving.

Size of original: 14.5 × 30.0 cm. Image courtesy of the Országos Széchényi Könyvtár, Budapest.

and practice of Enlightenment cartography in East-Central Europe. Mikoviny became influential not only through his theoretical publications and maps but also through his numerous students and followers who formed a new social context for a developing mapping paradigm in the region.

ZSOLT G. TÖRÖK

SEE ALSO: Geographical Mapping: Enlightenment; Military Cartography: Austrian Monarchy, with Topographical Surveying

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*Militär-Ingenieurakademie (Academy for Military Engineers; Austrian Monarchy)*. Starting in the 1690s, Prince Eugene steadily increased his influence on military affairs in the Habsburg monarchy. He was especially interested in establishing in Austria the advances made by the leading practitioners of French military cartography. In 1717, several of his initiatives led to the foundation of the *Militär-Ingenieurakademie* in Vienna, which was probably inspired by the francophone academy reestablished in Brussels in 1713 (Dörflinger 2004, 75–76).

The advantage of the *Militär-Ingenieurakademie* lay in rendering the Austrian army independent of foreign experts by providing a training school for specialists. This institution thus laid the foundation for the enormous increase in Austrian military cartography that was soon to assume a leading position in Central Europe. The first directors and teachers of the academy were the cartographers and engineers Leander Anguissola and Johann Jakob Marinoni, both of north Italian descent (Dörflinger 1989, 70–71; Fasching and Wawrik 1989, 115).

Marinoni was born in Udine in 1676. After studying at the University of Vienna, he worked as a mathematician at the Viennese court and as a geometer in Lower Austria. Marinoni's contributions especially influenced the development of surveying in the Habsburg Empire. Together with Anguissola, he was responsible for the first exact surveying of Vienna resulting in the *Accuratissima Viennæ Austriæ ichnographica delineatio* (1706) and cadastral surveys of the Duchy of Milan. Anguissola was mostly active in Vienna and its environs as well as in Hungary. In 1684 he was made junior engineer, followed by his promotion to lieutenant-colonel in 1701 (Dörflinger 2004, 76, 102–3).

The evolution of the Militär-Ingenieurakademie was dominated by several problematic traits. It was largely self-financed; contrary to later military training institutions, it received practically no state aid, which produced recurring financial difficulties. Another problem was certainly related to the location assigned to the academy in the seventeenth century. After being housed in private quarters, it was not given its own premises until 1755, but it had to move twice before the 1790s. In addition to these relocations, the academy changed its name several times: it was called Ingenieurakademie when founded in 1717, was renamed Ingenieurschule in 1755, and reverted to its original designation as an engineering academy from 1769 to 1851. Many graduates of this originally purely military academy did not follow a career in the Imperial and Royal Engineering Corps (k. k. Geniecorps) but rather in infantry and cavalry (Brunner and Kerchnawe 1942, 13–15).

The Imperial and Royal Engineering Corps was founded in 1747. Its internal regulations of 1748 required trained military engineers to draw ground plans of the surveyed terrain, which meant abandoning the old style of showing terrain in perspective. The development of uniform manuscript maps and original topographic records in the Habsburg Empire dates back to the time after the War of the Austrian Succession (1740–48) and in particular after the Seven Years' War (1756–63), always with valuable contributions by graduates of the Militär-Ingenieurakademie. The highpoint in the eighteenth century was the first Josephinische Landesaufnahme (1763–87) (Dörflinger 2004, 76–78); most employees of this survey were graduates of the Militär-Ingenieurakademie.

After Marinoni's death in 1755, the Militär-Ingenieurakademie entered a difficult period. Empress Maria Theresa was mainly interested in her Wiener Neustadt-based military academy founded in 1752 and largely shunned the older Viennese institution. In fact, the Viennese academy owed its survival to funds from the Chaos'sche Stiftung, a foundation for the training of young soldiers established in 1666 by the bequest of the

late Johann Konrad Richthausen. Starting in the 1760s, the Militär-Ingenieurakademie experienced an upturn in its development when Karl Klemens, Count Pellegrini, was appointed commander of the Ingenieur- und Sappeurs-Corps. He was the first to choose outstanding officers-engineers as teachers, which led to a tremendous improvement in practical and theoretical training. Another enormous asset was the appointment of Colonel-Engineer Joseph Toussaint Bourgeois as commander of the Militär-Ingenieurakademie in 1790, to whom the school owes its apogee in the first half of the nineteenth century (Brunner and Kerchnawe 1942, 33–39). Important cartographers who were graduates include Major-General Baron Andreas von Soriot de l'Host, Colonel Maximilian von De Traux, Major-General Ludwig Augustin Fallon, Artillery Lieutenant-General Franz Ritter von Hauslab, and Lieutenant-Field Marshal Julius Ritter von Albach (Brunner and Kerchnawe 1942, 28).

PETRA SVATEK

SEE ALSO: Josephinische Landesaufnahme (Josephine Survey; Austrian Monarchy); Marinoni, Johann Jakob; Military Cartography: Austrian Monarchy, with Topographical Surveying

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*Military and Topographical Surveys*. It is not always simple to separate military surveys from general topographical activity in the 150 years under consideration. The possible factors that define a survey as military may be its purpose, its use, that it was organized by a military institution, or executed by military topographers. These factors are muddled by the mixed character of the institutions that partially controlled military topographical activity; for example, Great Britain's Board of Ordnance was a civil organization with strong military responsibilities (Harley and O'Donoghue 1980, 2–12). Surveyors acquired the necessary skills for work in civil or military institutions according to the needs of war or peace. Even if a trend toward a clear distinction between civil and military topography emerged over

time, the partial survey of Egypt during the French expedition (1798–1801) at the very end of the eighteenth century demonstrated the continued union of civil and military engineers with a common direction. To isolate and define the characteristics of the military survey requires recognizing the trends and stages in its evolution, without ignoring its mixed character, and the uses and purposes of much of the topographical activity of this period.

In the second half of the seventeenth century, European armies continued to practice siege warfare. Military surveys of the time centered on the fort with a topographic representation of the surrounding area. Thus, topographic survey was one of the tasks of the engineers responsible for fortifications and required no differentiation in skills; around 1650, no military engineer specialized only in topographical survey to the exclusion of fortification. Nevertheless, at the end of the seventeenth century and the height of siege warfare, one can discern a trend toward expanding the area of land surveyed. The technical improvements in artillery that created a wider range of fire surely played a role. The *pré carré* of Sébastien Le Prestre, marquis de Vauban, is a clear example of an organized system of fortifications, wherein strongholds were not isolated but integral components to an effective defense of a clearly defined territory. Yet such systems demanded improved knowledge of the wider borders, not merely the immediate surroundings of one fortified position. Thus, siege warfare and topographical surveying should not be considered mutually exclusive. During the entire eighteenth century until the change brought about by the Napoleonic Wars, the border areas where the forts were built were the principal focus of military topographical surveys; gaining knowledge of the borders and maintaining the secrecy that surrounded this knowledge was a military responsibility. With this in mind, military engineers applied the same skills to topographical surveying that they used for fortifications, including the high level of mathematical ability they had acquired.

An initial differentiation in tasks and organization (but not in innate skills and background) among military engineers occurred in France in 1691: the *ingénieurs des camps et armées* (or *ingénieurs géographes*) were separated from the *ingénieurs du roi*, with the former specially charged with topographical surveys and the latter with fortifications. It is not a coincidence that in the same year a general *département des Fortifications* was created under Vauban. These administrative units followed on the foundation of the *Dépôt de la Guerre* created in 1688. The task of the *Dépôt* was to maintain and organize mapmaking materials to be used in wartime, and from 1744 onward the *Dépôt* directed all military topographical activity in France.

There was regular topographical surveying activity, with differing levels of competence, in European armies by the end of the seventeenth century. However, the graphic record, in terms of documents and therefore in historiography, is very limited until at least the 1740s. The factors that might account for this are inherent in the nature of military topographical activity and in the preservation of documents. The first, not surprisingly, is secrecy. Surveys of the border areas or reconnaissance made in wartime were not widely published so that detailed knowledge of these territories could not be acquired by the enemy. Large-scale national surveys carried out by military engineers and intended for publication were a later and relatively exceptional development of the less systematic but normal surveying activity that primarily served war and defense. The scholarly focus on national surveys and their origins, plus their generally good state of preservation, have partially obscured the existence of locally oriented surveys and of topographical wartime production. The institutions responsible for conserving topographical military materials became directly linked to the production of maps only in the 1740s, either through the direction of new surveys, as in France, or by copying and drawing, as in Britain (Berthaut 1902; Marshall 1980). Before then, the preservation of maps and the execution of military surveys were two distinct tasks with few institutional links, and many documents were not preserved, particularly those detailing the different stages of survey work before the production of the finished map.

The second half of the eighteenth century saw a broad structural change that became particularly clear after 1763 with the end of the Seven Years' War. During the preceding long years of conflict, European armies fighting both in Europe and in the colonies had recognized the need for topographical work to cope with a new type of warfare: the siege was giving way to the open field of battle. Knowledge of the terrain in which open battles were now fought required complete surveys, which in turn demanded topographers with both mathematical and military skills. As it is necessary to study military topography within the regular rhythms of peace and war, the peace following the end of the Seven Years' War represents the starting point for a total reorganization of topographical activity. With topographers now affiliated with the institutions of map preservation, new surveys were planned, and the information to be included in the surveys was revised. With the end of siege warfare, for example, an army needed to evaluate the resources of the area through which it passed and on which it was fighting in order to provide for its needs (Dupain de Montesson 1763). The configuration of the ground had to be rendered with great accuracy, since every detail was potentially useful to the opposing

armies both for defense and attack. Because war used everything for its purpose, the military survey had to describe everything. Considering these requirements and the strong mathematical background of military engineers trained to build fortifications, it is not surprising that military surveys provided a higher degree of accuracy when compared to contemporary civil maps, especially when it came to mapping mountains (Konvitz 1987, 82–102).

The survey directed by Pierre-Joseph de Bourcet in the Dauphiné from 1749 to 1754, and continued twenty years later, is a clear example of the extremely close attention paid to the rendering of the ground (Pichard 2002, 157–59, 166–85). Bourcet's *Principes de la guerre de montagnes* (1888) makes it clear that the full military purpose of the survey was to provide the most accurate contemporary information, both in detail and in overview, for a general to prepare his campaign. At this stage, military and civil topographical surveys were clearly distinct, both superficially in their appearance (strong attention to details in the rendering of the landform, for instance, made a finished military map easy to recognize) and more deeply in how they were planned and executed (fig. 543).

The comparatively good organization of military topographical activity in France and the particular training of French engineers were certainly among the reasons for such a high level of achievement. Indeed, the survey of the Dauphiné served as field practice for a whole generation of French military topographers trained under Bourcet. In Prussia too, cartographic skills were considered fundamental to military activity and were therefore regularly taught to officers. Survey handbooks were rapidly translated from French to German, from Paris to Berlin and vice versa (for example Brück 1767, translated as early as 1770), thus creating a common military topographical culture that went beyond alliances in war. Other European countries turned to French and Prussian works to fill the gaps in their own training, with some treatises being simply undeclared translations and others providing compendiums of earlier works on military engineering, such as *O engenheiro portuguez*, by Manoel de Azevedo Fortes, published in Lisbon (1728–29), which draws upon earlier French works according to the precepts of Vauban (Concieção 2006, 46–47).

According to J. B. Harley (1978b, 52–54), the American Revolutionary War showed how undeveloped British Army topographical education was compared to the French. However, the state of preservation of the historian's sources must be taken into account when considering comparisons between national approaches to topographical surveying. Prior to the establishment of the Ordnance Survey, we know much less about British military topographical activity than that of France.

National differences, both in the accomplishments and in topographical culture, are discernable but tend to be amplified by the state of preservation of the documents. In fact, the well-documented survey of Scotland carried out from 1747 to 1755 shows evidence of an organized military topographical enterprise, despite the youth of its leader, the military surveyor William Roy, who became an officer only in 1755. This operation was military in both its purpose—acquiring knowledge of an unruly area that had experienced a serious rebellion in 1745—and in its method—balancing the speed of execution against an attainable level of accuracy (Arrowsmith 1809; Whittington and Gibson 1986). The Ordnance Survey, which Roy began to contemplate soon after the Seven Years' War, was far more ambitious, so much so that the focus of its first years (included in our period of analysis) were completely devoted to geodesy.

The military surveys of the continental powers reached a turning point in 1763. In Russia the General'nyy shtab (General Staff) was established and methods were revised and adapted (Goldenberg and Postnikov 1985), and in the Austrian monarchy, a general and detailed survey was launched (Nischer-Falkenhof 1937; Rill 2001). In smaller countries with colonial empires, such as the Netherlands and Portugal, war strategies and the consequent planning of military surveys followed different paths in Europe and in the colonies. Defense requirements were the first concern at home and led to national peculiarities in the typical military rendering of the ground. In the Netherlands, for example, the smallest differences in height were indicated in flood plans (De Vries 1994, 43–50). By contrast, in the colonies all skills were employed to survey regions that were in principle considered hostile. Civil surveyors, military engineers, and native peoples, whose knowledge of the land and languages was indispensable, worked together (Abeydeera 1993), but the situation teetered between unstable peace and permanent war. Military surveys therefore had to be not only flexibly organized (their primary characteristic) but also able to accomplish tasks not dedicated purely to war. Where administrative and military issues were connected, the surveys served both, and the dividing line between the two is impossible to track. The models and methods applied in the colonies should be understood as an adaptation of the more stable surveying practices current in Europe.

The alternation of war and peace provided the fundamental methodological distinction for surveying practices in Europe. The fieldwork required of good military topographers was radically different during wartime than peacetime, and their capacity to apply the appropriate survey method to the situation was a central skill. A military survey directly linked a desired level of accuracy to available conditions and time. No method (and

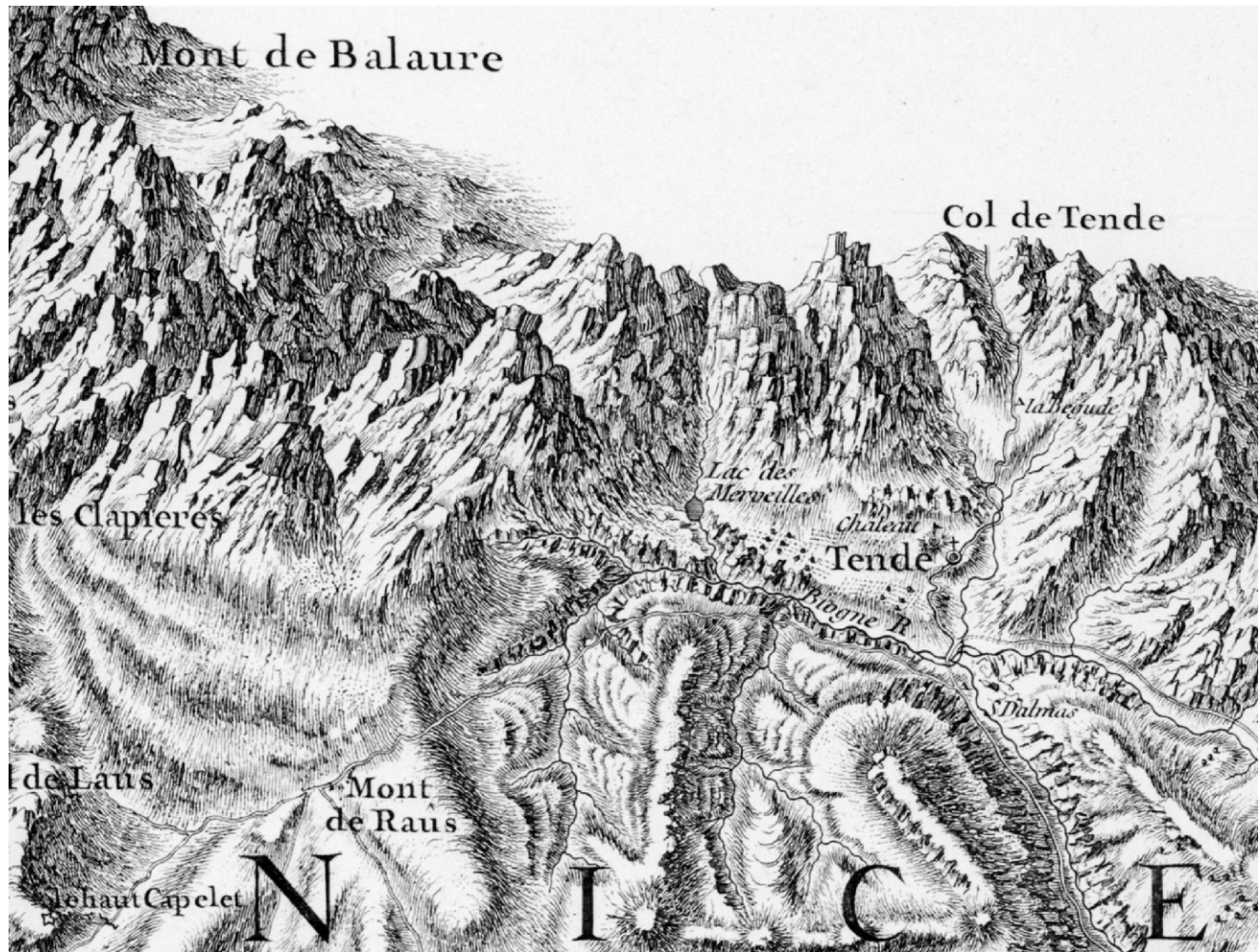


FIG. 543. DETAIL FROM PLATE 9 OF THE *CARTE GÉOMÉTRIQUE DU HAUT DAUPHINÉ ET DE LA FRONTIÈRE ULTERIEURE*, 1758, BY JEAN VILLARET. Engraved map on nine sheets, ca. 1:86,400. Based on a survey conducted under the supervision of *ingénieur géographe* Pierre-Joseph de Bourcet 1749 to 1754, the published version of the map of the upper Dauphiné region of France was reduced to the same scale as the Cassini *Carte de France*, which it antecedes.

The military surveyors paid particular attention to landforms, rendering the mountainous landscape with a combination of hachures and cavalier perspective, as may be seen here along the frontier with the Alps.

Size of each sheet: ca. 87 × 59 cm; size of detail: 15.0 × 17.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge CC 2061 [A]).

no instrument) was considered good or bad in itself but only in relation to the conditions of its use. This generally applied principle was strictly binding during periods of warfare when the lack of time and the presence of the enemy informed and motivated topographical activity. Only during peacetime could extensive surveys be undertaken, but they were seldom finished since the urgency attached to the preparation of new military campaigns claimed all available military topographers. But also during peacetime the quickest methods might be used. Expert surveyors would even travel incognito to foreign countries without instruments, sometimes not even a

pencil, and learn the lay of the land by heart, drawing it only after returning home. Such was the extraordinary work of the French chevalier François-Augustin Regnier de Jarjayes in the Alps in 1783, a meaningful (though unverified) episode (Berthaut 1902, 1:83–84).

With the exception of this last example, we can classify military surveys by their use of triangulation, by the methods used to determine the principal points of the larger series of triangles, and by the instruments used to measure the angles of the lesser series of triangles, which allowed topographers to draw the detail of the land. For the lesser series of triangles, theodolites were very rarely



used and the plane table and the compass very common. The plane table was considered more reliable, since the angles were directly drawn using the compass and did not need to be calculated, thus reducing errors. But of course in a geodetically based survey in the second half of the eighteenth century, the points of the first series of triangles and the first baseline would be determined using a theodolite (such as Jesse Ramsden's great theodolite [see fig. 410], used by Roy for the Greenwich-Paris triangulation, the effective foundation of the Ordnance Survey, or Jean-Charles Borda's repeating circle [see fig. 541], used for the survey of the meter). However, such an expensive instrument was rarely available. Most military surveyors, at least in Europe, used points previously determined by civil agencies or by local scholars, linked in a triangulation that, although not devised for military purposes, provided a reasonably reliable foundation for the smaller series of triangles and topographical detail.

In Egypt during the Napoleonic expedition, the loss of most of the instruments in the shipwreck of the *Patriote* added to the complicated working conditions. No full triangulation was possible, and the thirty-six points determined by the astronomer Nicolas-Antoine Nouet were linked by the surveyor while carrying out the last piece of fieldwork, the one that usually led to the drawing of the detail of the land.

In practice, the surveyors started from one of the thirty-six determined points and moved in the direction of another in a traverse; as they went, they pointed the alidade of the plane table or of the compass first at one object and then another, tracing angles until the goal of the other astronomically determined point was reached. This method excluded the measurement of the first linear base and the two broader triangulations. A geodetically based survey normally had three series of triangles: the first was traced by a team of engineers well trained in mathematics and geodesy; the second and the third were executed by officers with considerable practice in the survey and drawing of topography. In Egypt, the series with the smallest triangles was the only one actually traced by military surveyors.

Nevertheless, this method represents both the adaptation that was mandatory in military surveys and the working conditions of the surveyors who operated mostly with plane tables and compasses to measure angles. Linear measurement by chains or poles normally required assistants and slowed down the survey's progress. But military topographers were also trained to measure without instruments, to determine distances by sight or pace, to deduce them from the triangles, and to travel with a compass as their only instrument. Pure linear measurement could be useless at the detail level in a map survey that had to serve war: a note with distances

in terms of walking time calculated for the infantry, the cavalry, and the artillery often accompanied the finished map. During wartime activity and in the fundamental practice of reconnaissance, the military topographer worked with few or no instruments. Full geodetic triangulation and reconnaissance mark the two extremes of military survey activity. Their apparently incomparable differences in terms of detailed information and time of execution should not prevent us from considering them together, particularly since the same people accomplished both tasks. In addition, the value attributed to the work could be, surprisingly, inversely proportional to its apparent accuracy: reconnaissance, based on personal observation without instruments, was considered the most crucial work in military topographical activity (Harley 1978a, 9–25; Marshall 1980, 33–36).

In 1802 in Paris, the Commission topographique undertook to define new topographic language, to standardize methods and signs, and to adopt the metric system. By this time, France was not only the country that led the way in topographical surveys, but also the country poised to dominate Europe, which entailed an increasing need for military maps. The year 1802 marked the birth of a systematic program for military cartography in terms of accuracy and standardization; it was also the year in which the army assumed total dominance in the field of mapmaking and surveying in France, and later in the French First Empire. The trend toward a standardization of signs, methods, and units of measurement opened up new possibilities. The spread of the use of theodolites, though slow, permitted wider geodetically based surveys. Nevertheless, a critical problem exemplified a particular order of priorities still at work within the Commission's deliberations. This concerned contour lines, which were occasionally being used to represent height. After long discussions, the Commission refused to adopt them even though they were considered to represent height more accurately than any other method. This was because it was extremely difficult for a surveyor to define the height along the contours without performing true leveling operations, a relatively rare endeavor. The lines of ruling gradient, more commonly used at the time, were discernible to the eye and therefore easier to reproduce. Thus, while contour lines were the best method for representing elevation, they were not necessary in wartime, which required lower levels of accuracy. Though accuracy of the map produced had to be taken into account, the needs of the surveyor, who had to work rapidly in often difficult conditions, were still a greater priority in 1802. The Commission's decision reveals a powerful framework for any analysis of military surveys: although perfection was the aim, the needs of war came first.

SEE ALSO: Engineers and Topographical Surveys; Geodetic Surveying; Enlightenment; Military Cartography; Topographical Surveying; Traverse; Triangulation Surveying

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**Military Cartography.**

ENLIGHTENMENT

AUSTRIAN MONARCHY, WITH TOPOGRAPHICAL SURVEYING

DENMARK AND NORWAY

FRANCE

GERMAN STATES

GREAT BRITAIN

NETHERLANDS, WITH TOPOGRAPHICAL SURVEYING

OTTOMAN EMPIRE

PORTUGAL

SPAIN

SWEDEN-FINLAND

SWITZERLAND

**Military Cartography in the Enlightenment.** That maps aid in warfare is a truth so often repeated that it scarcely seems useful to discuss or analyze it. Without denying the strong association between war and cartography, not least within the popular imagination, one should define the concept of military cartography by identifying its limits, or rather by following the paths that cross its boundaries. The first step will be to identify the characteristics of military cartography as well as the cartographic documents produced and used by armies. This involves not merely highlighting technical features but also explaining the logic governing military cartography that distinguishes it from its civilian counterpart. The second step will be to establish a typology of activities and documents that may be defined as military. Finally, an analysis of those trends animating military cartography will provide possible points of contact with contemporary political, philosophical, and mathematical thought.

**CHARACTERISTICS** European armies during the Enlightenment organized and supported specifically military cartographic projects. Military personnel directed these efforts, and the cartographers carrying them out were also officers or became officers when they were chosen for the job. Beginning in the second half of the eighteenth century, these cartographic officers were more and more frequently attached to a specific army corps that remained active even in times of peace. There was a trend toward specialization that required adapted training as a necessary corollary. The art of surveying and making plans for military use was taught to the young officer within the military internal institutions, whether in special schools, through apprenticeship to experienced

officers, or as part of teaching at military schools. The progressive separation of civil and military competence in cartography is apparent, with evidence regarding conflicts that pitted the two camps against one another (Pelletier 1990, 139–56). However, the two worlds should not be imagined as mutually impenetrable. Cartographers moved from the military to the civilian domain and even more so in the opposite direction, particularly in periods of crisis. When a state of war demanded manpower and there was an insufficient number of trained military recruits, the army drew on the skills offered by civilian personnel. In France after the Revolution, the purges, and the emigration of nobles, the new *ingénieurs géographes*, a group assigned to the army's topographical projects, were recruited from the sons and nephews of existing military engineers, civil engineers, architects, and draftsmen—those who, it was thought, could be easily trained for military cartography because of their related preexisting skills. On the other hand, although engineers and military topographers rarely abandoned their positions to return to civilian life, administrations regularly used the skills of the military in geodesy and cartography, particularly for projects of large proportions (Postnikov 2000, 82–84). With their elevated level of scientific and technical training, generally superior to that of their civilian counterparts, military engineers and cartographers constituted a valuable skilled reservoir that governments could draw on in times of need. However, even though movement between the spheres of military and civilian cartography was frequent (accompanied by indefinite status and dual membership), truly official collaborations were rare. Each group used, when possible, the materials, strengths, and competences of the other, but each obeyed different directives and applied different demands to cartographic labors.

The frequency with which cartographers passed from the civil domain to the military (and vice versa) does not render the situation incomprehensible, since their social role and rank were for the most part defined and declared. On the other hand, when considering the cartographic documents themselves, it is very difficult and ultimately not very fruitful to define them as strictly civil or military. In many cases, maps actually had multiple lives: military commanders contacted well-known mapsellers to obtain general, medium- to small-scale maps or compilations that could be readied quickly for use (Bulatov, Delano-Smith, and Herbert 2001, 71–72); these same mapsellers had copied and then published manuscript maps and plans produced by soldiers, particularly plans of battles and sieges; moreover, the seizure of cartographic materials of all types was a common military practice in time of war. Where does one draw the line? Should one define military cartography as only the production of materials ordered and organized by a military

institution or as the fruits of labor actually undertaken by military personnel? In the latter case, should a large-scale survey made with the participation of officers for nonmilitary ends be included in the analysis?

In the confusion of institutional overlap and the multiple uses of maps, differences in cartographic *savoir faire* may serve as a more stable criterion for differentiation. In the military domain, there was an art of surveying plans for everything having to do with war (Dupain de Montesson 1763). The use of this *savoir faire* may serve as a guiding principle, enabling us to describe cartography as military even when this aspect was not inherent in all the stages of its production, its use, or the institutional affiliation of its producers. Among the numerous skills required of a cartographer-officer was the capacity to choose among maps, printed or manuscript, previously produced by civilians, to determine which were useful, and to adapt them to military use. In short, officers were required to use maps not originally designed for war and to transform them according to the *savoir faire* of military cartography. In the army, small-scale maps were used to follow unfolding military campaigns or to insert on-the-spot topographic surveys within an overall framework; different kinds of large- and medium-scale maps were brought together and reduced to a smaller scale in order to form an overall map that would otherwise be lacking. There was continual correction and adaptation performed both off-site, by compilation and juxtaposition of different documents *en cabinet*, and on-site by observation. A nonmilitary map thus reviewed and corrected by a competent soldier could even serve for the most delicate of tasks, the preparation for an imminent battle. The readapted map might be considered a military map because it shared the same fundamental goal and followed the same imperatives.

When the military cartographer observed and surveyed terrain, he related the spaces he saw—the natural elements as well as buildings—with military action, either action that had taken place or was soon to take place (Pansini 2003). In the eighteenth century, no document of military cartography was conceived independently of military action. This was true of maps at all scales, and the usual division of maps and plans into sieges, battles, and campaigns—based more on events than geography—confirms this. While the medium- to small-scale map of a campaign provided an overall view of the movements of armies and the distances they had to traverse, a large-scale topographic plan localized the details of events and placed them in direct relation to the data regarding terrain and the army (distances including firing ranges, for example, or road widths to accommodate variously sized artillery pieces). These relationships had to be established when the map was produced, even if their actual representation was not necessarily obliga-

tory. The officers using the plans would recognize the relationships as much as the topographers and would therefore require no explicit reference for reading them. If the immediate purposes of different military cartographic documents might not coincide (some were intended to prepare for military action or encampment, others furnished an overall view of a military campaign, and still others were meant to celebrate a battle or facilitate its study), their focus was nonetheless the same: military action and its location in space.

Two consequences emerge from this observation: on the one hand, martial objectives demanded strong pragmatism, which moderated or at least guided the focus of knowledge implicit in cartographic activity. On the other hand, the direct relation between cartographic representation and military action necessarily involved a temporal dimension. These two characteristics ensured a certain specificity about military cartography.

Absolute pragmatism was the consistent standard of martial activities: victory was the goal, and choices were evaluated based on the results they might produce. The victorious army (e.g., the Prussian army of Friedrich II or that of Napoleon) might immediately become a model because of its victory on the field of battle. This radical pragmatism, which gave priority to choices aiding success, could sometimes be in conflict with scientific ambition. Officers had to serve two masters, one military and one scientific. The possible contradictions between the two became more serious in the closing years of the eighteenth century, when the scientific ambitions of many cartographers (often members of learned societies and experts in other disciplines) and of the discipline of cartography itself became more defined. This double loyalty solidified a fundamental problem of military cartography: the rapid and direct tension between the time available for a given task and the level of completion and precision achievable in that time. It was the duty of the cartographer-officer to resolve that problem in the most advantageous manner possible by choosing an adequate level of precision and by furnishing the best possible document to the military command. The primary goal of supporting martial activity certainly set limits on cartographic achievement, forcing its ends to be adapted to contingent circumstances.

However, the contradictions were not as marked as one might suppose, for war was also very demanding scientifically. Support of military action required a surprising amount of information and placed a high value on precision. As siege warfare gradually gave way to a more mobile warfare (ca. 1740s), the high level of expertise developed for fortification architecture extended to the terrain, where armies henceforth were grouped and confronted one another. As the mass of potentially useful information grew, cartography became its principal

mode of visual representation. It was not the military character of cartography that limited the scientific ambitions of cartographers but rather the time available to complete it. This same temporal dimension inevitably affected the conception and production of maps in many ways. If space was represented in relation to a military action or event, it was also represented in time. This necessary relationship led to original technical solutions, as in the case of battlefield plans where successive positions of the opposing armies were indicated by different reproductions of the same topographic background with the troops displacement indicated by arrows. However, the temporal dimension was not limited to maps or plans representing an event. It entered into all types of military cartography, whether conceived to prepare for a future action or to study an action in the past. The military cartographer had to have the imagination to envision the movement of armies in the terrain he was representing and to insert details essential to their operations. He had to see the space at the moment of action and represent it on a map.

**TYPOLGY** Despite the characteristics shared by military cartographic production in the eighteenth century, its typology remains extremely varied. Military engineers produced a wide range of different cartographic documents as well as attached texts and memoirs. Paintings of battles or other representations in frontal view, such as those of besieged fortresses, also figured among complementary documents but will not be considered here.

The fortification plan represented at a very large scale a fortified building and the surrounding terrain. Produced initially in manuscript and sometimes printed commercially after war's end, it was the fundamental product of military cartography from the end of the seventeenth century until the middle of the eighteenth. Its purpose was essentially defensive. Coastal maps and the cartographic representations of ports met this same demand. Clearly, a detailed plan of a fortification and its surroundings was a valuable document and was intended to be kept secret. The decline of the secrecy surrounding these documents may, moreover, be read as a sign of their decreasing strategic importance. The construction and maintenance of fortifications was a principal responsibility of military engineers, in addition to undertaking topographical operations. In this context, cartographic representation was just one aspect of a larger activity, undertaken by a corps of personnel whose functions were not yet differentiated. Only in France, the country at the forefront in the development of military cartography and fortifications, was there (beginning in 1691) a group of engineers, *ingénieur géographes militaires*, specially charged with topographi-

cal operations, but their progressive autonomy was marked by numerous conflicts (Berthaut 1902; Gibiat 2001). The representation of fortified buildings, as well as cities, remained important even when siege warfare was abandoned. Attention then shifted to the battle zone or encampment, but the representation of the fortress or the walled city still remained necessary, as fortresses constituted strategic elements in a war zone and invited defense or attack. So the list of priorities was reversed. In the seventeenth century and the first half of the eighteenth, the center of cartographic representation was the fortified zone, with the surrounding terrain depicted only in relation to it. Between 1750 and 1760 the terrain itself became the focus, with fortifications shown simply as part of the mass of topography (fig. 544).

The plan of a fortified zone also provided the foundation for the cartographic representation of sieges. Siege plans often included the position of the besieging troops as well as the lines of fire for both sides. The siege was directly inserted into the representation, albeit in a static and schematic fashion. Frontal views of attacks might also be included, as well as other similar views that often gave architectural details; all belong to the system

of military cartography. During the eighteenth century, there was no standardized distinction between perspective view versus plan, although a clear trend in the direction of the plan can be discerned. The truly exclusive and institutional choice of the zenithal projection (or plan) in military cartography occurred only in 1802 in France, when it was decreed by the Commission topographique, which brought together in Paris the directors of different cartographic institutions. This decision did not, however, suppress representation by frontal view or by pictorial representation; both continued to play a documentary role in conjunction with topographic plans at least through the era of the Napoleonic Wars. It was the mixture of plan and view, or, to put it another way, the mixed use of several types of representation (e.g., orthogonal plan and bird's-eye view) on the same map or plan that was proposed for elimination. This mixture of plan and view was widespread throughout the eighteenth century in both civil and military cartography and was used for representing buildings and cities other than those that were the focus of the map. For example, the plan of the siege of Guelders from 1703 (fig. 545) shows the city under attack in plan form, with

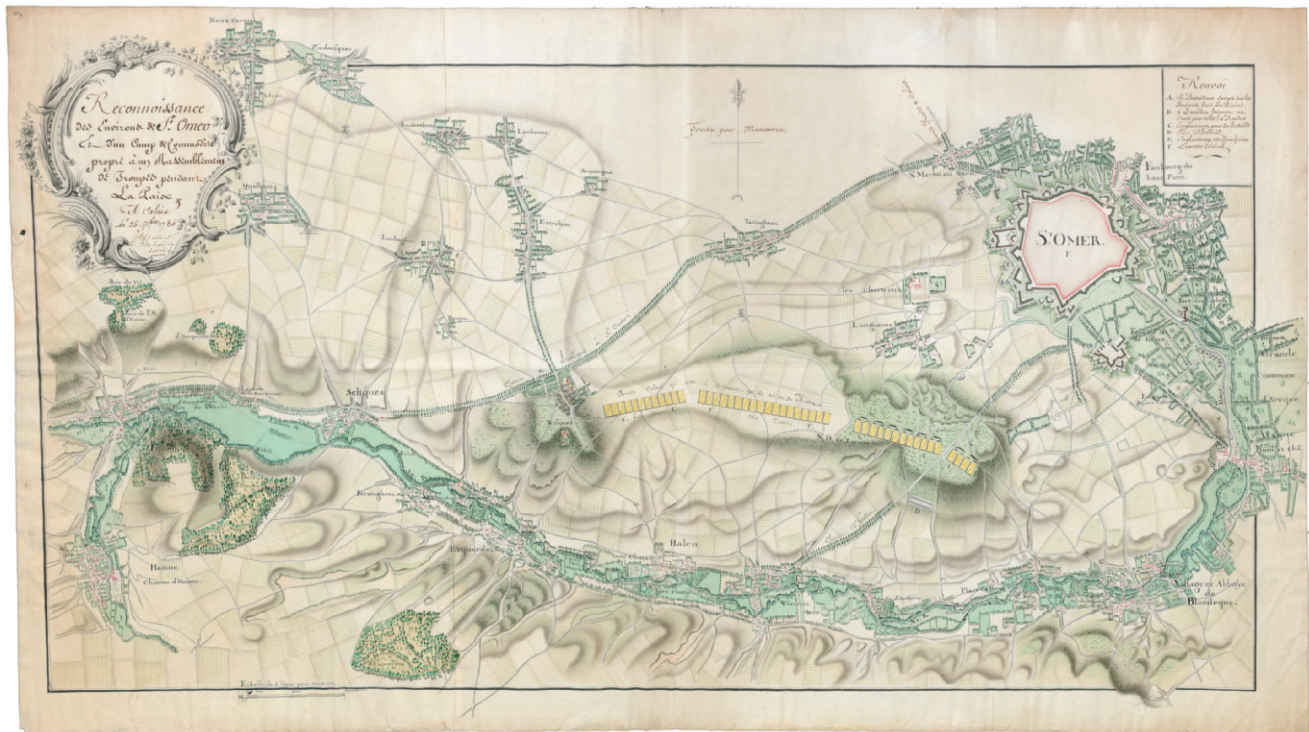


FIG. 544. GEORGES-HENRI-VICTOR COLLOT, "RECONNOISSANCE DES ENVIRONS DE S<sup>T</sup>. OMER ET D'UN CAMP DE COMMODITÉ PROPRE À UN RASSEMBLEMENT DE TROUPES PENDANT LA PAIX," 25 SEPTEMBER 1785. The fortified city of Saint-Omer, which once would

have been pictured at the center of the whole map, is now relegated to the right side, while attention is centered on the area of the *camp de commodité*.

Size of the original: 55 × 98 cm. © Service historique de la Défense, Vincennes (GR 1 M 1052-21).



FIG. 545. GUELDRE: CAPITALE DE LA GUELDRE PRUSSIENNE, ATTAQUÉES ET PRISE EN 1703. PAR LES TROUPES DU ROY DE PRUSSE. The approximate character of the representation of terrain transforms depictions into

symbols: the rectangular, stereotyped fields symbolize cultivated lands rather than representing them. Size of the original: 42 × 35 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge D 3553).

the remaining buildings represented in view. Throughout the century, elements shown in view gradually evolved into symbols. No longer were specific buildings represented in frontal view; rather a topographic sign designating buildings was inserted to indicate their presence. The same process evolved for symbols designating trees or crops. The Commission topographique of 1802 determined that certain symbols in frontal representation would be maintained and others replaced. Nevertheless, their insertion was part of a detailed orographic representation for which symbols provided information that color and shading could not. On the contrary, in the plan of the siege of Guelders, details of terrain were shown so approximately that even this representation became symbolic. Juxtaposed squares marked cultivated land in contrast to marshes, which were depicted more irregularly but equally stereotyped. In this plan there

was no desire to depict faithfully the appearance of all types of terrain; it sufficed to contrast cultivated land with swamp—landscapes that offered different challenges to passing troops. Even higher-quality and more detailed plans of sieges focused on similar information and tended toward similarly stereotyped figuration. The plan of the siege of Philipsbourg of 1734 (fig. 546) achieved detailed representation of the fortification, but the terrain remained merely a white background on which only the troops and a corner of forest were symbolically placed.

Siege plans are more difficult to analyze, for they were often the victims of their own success. Manuscript maps produced by soldiers were certainly copied (by agreement with the author), collated, and even sometimes juxtaposed with other representations. This is the case with plan of the 1741 siege of Prague, found in



FIG. 546. ACCURATESTE U. WAHRE ABBILDUNG DES FRANZÖSISCHE LAGERS . . . VOR DER HAUPT VESTUNG PHILIPSBURG, 1734. There is a sharp contrast between the perfection of detail in the fortification and the generic representation of the terrain.

Size of the original: 29 × 39 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge D 4894).

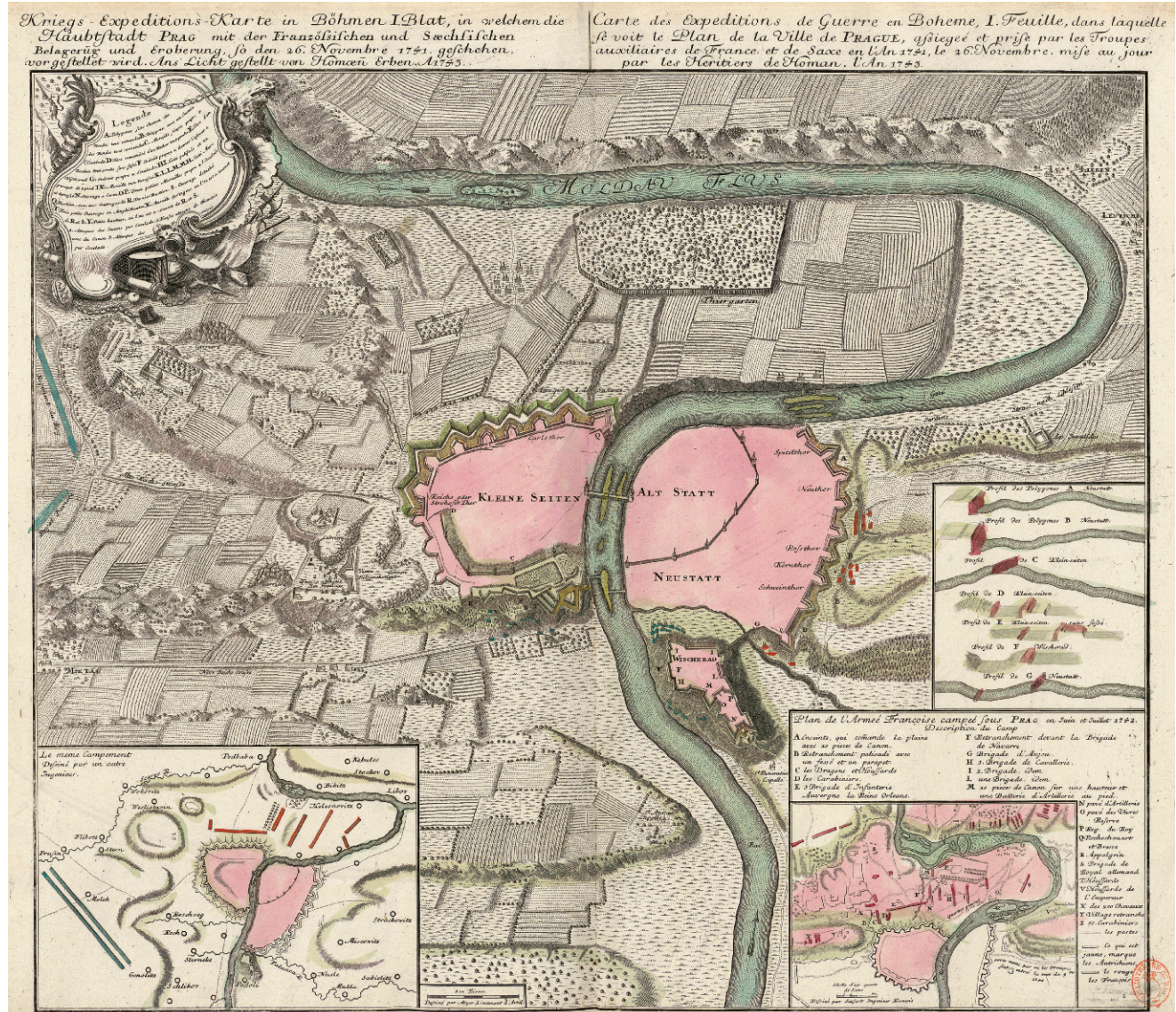


FIG. 547. KRIEGS-EXPEDITIONS-KARTE IN BÖHMEN = CARTE DES EXPÉDITIONS DE GUERRE EN BOHÈME, 1743. From the *Atlas d'Allemagne* by Homann Heirs. The map depicts the end of the siege of Prague, which fell 26 November 1741. In the insets, two different representa-

tions by different engineers of earlier moments in the siege are juxtaposed.

Size of the original: 50 × 59 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge CC 1280 [53]).

the *Atlas d'Allemagne* (1743) by Homann Heirs, which contains two plans of the same siege, each a different rendition (fig. 547). One of them, drawn by the French engineer Sinsart, perhaps served as the source of the other, which is drawn in view. Detailed analyses of the successive stages of copying and compilation (legitimate or otherwise) for siege plans, a genre so widespread and commercialized, would require deep textual analysis for each representation.

Like the plan of a siege, the plan of a battle is a cartographic document that directly presents the action

of war. Conceived after the fact, it divides events into phases so that they can be individually studied and reveal the mechanics of the battle. Increasingly popular from the 1740s, the battle plan incorporated new types of information, which posed new problems. Before troop symbols could be placed on the map, the cartographer—usually a military topographer—had to establish with certitude the time and sequence of when troops took their positions. Since the action was no longer limited to the immediate surroundings of the fortress, the possibilities of movement increased and concurrently



the difficulty of correctly reproducing them. Overseen by the commander, the cartographer was responsible for locating symbols according to official reports, other documentary sources, and verbal testimony. He then established a plan that fixed the image of the battle for study and for memory. In this context, even the limits of the terrain represented posed problems. To define them required determining the boundaries of the unfolding military action and consequently omitting zones whose representation would not be useful. Nevertheless, such “useless” terrain did find a place in military cartography on maps drawn at smaller scales depicting the army’s march. However, the location of the battle had to be represented in detail to allow for an accurate representation of troop movements (fig. 548). Open-field battle, a dynamic event, could not be represented in a static fashion, since the science of war—for which the battle plan provided the essential document of study—became essentially a science of movement during this period. Various

solutions emerged for technical problems of showing movement, which have been analyzed for the Napoleonic era (Palsky 1996). The arrangement of arrows on a single sheet was the most economical approach, while the juxtaposition of multiple images showing successive troop positions was the most common solution. The latter approach sometimes employed multiple frames grouped on the same page or on successive sheets, as in the plans created for the *Relation de la bataille de Marengo* by Louis-Alexandre Berthier (1805). Berthier, Napoleon’s minister of war, added a series of four plans plus a large-scale map and a view “indicating the different troop movements, surveyed geometrically by the *ingénieurs géographes* of the *Dépôt général de la guerre*,” allowing the reader to follow the account of the battle (quote on title page). The *ingénieurs géographes* who undertook the survey also determined the positions of troops on the plans, verified and corrected afterward by Berthier (Pansini 2002, 23, 394–97).

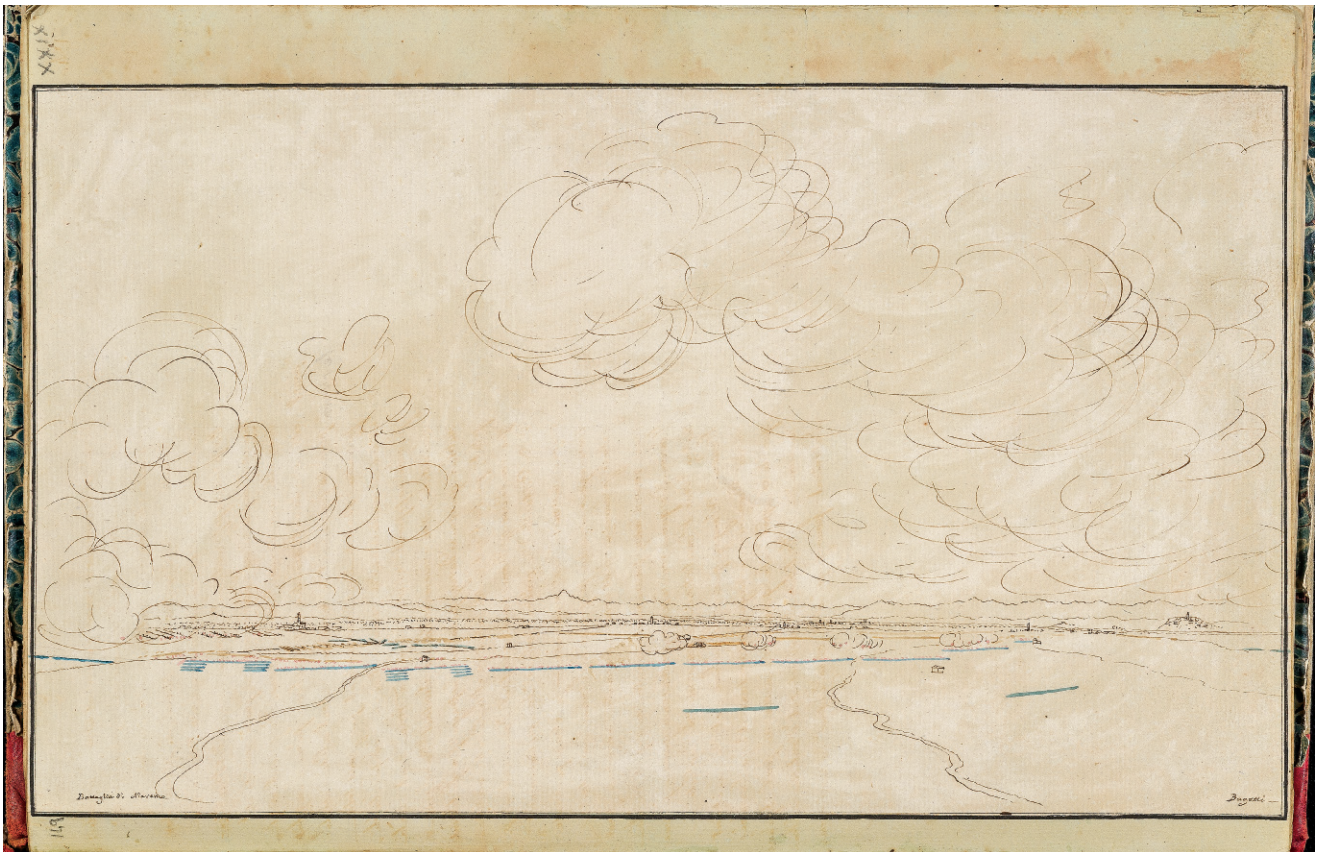


FIG. 548. GIUSEPPE PIETRO BAGETTI, SKETCH OF THE VIEW OF THE BATTLE OF MARENGO. From “Instructions faites par le chef de section Martinel dans les campagnes de l’an 11 et 12 pour les vues des champs de batailles tant français qu’ennemis.” Bagetti chose a perspective higher than the true point of observation in order to allow for the representa-

tion of troops on the plain of Marengo in June 1800. Those overseeing the *Dépôt de la Guerre* rejected the first painting based upon this sketch because it was illegible.

Size of the original: ca. 20 × 34 cm. Licensed by the Ministero dei beni e delle attività culturali e del turismo–Musei Reali Torino (MSS. Saluzzo 248).

Berthier was a member of one of the great French cartographic families of the eighteenth century—the eldest son of Jean-Baptiste Berthier, who had been the head of the king's *ingénieurs géographes* and the director of the celebrated *Carte topographique des environs de Versailles*. Louis-Alexandre Berthier had entered service as an *ingénieur géographe* at the age of fourteen and had served in this capacity during the American campaigns of the army of Jean-Baptiste-Donatien de Vimeur, comte de Rochambeau, accompanied by his very young brother (Rice 1972, 1:191–282).

Studying Berthier's work reveals the function of the battle plan. As a commemorative document, it played an important role in a small volume dedicated to a battle that was politically significant though tactically uninteresting. Parallel productions of battle views and other pictorial works could lead interpreters to emphasize the commemorative function and not to consider the scientific role of such cartography. While one should not ignore the battle plan's commemorative value (since the document, once created, could subsequently be used in different contexts), one should note that its creation was motivated primarily by the need to document the battle. The contradictions incorporated within it arose in particular from the divided loyalties of the mapmakers—cartographers and painters—who were sometimes forced to choose between military priorities and the requirements of their own disciplines (Godlewska, Létourneau, and Schauerte 2005; Pansini 2002, 212–25). As to painting, one should distinguish between a view—a genre of painting that was primarily documentary, rendered according to nature and assuming a value of reliable testimony—and the great historical paintings, which were more valued as a genre but were created in a workshop and not based on nature (Milizia 1797, 2:277). Both genres might represent war, but the first represented the battle and the second the drama of combat (Lavezzi 1999, 372). These different objectives yielded two different genres of painting, and only the first, which presented the disposition of troops, the terrain, and movement, was directly related to military cartography.

The battle plans and siege plans, whether manuscript or printed, were often accompanied by more general maps, sometimes called maps of troop movement, campaign maps, or maps of the theater of war. These were small-scale maps, compiled from a variety of sources and usually printed, which provided a composite view of the whole zone in which troops were moving and where the entire military campaign was unfolding. As indicated by their titles, these maps were geared toward either study or commemoration but were nonetheless necessary for understanding a campaign and comprehending its phases. Pierre-Joseph de Bourcet, in his work on moun-

tain warfare, went so far as to insert a general map to illustrate an imaginary campaign (fig. 549). These small-scale printed maps, often inserted in atlases, were usually copied from other medium- to small-scale general maps. But cartographers following armies on campaign were charged to prepare a type of map called a *carte de marches*. As the army moved along, the military topographers surveyed the surrounding terrain, their precision determined by their methods. They constructed their maps in a linear, nearly two-dimensional fashion, based on the surveyed valley or portion of the route. These sketches were assembled later in the camp or *cabinet*, then used for constructing a *carte de marches*, one of the cartographic tasks of a campaign, such as preparing plans of encampments, that was not directly linked to combat. The originals of these manuscript documents are rare in modern collections, for such sketches were not meant to be saved. Serving as the basis for more developed maps, they risked being destroyed, thus sharing the fate of many intermediate documents of cartographic production.

The same situation applies to the preservation of reconnaissance maps, although preparation of these maps was fundamental for military cartography. Right before a battle, an officer with topographic talent was responsible for reconnoitering locations to anticipate where the armies would fight and with which units. This reconnaissance resulted in a manuscript sketch, to which a short, written document might be added, that was presented to the general. The officer might also make notes on a preexisting plan in order to verify it. Urgency and the presence of the enemy certainly limited the possibility of exactitude. The importance of the work seemed inversely proportional to its possible precision. Reconnaissance was entrusted to the most experienced men; it allowed the talent of a military topographer to be recognized. But the manuscript documents produced, so valuable for the preparation of military action, had little in common with a finished map. In addition, the circumstances of conservation condemned them. Since these sketches were prepared in time of war, submitted in secret, and used during the heat of conflict, they were rarely conserved. Although hundreds of maps and plans preserved in archives and libraries bear the title “reconnaissance,” they very seldom correspond to productions made on the eve of battle. Their titles might indicate a later reworking of wartime reconnaissance or simply a document of limited precision. In addition, a true reconnaissance map always focused on the preparation for a battle or an encampment or choosing terrain for construction. Naming a cartographic document a “reconnaissance” map was a means to emphasize its function. The peacetime counterpart to wartime reconnaissance was spying operations, which required the same carto-



FIG. 549. PIERRE-JOSEPH DE BOURCET, *CARTE RELATIVE A LA GUERRE FACTICE*, 1775. Bourcet used this map concerning an imaginary war as a model for explaining mountain warfare. From Bourcet 1888, vol. 2, pl. 32.

© The British Library Board, London (General Reference Collection 8827.k.8).

graphic talent and military appraisal, and the resulting documents suffered the same fate.

Survey operations also occurred during peacetime. When engineers and military cartographers were not occupied by wartime labors, they participated in organized geometric surveys and thus produced maps of great precision. These highly technical maps (particularly those mapping mountains) focused on the frontier zones. Since armies confronted one another near the frontiers, access to these zones had to be denied to the enemy, defenses had to be organized, and finally, the army had to coordinate its movement and supplies near the border. For these reasons, military cartographers maintained a monopoly on the survey and representation of frontier zones, sometimes at the cost of conflicts with civil authorities (Pelletier 1990, 2001). The highest level of secrecy was applied to these documents. After 1789, and even more during the wars of conquest in the Napoleonic era, the situation changed radically. Frontiers were

crossed, confrontations took place in zones that had never been surveyed, and the terrain that was considered important to map was not the same anymore. The example of the French-Savoy frontier helps illuminate these changes. The alpine border, considered of the highest importance, had been the object of one of the most famous military surveys of the eighteenth century, begun in 1749 by Pierre-Joseph de Bourcet. But this same frontier was only peripheral to confrontations in 1795, when French troops bypassed the area, traveling along the Nice and Ligurian coasts to reach the valleys south of the Piedmont where the first great battles of this campaign took place. The almost complete lack of reliable documents for these areas swiftly became evident. Cartographic demands increased as the movements of the armies broadened in scope and separated them from their supply centers. All these factors required logistical autonomy that only a detailed knowledge of local resources could make possible. By the end of the 1700s,

the military machine carried to the extreme the trends already highlighted earlier in the century: harnessing topographical knowledge to allow the command to see, know, and control everything.

The last type of military cartography is a written document: the memoir. Sometimes called the military memoir and later the statistical memoir, it assembled data that the map alone could not convey. In 1763 Louis Charles Dupain de Montesson explained how to prepare them and what information merited inclusion. His list was not short: local population figures; number of mills, horses, and wagons; the nature of local commerce and the character of the land were just a few of the “principal items that should constitute the foundation of a memoir connected to a map drawn up for military service” (Dupain de Montesson 1763, 185). The memoir recorded facts relating to past conflicts that had taken place in the battle zone. For military analysis of a locale, a record of past battles was important. Whether it provided statistical or historical data, the textual memoir was thus conceived as an appendix to the map, permitting the study of a battle zone according to consistent rules of military science.

PERCEPTION AND CONTROL As European theaters of conflict broadened after the abandonment of siege warfare, cartographic documents and their annexed material fulfilled the need to see and register increasing quantities of information. Although everything was potentially useful for warfare, it was impossible to collect all relevant information. The central principle of military cartography was the regulation of the collection of information by adopting the most productive balance possible between satisfactory precision or detail and the time available to achieve it. The result was a trend toward idealization of both perception and control, two closely linked ideas that structured military thought in the eighteenth century. This system of thought joined cartographic practices to the heart of warfare.

Seeing is the first act in cartographic labor. The operation of perception precedes and permits that of reproduction. Writings and manuals by military topographers in the eighteenth century (e.g., Brück 1767; Dupain de Montesson 1763; Verkaven 1811) often evoked the desire to overcome any physical barriers limiting the possibilities of perception, whether endemic to the human organism or integral to the exterior world. The methods used proved the continual force exerted against these limits, which were often called “deformations.” Sight limits were used to evaluate distances, for it was known at what distance under particular conditions an observed object became indistinct. Further, based on experience and the establishment of analogies, one could deduce the form of terrain hidden from view (or that one

had insufficient time to traverse) from known, nearby terrain. Perfect vision—which had no limitations—remained the constant reference point for the military topographer, who was an incarnation of the sense of sight. He operated like a detached organ, an eye capable of autonomous perception. Connections with theories of perception in the age of Enlightenment, from René Descartes to John Locke, Étienne Bonnot de Condillac, and Denis Diderot are evident, even if the precise relationship is quite difficult to establish (Crary 1990; Hatfield 1990, 8–9). The eye, which was the topographer, nonetheless had to remain connected to the brain by direct and privileged communication in order use the information gained through perception. The brain was thus the general who, charged with the task of command, could manage the information sent to him by the eye in order to obtain final victory. The communication between the topographer and the general incorporated an idealized perception linked to idealized control: the act of complete perception was motivated by the act of total control. In fact, the battle was still conceived as a kind of duel between opposing commanders who would commit to the action all the means at their disposal by their own will. Once knowledge of all details was acquired, their application to the action at hand was thought to be possible without any other precondition. Such total knowledge leads naturally to the core of cartographic idealism: reproduction at a scale of 1:1, a document that so closely corresponds to reality that the possession of one equals the possession of the other. In order for the control and management of data to be thought possible, the cartographer nonetheless had to translate the perceived reality not only into cartographic language but into the language of military cartography (Pansini 2003). His chosen symbols did not refer simply to a perceived object, but to this object in its relation to the army’s needs. By providing information about the terrain that could be used in battle, cartography offered a technical means for the headquarters to control action during war and to understand it afterward. Cartography lay at the heart of the system—a tool permitting the perception of war despite its immense complexity (fig. 550).

The role of the military cartographer in such a situation may be compared to statistical investigation, in particular the descriptive statistics of eighteenth-century Germany (Garner 2006). The art of government and the art of war both aimed at control and employed parallel technical means to reach the necessary prerequisite for such control: knowledge. The documents emanating from these two scientific practices—statistical investigations on the one hand and memoirs connected with military maps on the other—resembled one another in substance and appearance, but they differed in their im-



FIG. 550. ENGRAVED FRONTISPIECE FROM P. P. A. BARDET DE VILLENEUVE, *TRAITÉ DE L'ARCHITECTURE MILITAIRE* (THE HAGUE: JEAN VAN DUREN, 1741). The work is volume 5 of Bardet de Villeneuve's *Cours de la science militaire*. The goddess Minerva stands before a scene of battle while putti use maps, a globe, and geometric instruments. Image courtesy of the ETH-Bibliothek Zürich, Archives and Private Collections (Rar 7516).

mediate goals and probably also in their relations with the object represented. Military cartography in fact represented an attitude more closely aligned with probability because it was more pragmatic: “in the sciences whose goal is to teach how one should act, one may, as in the conduct of life, content himself with greater or lesser probabilities, . . . the true method therefore consists less in searching out rigorously proven truths than in choosing between probable propositions, and especially in knowing how to evaluate their degree of probability” (Condorcet 1784, 50–51). In the eighteenth century, mil-

itary cartography was a science whose goal was to define how one should act and which, in its practices, chose to evaluate degrees of probability rather than to seek a rigorous demonstration of truth. This may be observed in the practice of measurement correction during a survey (operations continued not to the point of obtaining the perfect measurement, but to the point that the margin of error was small enough for the measurement to be useable) or in the investigation of resources (the quantities of interest were not the “true” quantities but those reported by the inhabitants, which indicated the useable quantity) ([Bourcet]1875; Dupain de Montesson 1763). Controlling error was a sufficient foundation for action, and it allowed engagement with the enormous quantity of data that one aimed to treat, translate, and include in a cartographic document. This leads to reflection on the nature of a map, what it aims to be, and, especially for the purpose of our analysis, how it should be evaluated. What is the measure of a map's precision? Is it the correspondence with reality or the relationship between the means applied and the preestablished goal of its production? The rhetoric of “precision” or “accuracy” may not only be anachronistic but completely out of step with the documents and their function.

“It mattered little to soldiers whether the earth was, according to Descartes and Leibniz, a little stagnant sun, or, according to Buffon, a splatter from the Sun itself” (Anonymous 1803, iii). What did matter to a soldier was the ability to represent the earth in order to command. However, knowledge was not merely a side effect of the science of war. The dialectic between knowledge and military demands was constant throughout the eighteenth century, and it aroused conflicts that by the century's end clarified the tendency of military cartography to affirm its autonomy from the goal of military victory.

These conflicts also concerned the place of cartography in the art of war. Among military writers are found not only numerous justifications of the central importance of cartography, but also their exact opposite, that is that war might be reduced to its geometric principles (Bülow 1801). If this conflict had no victor, it was nonetheless clear that when cartography and military cartographers detached themselves from the principal focus of warfare in their quest for scientific autonomy, cartography lost, almost by renunciation, its central place in the system of war. The result would become evident in the nineteenth century, when the trend grew for military cartography to produce documents of very high precision but more and more comparable and parallel to those of civil cartography.

VALERIA PANSINI

SEE ALSO: Engineers and Topographical Surveys; Military and Topographical Surveys; Military Map; Modes of Cartographic Practice; Topographical Surveying

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*Military Cartography and Topographical Surveying by the Austrian Monarchy.* Until well into the second half of the seventeenth century, military cartography played only a relatively minor role in the Austrian monarchy. In the event of war, military commanders had at their disposal *dessineurs* (draftsmen) who recorded positions, marches, and troop movements cartographically. They mapped the terrain on both sides of the marching lines, sketched reconnaissance, and recorded the battlefield during confrontations. In peacetime, military cartographers were mainly employed in the construction of fortresses. By the end of the seventeenth century, military cartographers had gained in prominence over civilian cartographers due to the second siege of Vienna by the Turks (1683) and the subsequent offensive war against the Ottoman Empire (1683–99), events that led Prince Eugene of Savoy to promote military cartography. In the first half of the eighteenth century, the Austrian monarchy relied almost exclusively on military officers and engineers for its cartographic production, and they subsequently provided the majority of maps and plans. The officers of the quartermaster general's staff (Gene-

ralquartiermeisterstab) were responsible for all military mapping, with the exception of fortifications. From the mid-eighteenth century, cartography was practiced for the most part within military structures in the Austrian monarchy. In 1758, the quartermaster general's staff, which had previously been disbanded after each military campaign, was established as a permanent institution. Its most important task in peacetime was to survey territories, to compile military-related land descriptions, and to make maps. From then on, only officers with a proven aptitude for cartographic work were commissioned. The imperial government's order for the first all-country survey from May 1764, conducted by the quartermaster general's staff, marked the beginning of official military cartography in Austria. Until 1918, military cartographers shaped most small-scale cartographic activity in Austria. Their work became the basis for and source of private sector civilian cartography.

A distinction between civilian small-scale cartography and military cartography along traditional lines does not seem useful during the Enlightenment. Due to the immense importance of military cartographers in terms of on-site surveying and cartographic representation of the Austrian monarchy (undertaken partly on behalf of civilian government institutions), "military cartography" is deliberately understood to be broader here than, for example, the term "military map" ("any map on either a large or a small scale made for military use or to show the results of military actions"; Wallis and Robinson 1987, 114). It is also different from Johannes Dörflinger's (1984) classification of eighteenth-century maps into "military cartography," "civil cartography," and "private commercial cartography" based on the concepts of "client" and "map purpose." This entry looks at military cartography in two ways: the surveying and mapping projects commissioned on behalf of military commanders or institutions for military purposes regardless of whether they were carried out by military personnel or by civilian cartographers, and the surveying and mapping projects carried out by military personnel on behalf of civilian governmental institutions. Not considered here are cartographic products made by military personnel for private commercial purposes (e.g., for private publishing houses) and commercial cartographic materials that reflected military events, which may have been drafted by military or civilian cartographers (for example, maps of military campaigns, battle plans, and war atlases), which may be found in other entries in this volume.

Military cartography started as early as the middle of the sixteenth century, primarily in the form of local surveys of fortifications. Natale, Nicolo, and Paolo Angielini from Milan made several manuscript maps of the Croatian, Slavonian, and Hungarian border areas

with the Ottoman Empire, as well as maps of other Austrian border regions and of the Hungarian battleground (Pálffy 2011).

Regular cartographic activity at the borders of the Austrian monarchy and the Ottoman Empire had already begun in the middle of the sixteenth century. The resulting manuscript cartographic representations were updated from time to time. Military cartography, in the sense defined above, became more established and tangible in the seventeenth century, mainly due to the military threat from the Ottoman Empire, which bordered on the Austria monarchy in southern and eastern Hungary at that time, and the subsequent wars with the Ottoman Empire (fourth Austro-Turkish War, 1661–64) through survey work connected to the installation of fortresses for defense and warfare. Numerous large-scale city and fortification plans, medium-scale maps of the vicinities of cities and fortresses, and smaller-scale maps of different zones were drafted by military cartographers in the area of the so-called *Militärgrenze* (military frontier), a region of varying width along the south, southeast, and eastern borders of the Austrian monarchy, which, irrespective of its constitutional affiliation with the Hungarian Crown, was used by the military administration to defend against the Turkish threat. Beyond a few names, little information exists about the authors of these cartographic representations, but Giovanni Battista Pieroni da Galiano, Johann Ledentu, and Martin Stier are especially well known.

From 1636 to 1639, the Innerösterreichischer Geheimer Kriegsrat placed Pieroni in charge of reports on the state of walled cities and towns in Croatia, Carniola, Styria, and Istria, including suggestions for their improvement. His 1639 report contained a number of completed manuscript plans and views. Ledentu's manuscript views and plans of fortified towns and villages in Hungary and in the border area with the Ottoman Empire also survive, drawn in 1639 on the order of Emperor Ferdinand III (Krompotic 1997).

From 1657 to 1660 Stier carried out imperial orders by inspecting fortified towns and settlements in Styria, Carniola, Croatia, and the Habsburg possessions on the Adriatic. He wrote descriptions of the conditions of fortifications, suggested improvements, and made cost estimates, which he enhanced with numerous large-scale plans and maps (fig. 551). Stier also produced drawings and plans of fortifications in Bohemia, boundary maps, and a map of Hungary and the neighboring areas, which was reproduced as a copper engraving in 1664 and 1684 (Nischer 1925, 25–26).

In the second half of the seventeenth century, the advance of the Turks to the north, the second siege of Vienna, and the war against the Ottoman Empire led to an upsurge of military cartography in the Austrian



FIG. 551. MARTIN STIER, "ABRIß DER VÖSTUNG CARLSTADT SAMBT DEN VORLIGEN DEN WACHTEN UND PÖSSTEN," IN HIS "RELATION UND BERICHT," 1660. Ink on paper, hand colored, ca. 1:90,000. Map of the southern vicinity of the fortress Carlstadt (today Karlovac) with several

military-related elements with regard to defensive fortifications against the Ottoman troops.

Size of the original: 37.5 × 50.4 cm. Image courtesy of the Sammlung von Handschriften und alten Drucken, Österreichische Nationalbibliothek, Vienna (Cod. 8608, fol. 74r).

monarchy. Mostly under the orders of Prince Eugene (commander in chief of the imperial army and, from 1703, president of the Hofkriegsrat), military engineers over the course of numerous wars produced a considerable number and variety of maps, especially fortification plans, siege plans, and war and boundary maps. Standing out among them are several siege plans of Vienna by Daniel Suttinger, as well as by Leander Anguissola (Broucek, Hillbrand, and Vesely 1983); the map of Transylvania with several cartographic elements related to the recent campaigns against the Ottoman troops drawn by Giovanni Morando Visconti and printed in 1699 (Plihál 2000); and the map of the new border with the Ottoman Empire after the Treaty of Karlowitz, drawn in 1706 by Johann Christoph Müller (see fig. 101). Luigi Ferdinando Marsigli and Müller made astronomical lo-

cation measurements and surveys in Hungary, Croatia, and Slavonia; drew maps of these areas; and produced, among other things, a detailed map of the Danube between Kahlenberg, near Vienna, and the mouth of the Yantra River in northern Bulgaria, finally published in 1726 (see fig. 530).

For the training of Austrian military engineers, who were now responsible for cartographic work, the Militär-Ingenieurakademie was founded in 1717 in Vienna, with Anguissola as director and Johann Jakob Marinoni, surveyor, cartographer, and court mathematician, as his deputy. They instituted a curriculum of theoretical and practical surveying and of map drawing at the highest level.

Commissioned by Emperor Joseph I, Anguissola and Marinoni drafted a detailed map of Vienna based on



surveys conducted in 1703–4 and printed in 1706 (Mokre 1995a). Werner Arnold Steinhausen drafted another survey-based manuscript map of the city of Vienna in 1710—presumably on behalf of the Lower Austrian Estates (Mokre 1995b).

Numerous militarized conflicts in the first half of the eighteenth century (War of the Spanish Succession, wars against the Ottoman Empire, War of the Polish Succession, War of the Austrian Succession) caused engineer officers to draft copious maps and plans of the war theaters in Flanders, Sicily, and Walachia. Of particular note are the operation maps of the campaigns of Prince Eugene on the upper Rhine (1702–13), in southern Germany (1702–12), and in Hungary (1716), and some battle plans and operation maps of Sicily (1718–20) drafted by Cyriak Blödner (Bonacker 1957). During the war against Spain, troops were to reconquer Sicily. On the imperial command from Austrian engineer officers, Samuel von Schmettau was commissioned to draft a map of Sicily, Malta, and Gozo based on surveys in 1719–21 (Dufour 1995; Hühnel 1995) (see fig. 305). In 1722 military cartographer Friedrich Schwantz (later von Springfels) drew a map of Lesser Walachia (Holban 1997). A map of the Banat of Temeswar made on the orders of Prince Eugene by D. Haring in 1723 still survives. In 1733 and 1734, Johann Conrad von Weiss undertook a major topographic survey in Transylvania.

But even in peacetime, military cartographers were entrusted with important cartographic work. Emperor Joseph I wanted a survey of his lands and transferred this task to Johann Christoph Müller, who had already achieved great acclaim as a military cartographer. Müller drafted a map of Hungary and Transylvania (retaken from the Turks) that was engraved on copper and printed in 1709. Müller also made maps of Moravia (1716) and Bohemia (1722). Müller died in 1721 before completing his map of Silesia, but his work was continued by Johann Wolfgang Wieland and Matthäus von Schubarth and published in 1752 (Konias 1995). The Estates mainly provided the financing of these four national maps, but the Hofkriegsrat also made a financial contribution. In 1747, those engineer officers working as fortress builders, surveyors, and cartographers in the imperial army were combined into a special military unit, the *k. k. Geniekorps* (Imperial and Royal Engineering Corps).

The Austrian monarchy, consisting of the Austrian hereditary lands, the lands of the Hungarian Crown, the Austrian Netherlands, and the Austrian possessions in Italy, always had a decentralized structure managed by civil governments, which only shared a sovereign and supreme authority for the conduct of foreign affairs of war and finances. Correspondingly, there had only been a need for maps of individual territories, not for a unified cartographic representation of the whole. Military

necessity, however, made the preparation of such a map compulsory. For this reason, officers destined for the newly founded *Geniekorps* drafted and designed a large general map of Habsburg landholdings even before the corps was officially established (Regele 1947).

In 1750, Constantin Johann Walter, who produced numerous maps and plans for military purposes, executed an accurate survey of the city of Vienna. This was most likely done under the auspices of the *Ingenieurkorps*, which was responsible for supervising fortifications. Based on his survey, Walter drafted a map that focused on a detailed representation of the fortifications of Vienna (Ulbrich 1955–56) (fig. 552). In addition, Empress Maria Theresa commissioned Walter to include a detailed survey of the border area between the two Habsburg territories of Lower Austria and Hungary. He completed these projects between 1754 and 1756 and drew a highly detailed map of the area in 1756 (Ulbrich 1952).

After the end of the War of the Austrian Succession (1740–48), Austrian officers began topographic surveys and the development of standardized manuscript maps of larger areas of the monarchy. From 1749 to 1753, Johann Lambert Kolleffel produced a very detailed manuscript map and a topographical description with more than five hundred detailed settlement plans of the margraviate of Burgau in Swabia, which was under Habsburg rule (Pfaud 1974). This map is considered the oldest example of surveying and mapping of a larger area by the quartermaster general's staff and was a precursor to the *Josephinische Landesaufnahme*, the first general government land survey of the Austrian monarchy and named after Emperor Joseph II.

The heavy losses incurred by Austria during the Seven Years' War (1756–63), made the lack of reliable maps for warfare abundantly clear. After the Treaty of Hubertusburg (1763), Franz Moritz Graf von Lacy reported this dearth of cartography to the president of the Hofkriegsrat, Leopold Joseph, Graf von Daun, who forwarded the report to Maria Theresa. Already in 1763, officers of the quartermaster general's staff began mapping the part of Silesia that the Austrian monarchy had retained. After this work was successfully completed in April 1764, the quartermaster general's staff, on imperial command, began surveying and mapping the entire territory of the Austrian monarchy using uniform techniques, scales, and symbols. The military was the only state institution able to cope with such a large and lengthy task, for which it had adequately trained staff. By 1787 almost the whole territory of the monarchy had been surveyed, at a scale of 1:28,800, province by province, without a uniform triangulation grid. A plane table was used independently for each survey of the individual territories, and in the beginning, older maps served as base maps for some regions (fig. 553).



FIG. 552. CONSTANTIN JOHANN WALTER, "PLAN VON DER KÄYSERL: KÖNIGL: RESIDENZ UND FESTUNG WIENN," 1750. Ink on paper, ca. 1:1,800. This remarkably accurate plan of the city of Vienna with its fortifications is based on an original plane table survey.

Size of the original: 111 × 115 cm. Image courtesy of the Kriegsarchiv, Österreichisches Staatsarchiv, Vienna (Kartensammlung G I h, 768-10).

In some surveyed areas, military cartographers under imperial orders were charged with conducting necessary economic surveys for tax collection and administration of civil government; some of them were directly employed to measure the properties required for the cadastre. This became an inextricable link between military defense and civil government activity.

Mapping of the Austrian Netherlands in the years

1770 to 1775 was not carried out by officers of the quartermaster general's staff. Instead, it was modeled on the *Carte de France* and executed on a scale of 1:11,520 under the leadership of Joseph Jean François de Ferraris and members of the imperial Austrian Netherlands field artillery corps.

The quartermaster general's staff worked continuously until 1805 to revise measurements in Bohemia,

Moravia, and Silesia; to perform the cartographic surveys of Tyrol and Lombardy; and to map newly acquired territories of western Galicia and Venice. In the course of the war against the Ottoman Empire from 1788 to 1790, they made surveys of western Moldavia and Walachia, as well as parts of northern Serbia. During the wars against the French Republic, from 1792 to 1802, they mapped larger areas of southwestern and southern Germany (including Austrian Vorarlberg), a part of northeastern France, and parts of northern Italy and Switzerland as well as northern Istria (Nischer-Falkenhof 1937, 86–87).

In 1776, the president of the Hofkriegsrat, Andreas Graf Hadik von Futak, decreed the consolidation of all militarily relevant maps and plans and corresponding textual descriptions into the office of the Hofkriegsräthliches Archiv (from 1801, Kriegsarchiv). The so-called Karten-Depot (Map Collection) was the first headquarters of state cartography.

By 1805, Austrian military cartographers had sur-

veyed and mapped an area totaling approximately one million square kilometers in central and eastern Europe, a breadth of coverage that exceeded all other European surveys of the eighteenth century, making their work one of the most remarkable achievements of European military cartography. The policy of secrecy based on military considerations meant these cartographers did not receive contemporary international recognition. Only three maps from the Josephinische Landesaufnahme were printed: the *Carte chorographique des Pays-Bas autrichiens* (1777–78) (see fig. 238), the *Mappa von dem Land ob der Enns* by Carl Schütz and Franz Müller (1787) (Dörflinger 2004, 112–13), both at reduced scales, and a map of Vienna and its surroundings by Stephan Jakubicska, *Neuester Grundriss der Haupt und Residenzstadt Wien* (first published in 1789) (Oppl 2004, 63–64) (see fig. 69).

While work on the Josephinische Landesaufnahme was taking place, Austrian military cartographers completed other important cartographic projects until the

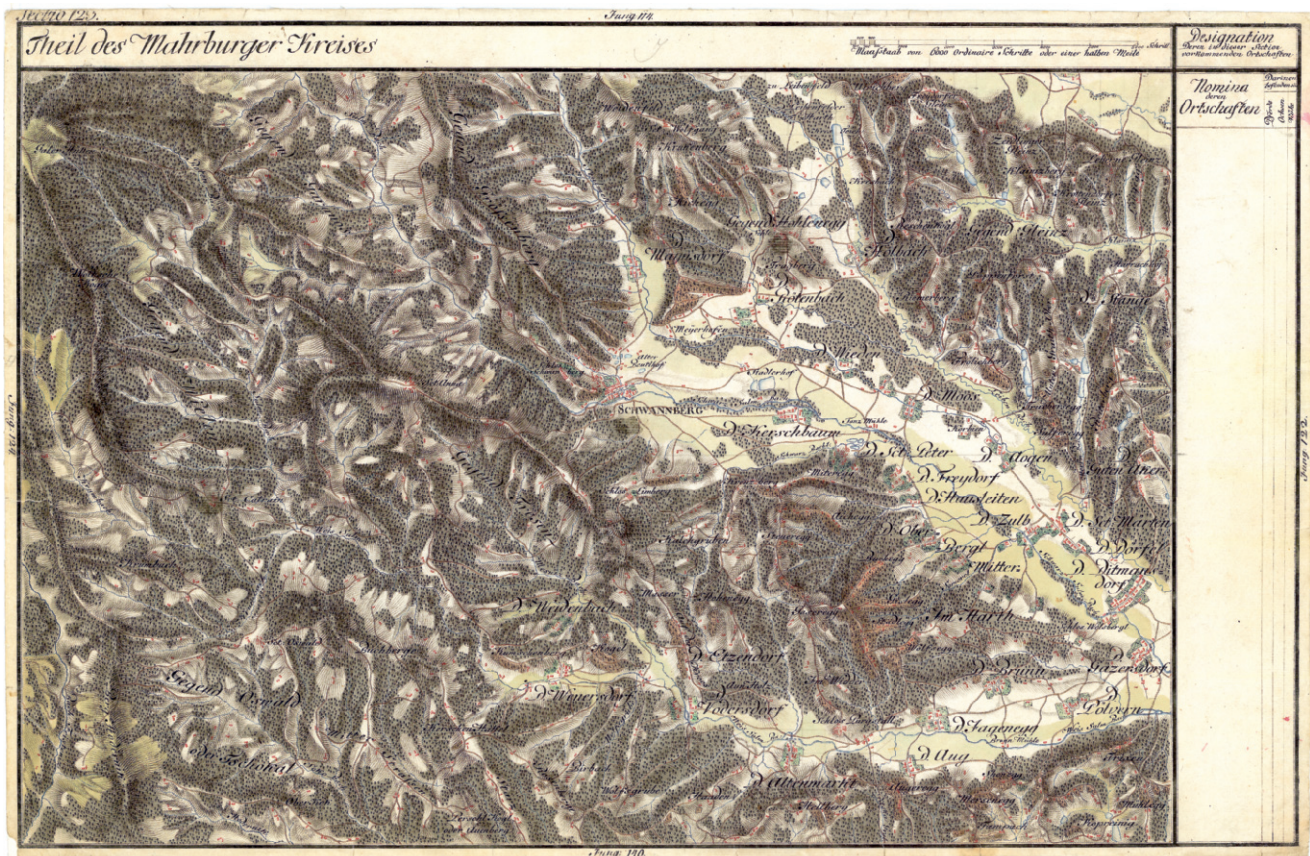


FIG. 553. AUSTRIAN QUARTERMASTER GENERAL'S STAFF, "THEIL DES MAHRBURGER KREISES," 1784–87. Ink on paper, hand colored, 1:28,800. One of the more than 3,500 sheets of the Josephinische Landesaufnahme showing the area around the township Schwanberg in western Styria (Austria).

Size of the original: 46.0 × 71.8 cm. Image courtesy of the Kriegsarchiv, Österreichisches Staatsarchiv, Vienna (Kartensammlung B IX a 54 Section No. 123).

end of the century. Ignaz Müller executed a manuscript map of Hungary from 1764 based mostly on classified military documents, on behalf of Lacy. This map was printed in 1769 in a very small number of copies with the title *Mappa geographica novissima Regni Hungariae* (Bendefy 1974; Dörflinger, Wagner, and Wawrik 1977, 174–75). In 1769, Joseph Daniel von Huber, who worked on the survey of Bohemia, on his own initiative drafted a large and extraordinarily attractive bird's eye view of Prague titled *Wahre Laage der Königlichen Haupt und Residentz Statt Prag* (Mokre 2017). Maria Theresa bought this map with her own funds and commissioned Huber to produce the same kind of map of Vienna, with her financial backing. From 1769 to 1773, Huber was released from his other survey-related duties while he drew the map "Scenographisch. oder Geometrisch: Perspectiv. der Kayser. Königl: Haupt u: Residenz-Stadt Wien" (1773), published as *Scenographie oder Geometrisch Perspect: Abbildung der Kayl: Königl: Haupt u: Residenz Stadt Wienn in Oesterreich* in 1778 (Heinz and Mokre 1991–92) (see fig. 889).

When Austria gained possession of sea and coastal territories and an Austrian navy became part of the imperial forces at the end of the eighteenth century, its mapping efforts were based on Venetian, Neapolitan, and French preliminary surveys. Austrian marine cartography did not begin until 1810 and therefore lies outside the scope of this volume.

JAN MOKRE

SEE ALSO: Anich, Peter; Austrian Monarchy; Josephinische Landesaufnahme (Josephine Survey; Austrian Monarchy); Marinoni, Johann Jakob; Mikoviny, Samuel; Müller, Johann Christoph

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**Military Cartography by Denmark and Norway.** In the seventeenth century, Denmark’s army comprised the militia and a standing army dominated by expensive foreign mercenaries; after 1650, reliance on foreign troops steadily decreased as the Danish kings marshaled their resources to turn Denmark, by 1700, into one of the most militarized states in Europe (Kaspersen 2004, 80). Denmark’s military growth emphasized its large navy, infantry, and a cavalry freed from the control of the nobility. To improve the quality of officers, the Søkadetkademi was established in 1701 to teach midshipmen all aspects of ship handling and navigation and the Landkadetkademi in 1713 to educate boys in military practice. Even so, the officer and specialized corps continued to be dominated by foreigners and, until the political reforms of 1772, the language of the military command remained German. Thus, a Danish corps of engineers was organized in 1684 (Mead 2007, 1800n66) but relied on engineers trained elsewhere in Europe. In this context, while several wars produced a demand for both

the mapping of fortresses and their environs as well as of battles, military cartography by the Danish-Norwegian state was poorly organized before 1800.

An initial period of fortifications and other military mapping was accomplished in Denmark by a group of Silesian-born engineers who arrived in the 1640s and 1650s to work on Frederik III’s expansion of the fortifications of Copenhagen and of multiple towns in Jylland (Jutland): Georg Hoffmann, his younger brother Gottfried, and their cousin Christoph Heer. Together, they produced a number of maps of the newly established fortress of Frederiksodde (Fredericia), placed strategically on the sound between Jylland and Fyn. During war with Sweden 1657–59, Gottfried worked first in the ceded areas of Skåne and was later moved to Copenhagen during the siege of that city; he continued to map various fortifications and their environs (fig. 554) until his death in 1687, after which there were few military mapping activities in Denmark. Georg was likely responsible for

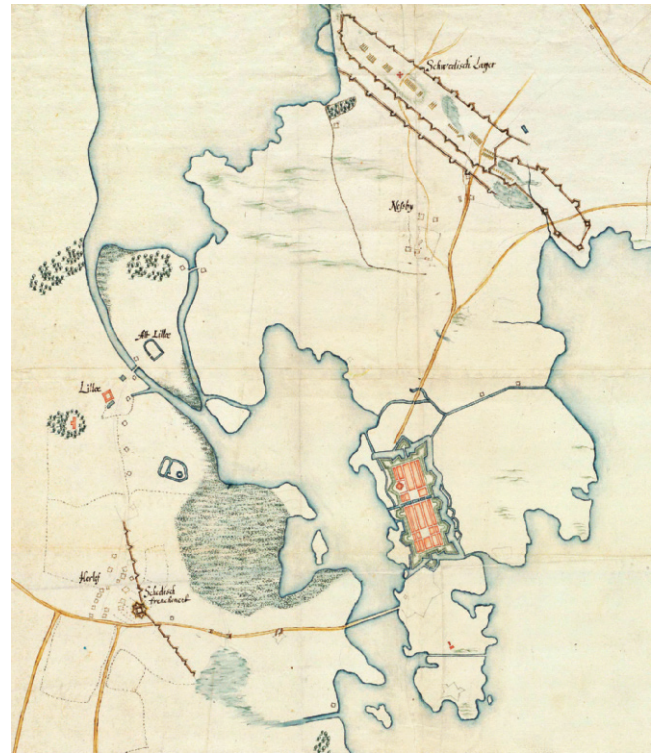


FIG. 554. DETAIL FROM GOTTFRIED HOFFMANN, “CHRISTIANSTATT AO 1677 BEY KONIGL. SCHWEDISCHE ARMEE BELAGERT,” 1677. This manuscript plan depicts an early stage of the Swedish siege of Kristianstad during the Scanian War (1675–79), before the Danes ultimately surrendered in August 1678. The Swedish lines are clearly indicated to the north and west of the walled city. Size of the original: 62 × 52 cm. Image courtesy of Det Kgl. Bibliotek; The Royal Danish Library, Kortsamlingen, Copenhagen (KBK Ingeniørkorpsets Samling XVIII, 4, 1).

creating a particular technique, common to this group's otherwise manuscript maps, of using a hand press with metal type to impress place-names (Dahl 2003). This technique can be seen in the large map of Denmark and Norway that Gottfried compiled for the Crown in about 1660, "Daniae et Norvegiae tabvla" (see fig. 203).

An active effort was made to map the fortifications and terrain of Norway in the same era. In 1644, Isaac van Geelkerck, a Dutch military engineer, was engaged to construct fortresses and make military maps. Over the next thirteen years, he produced hundreds of maps, from detailed fortress plans (at about 1:2,000) to general maps, including sources for the "Daniae et Norvegiae tabvla." Unlike in Denmark, mapping of fortifications continued into the eighteenth century; many of the resulting plans of towns and fortresses were collected in the great atlas assembled by Frederik V, including detailed plans of Christiania (Oslo), Bergen, Trondheim, and Frederikssten.

General topographical mapping of Denmark was limited. In seeking to rationalize the income and military supplies received from royal estates, Christian VI commissioned a series of surveys in 1720–23 by Captain Abraham Christian Willars of each *rytterdistrikt* (cavalry district; see fig. 16). These topographical maps would be supplanted after 1762 by the survey and map of the Kongelige Danske Videnskabernes Selskab. The academy's maps were criticized by military officers, especially for their lack of detailed terrain information.

In the period 1752–66, the border between Norway and Sweden was finally mapped by military engineers after an agreement between the two countries, with complete sets of these maps deposited in the Swedish and Norwegian state archives. Some of the maps from the same survey, made by Jørgen Nicolai Holm, are also in the so-called Frederik den Femtes Atlas. Hostilities continued despite the boundary agreement and survey, so that in 1771 German-born general Heinrich Wilhelm von Huth, chief of the engineers and artillery corps, moved to Norway to survey the border areas. Managing to secure the requisite funding, Huth was central to the founding in 1773 of the Norges Grændsers Opmaalning (later the Norges Geografiske Opmåling) (fig. 555). Starting in 1779 the survey undertook a systematic triangulation by Johan Jacob Rick (or Rieck) and Ditlev Wibe, who had been trained in Copenhagen by Thomas Bugge. After 1805, the topographical survey was extended to include more detailed surveys to serve as the basis for a land registry (Harsson and Aanrud 2016, 14–33).

Huth also cultivated a young military engineer and instructor at the military academy in Christiania, Jørgen Henrik Rawert. On his return to Copenhagen after 1790, Huth brought Rawert with him and secured his position as an instructor at the military academy there. Also, with the permission of the Crown prince, the future Frederik VI, the effective ruler during the mental infirmity of Christian VII, Huth had Rawert undertake a



FIG. 555. DETAIL OF THE SOUTHEASTERN CORNER OF KVADRATMILKART 101, 1781. One of the 210 manuscript *kvadratmilkarten* (military squares) mapped at 1:10,000 by the Norges Grændsers Opmaalning between 1774 and 1808. The series covered most of Østfold and the border portions

of Akershus and Hedmark as far north as Sør-Trøndelag. For modern reference, this detail shows the area between Fagernessjøen and Lake Hærssjøen (north and south). Image courtesy of Kartverket, Norges Geografiske Opmåling, Hønefoss (Kvadratmilkart 101).

secret project to map the regions north of Copenhagen at the large scale of 1:13,333. Detailed information on this project is lacking, and only about fifteen manuscript maps are preserved today in Rigsarkivet. In this work, Rawert followed the methods he outlined in his instructional text on military surveying, *Forelæsninger over den geometriske trigonometriske og militaire landmaaling tilligemed nivelleringen* (1793), which included standardized sets of map signs. After Copenhagen's great fire in 1795, Rawert was appointed as town architect in charge of the reconstruction.

Only in 1808 did the quartermaster general's staff organize a more systematic survey of Denmark (Korsgaard 2006, 56–57). The Danish corps of engineers made many maps of both Danish territories and of foreign areas and fortresses, both for the education of engineers and for actual use in battles. The whole collection has been divided between Rigsarkivet (Statens Arkiver) for the Danish areas and the Kongelige Bibliotek for foreign areas; all maps and plans of Norway from these collections were transferred to Norway in 1935 following an agreement with the Norwegian government.

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SEE ALSO: Denmark and Norway; Urban Mapping: Denmark and Norway

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**Military Cartography by France.** As military cartography expanded and developed in France in the sixteenth century, it increasingly became the work of specialists. Although its products remained largely in manuscript, certain maps were engraved: some had only a limited circulation, others celebrated royal victories, and still others added to the documentation available to commercial editors of maps and atlases. During the seventeenth century, military cartography benefited from the creation of the royal service of fortifications, whose engineers (*ingénieurs du roi*) had to measure and survey the fortified places of their respective provinces. During the reign of Louis XIII (1610–43) the number of *ingé-*

*nieurs du roi* increased to around fifty. They produced numerous manuscript atlases covering the frontier provinces and several European countries.

The reign of Louis XIV (1643–1715) confirmed the importance of maps: they accompanied the king in his travels, depicted the fortified places defending the frontiers (which were transformed by Sébastien Le Prestre, marquis de Vauban, and received royal visits), and kept alive the memory of glorious engagements. The ornamentation of maps intended for the king, particularly the cartouches, was often rich and original. Texts and paintings demonstrate Louis XIV's interest in maps of theaters of operation (fig. 556), an interest shared by his minister François-Michel Le Tellier, marquis de Louvois, who possessed a substantial collection of maps (mostly in manuscript) mentioned in an inventory after his death (Pelletier 2012, 20). Among the manuscript atlases at the king's disposal were compendia of the campaigns of Louis XIV, which focused on the war in Holland between 1675 and 1678. Composed on vellum, these were the work of Jules Louis Bolé, marquis de Chamlay, *maréchal général des logis aux armées et camps du roi*, and his collaborator François La Prée, first baron of Bontin (Martin 1972; Cénat 2006). Composed of texts, maps, and paintings (either map cartouches or views covering the whole page), they show a collaboration of talented artists. In the seventeenth century, the great master of the engraved military commemoration was Sébastien de Pontault, sieur de Beaulieu. A 1647 royal privilege gave Beaulieu—*commissaire ordinaire* and *contrôleur de l'artillerie* in Arras, but also *ingénieur et géographe ordinaire du roi*—exclusive right to the publication of views and maps of sieges and battles, plates that were intended as tools of propaganda (fig. 557).

The collection of fortification plans corresponded to the rationalization and the consolidation of the frontiers. Several series of manuscript atlases reminded the king of his initiatives. One series on vellum, dating from the 1680s, includes three volumes dedicated to France, with sumptuous cartouches ornamenting the maps (Vincennes, Service Historique de la Défense, atlas 108 [1–3]). Another (dated 1693), copied during the War of the League of Augsburg, consists of two volumes, while a brightly watercolored series, dating from the beginning of the eighteenth century, maps the areas surrounding fortified places along the frontiers (Paris, Bibliothèque nationale de France, Cartes et plans, Rés. Ge. DD. 4585 and Rés. Ge. DD. 4586 [1, 2, 4 and 6], respectively).

Richer in detail was the collection of *plans-reliefs*, which grew rapidly to 144 models by 1697. These "portraits in relief" modeled the cities and surrounding countryside extending out to the range of artillery volleys (Warmoes 2006). Vauban judged them too costly, but useful for convincing his interlocutors. The interest in new fortifications and the attraction of siege warfare,



FIG. 556. CHARLES LE BRUN, “LE ROI DONNE SES ORDRES POVR ATTAQVER EN MESME TEMPS QVATRE DES PLVS FORTES PLACES DE LA HOLLANDE, 1672.” This painting decorates the ceiling of the Hall of Mirrors (La galerie des Glaces or Grande Galerie) at Versailles, completed around 1678. The map locates “four of the strongest fortified towns in Holland”: from south to north, on the left bank of the Rhein, Orsoy, Rheinberg (Rhyenberg), Buderich (Burick); on the right bank, Wesel. Figures dressed in Roman clothing surround the king: on his right (on the left in the painting), his brother, Monsieur (Philippe [II] d’Orléans), and le Grand

Condé (Louis II de Bourbon); on his right, Henri de la Tour d’Auvergne, vicomte de Turenne. Paul Pellisson-Fontanier, the royal historian, wrote in a letter (20 May 1672) to Madeleine de Scudéry: “We have seen him these past days at his *petit coucher* with his back turned [to us] at a large geographic map made expressly for the purpose, amusing himself by putting his finger, without ever missing, on places of some consequence whose names were proposed to him” (Paul Pellisson-Fontanier, *Lettres historiques*, 3 vols. [Paris: F. Barois, 1729], 1:78–79). Réunion des musées nationaux (Inv. 2920, Musée national du château et des Trianons, Versailles)/Art Resource, New York.

conceived as veritable theatrical performance, stimulated the publication of atlases. The *Plans et profils* of fortified cities, abundant in the seventeenth century, disappeared in the following century, while the “theaters of warfare” developed: collections of maps and plans illustrating the latest campaigns or separate maps depicting the theater of operations.

In 1688 Louvois ordered the centralization of the correspondences received by the war services. At this time

military command was making systematic use of maps that provided information on topography of regions traversed by its personnel—routes used and usable, places fit for encampment and for battle—and reports on the local resources required by armies in the field. The first *ingénieurs géographes* (geographic engineers), initially called *ingénieurs des camps et armées*, attempted to respond to these exigencies. Instead of leaving service during peacetime, they remained to update their documen-



tation and, if necessary, to make reductions of the maps surveyed during the campaigns. At the beginning of the eighteenth century, the *Dépôt des cartes et plans de la Guerre* was created to collect and conserve cartographic materials for future use either at Versailles or in the field.

In addition to the maps required by the campaigns, military engineers, either *ingénieurs géographes* or *ingénieurs du roi* (fortification engineers), dedicated themselves to the cartography of frontier provinces. Their first surveys resulted in maps at a scale of 1:28,800: a map of the Atlantic coast drawn up between 1688 and

1724 by Claude Masse, a map of the Flanders border carried out in 1723 by Jacques Naudin, le jeune, and a map of the northern border by Masse and his sons, surveyed between 1724 and 1737. The map of the Pyrenees by Roussel, first geographic *ingénieur en chef*, and Jean-François de La Blottière, *ingénieur des fortifications*, was completed in 1730 at the scale of 1:36,000. Although subject to justified criticism, the map was nonetheless engraved at a smaller scale of 1:216,000, certainly for limited and controlled circulation.

The precision of French military cartography pro-



FIG. 557. SÉBASTIEN DE PONTAULT, SIEUR DE BEAULIEU, *BATAILLE DES DUNES PREZ DUNQUERQUE GAGNÉE PAR L'ARMÉE DU ROY COMMANDÉE PAR LE VICOMTE DE TURENNE, SUR L'ARMÉE D'ESPAGNE COMMANDÉE PAR DON IUAN D'AUSTRICHE, LE 14 IJUN 1658, ENGRAVED BY FRANÇOIS ERTINGER (PARIS, S.D.)*. Engraved well after the Battle of the Dunes by

Jean Baptiste Hamont, sieur Des Roches, the nephew of Beaulieu, who used the services of Ertinger. This impression was taken after the plates had been acquired by the Cabinet du roi in 1727.

Size of the original: 44.4 × 52.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge CC 4804 [11]).

gressed in the second half of the eighteenth century thanks to the adoption of a framework of large triangles, following the example of the work by the Académie des sciences and the Cassini family (Pelletier 2006). At the same time, maps of fortifications were specifying the altitude of several points. Ministers of war, such as Marc-Pierre de Voyer de Palmy, comte d'Argenson, and Étienne-François, duc de Choiseul, encouraged the progress of cartography. In 1748 d'Argenson founded the École du Génie de Mézières to provide *ingénieurs des fortifications* with well-structured training in cartography, at the expense of the *ingénieurs géographes*, who were less numerous and not as well organized.

The military engineer played an important role: he saw what ministers and generals could not see and communicated it to them—orally, in writing, or with the help of a map that could replace or complement a visit to the field. The surveys, generally at a scale of 1:14,400, were accomplished with a plane table, compass, and surveyor's chain. The engineer had to know what strategists would require and to imagine military action in the space he was describing (Pansini 2003). Although quite often unfamiliar with the places he was mapping, he knew how to take into account the variety of terrains. The colors he used attempted to reproduce those of the countryside, which facilitated interpretation of his work.

The first framework of large triangles was established by a civilian, César-François Cassini (III) de Thury. Beginning in 1746, he applied to Flanders and Brabant the triangulation operations completed in France. Two years later, French troops invaded the *comté* of Nice, and the minister of war immediately ordered an *ingénieur géographe* to carry out the triangulation operations that had to precede surveys and were to extend as far as possible. Pierre-Joseph de Bourcet, an *ingénieur du roi*, was named director of the map, which was at a scale of 1:14,400 and based on this triangulation (fig. 558); the surveys extending to the Dauphiné mobilized three *ingénieurs géographes*—Jean Villaret; Louis Charles Dupain de Montesson, theoretician of the graphic representation; and de Montannel (Michel-Jean-Auguste Cruels)—as well as seven *ingénieurs du roi* (Limacher 1963). Villaret executed two reductions of the map of the upper Dauphiné and the *comté* of Nice, at scales of 1:28,800 and 1:86,400 respectively; the second, engraved in 1758, was intended for limited circulation (see fig. 543). The work of Bourcet marked an important step in the representation of relief in a more or less accessible area crossed by many roads. The engineer used color and shading, combining a vertical projection for the middle heights with a cavalier's perspective for the highest ranges.

The makers of boundary maps had both military and political goals in mind. The precision afforded by



FIG. 558. DETAIL OF LIEGE FROM A SHEET OF THE MAP OF BELGIUM AT A SCALE OF 1:14,400. Produced by French *ingénieurs géographes* in 1748 based on the triangulation of Cassini III.

Size of the entire original: 67.5 × 95.0 cm; size of detail: 38.0 × 40.5 cm. Image courtesy of the Cartothèque, Institut géographique national, Saint-Mandé (chem. 292-69).

the geometric operations made these documents indispensable. Thus, Bourcet participated in establishing the Franco-Sardinian border, and the minister for foreign affairs created a map depository in 1772, first integrating the collection of Jean-Baptiste Bourguignon d'Anville. Texts establishing standardized procedures were also needed: in 1755 Cassini III provided instructions for a survey of the Channel coasts, and in 1761 instructions were sent to the engineers of the army of the Bas-Rhin (Bousquet-Bressolier 2002, 50–51).

The Seven Years' War increased the number of *ingénieurs géographes* to forty in 1765 (Berthaut 1902, 1:40), while the ordinance of 1762 established that the corps du Génie should include four hundred officers, all *ingénieurs du roi* (Blanchard 1979, 218). The end of the war saw increased cartographic operations of a broad scope, as designed in a 1762 program by Jean-Baptiste Berthier. Enjoying Louis XV's favor, Berthier became the mainspring of the "Carte des chasses du roi," the surveys for which were undertaken by the *ingénieurs géographes* in 1764 and finished in 1774 (Blumenfeld 1997). As head of the *ingénieurs géographes* and of the Dépôt des cartes et plans de la Guerre from 1758, Berthier deemed two activities most important: the survey of the French colonies and the survey of France's coasts, to complement operations already carried out along the land frontiers (Ract 2002, 5–29).

Work in the colonies began in 1764 in French Guiana and Guadeloupe, at Martinique, Saint Lucia, and Saint Domingue (Berthaut 1902, 1:38–39), while work continued on the land frontiers of the kingdom. In 1768 *ingénieur géographe* Joseph Tonnet, who had worked on Cassini's map, was ordered to assemble an atlas of fortified locations in Alsace as well as a general map of the province. Tonnet had to conform to the orders of the director of fortifications, a requirement that he did not appreciate (Berthaut 1902, 1:56–57, 85–87, 90–91). On the northern frontier, beginning in 1771, the *ingénieurs géographes* attempted to improve upon the works of the Masse family by conforming them to the Cassini map of France, an exercise that proved difficult (Berthaut 1902, 1:49–56).

In 1771–72, mapping the Atlantic coast, continually menaced by the English enemy, became urgent, and in April 1774, priority was given to the Breton coastlines, whose survey was completed in 1785 (fig. 559). Instructions for these surveys had been drawn up in 1771: only the regions close to the sea were to be surveyed, quality triangulation was extended to islands and rocks overlooking the sea, and the detailed illustration of numerous features limited the need to rely on written reports accompanying the maps (Ract 2002, 191–95). Although the first sheets were very precise, those following were

somewhat less so. These surveys remained incomplete: the sea from which islands and rocks projected bore no indication of depth because the hydrographers had not been able to fulfill their mission, thereby opening a significant rift between topography and hydrography.

In 1774, the minister of war decided to create a series of atlases of French fortified places—one atlas per fortified site containing three principal maps, one of which expressed height measurements (Lacrocq 1981). An important stage had been reached that would lead to a map showing respective levels using contour lines, later carried out in Italy for the great projects of the Consulate and the Empire.

The cartographic projects of the military engineers culminated in the works of Jean-Claude-Eléonor Le Michaud d'Arçon, who became an *ingénieur du roi* in 1755. He was charged twenty years later with continuing Bourcet's map of the Dauphiné and Provence frontiers. In instructions of 1777, Le Michaud d'Arçon gave priority to works of triangulation; he reserved for himself the construction of the large triangles and created different teams that each worked outward from a central point. The map's objectives remained military: the number of points depended on their military importance; they were more numerous in cultivated, cultivable, and accessible

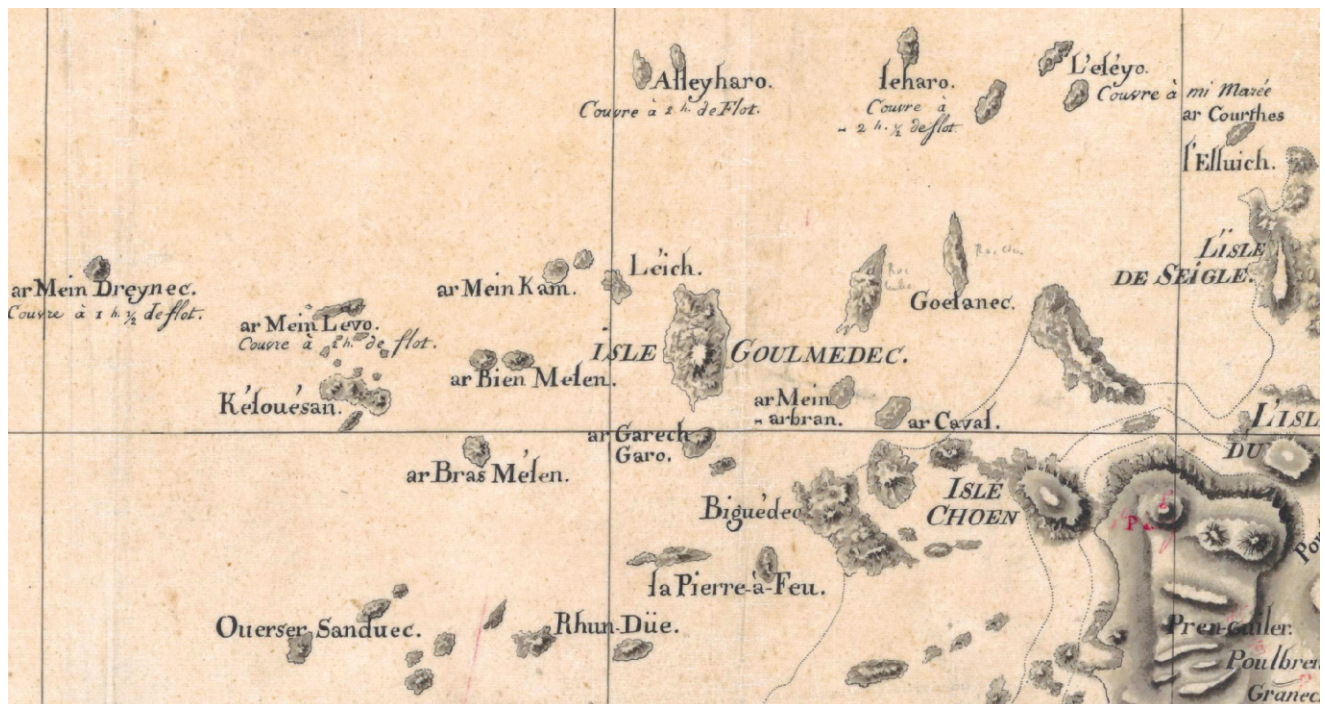


FIG. 559. DETAIL FROM A MANUSCRIPT SURVEY PLAN BY THE *INGÉNIEURS GÉOGRAPHES* TO THE NORTHEAST OF THE BAY OF LANNION (CÔTES D'ARMOR) CARRIED OUT AT A SCALE OF 1:14,400 BETWEEN 1774 AND 1785. Note the abundance of islands and rocks, the latter caught at the moment when they are exposed by low tide.

Size of the entire original: 42.5 × 59.5 cm; size of detail: 17.0 × 31.8 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge SH 18<sup>e</sup>, pf 43, div 3, p 67D).

areas, and fewer in the “wilderness areas” (Pelletier 2006, 175–77). In 1779 Le Michaud d’Arçon was summoned to the Jura frontier; he made his way to Belfort and Montbéliard in 1781 and continued work in Alsace (Berthaut 1902, 1:76–77). He drew up new instructions for surveys to be carried out beyond French territory. In his view, the cartographic expression of information should not obviate preparing written reports to describe different geographic entities and express military observations closely connected to the political situation.

The military surveys of the second half of the eighteenth century, based on triangulation operations and carried out on a large scale, could be easily assembled despite being scattered in space and time. Although they surpassed the work of Cassini’s engineers in quality, they still covered only a part of French territory and were protected by military secrecy. Increased surveying activity and resulting data required standardization. The commission of 1802, with the director of the Dépôt de la Guerre presiding, attempted to find good solutions for standardization that would be applicable in all cases. The plates of Cassini’s map had been transferred to the Dépôt de la Guerre in 1793, but the military wanted a truly new document at their disposal. Prepared by the work they had carried out in the eighteenth century, they were ready for the enterprise of the *carte de l’État-Major*—after Cassini’s *Carte de France*, France’s second foundational map.

MONIQUE PELLETIER

SEE ALSO: Commission topographique of 1802; Dépôt de la Guerre (Depository of the War Office; France); France; Masse Family; Military Map: *Plan-relief*; Naudin Family

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**Military Cartography by the German States.** The structure of the politically fragmented Holy Roman Empire, or *Reich*, produced a complex military system. The smaller estates supplied imperial levies that were organized by each *Kreis* (imperial circle); the levies did not form a standing army but were mobilized only as needed for the *Reich*’s defense. This system progressively declined in effectiveness after 1735. The *Landesherrn* (sovereigns) of the great estates were permitted to organize and field their own regiments. These troops were mobilized for the sake of the *Reich*—for example, in the relief of Vienna in 1683 and the subsequent Great Turkish War (1683–99) (maps of Hungary and the Balkans can be found in the provincial archives of Karlsruhe [Baden]) and also in the wars with Louis XIV of France (1688–97 and 1701–13) (Wilson 2004, 170–75). The expansion of Brandenburg-Prussia after 1700 intensified internal conflicts among the *Landesherrn* and drew the German states into wars of divided loyalties; for example, the Seven Years’ War between Prussia, Great Britain, Hanover, Brunswick-Wolfenbüttel, Hesse-Kassel, and Schaumburg-Lippe on the one hand, and France, the Holy Roman Empire, the Austrian monarchy, Saxony, Bavaria, Russia, Spain, and Sweden on the other. Most European wars between 1650 and 1800 were fought on German soil, so German territories were mapped by all combatants; conversely, the main German estates mapped their own and other territories for military purposes, as discussed in this entry.

In line with general military trends, standing armies in Germany increasingly required a variety of maps that were essentially modified topographic maps. In order of decreasing scale, these can be grouped into local maps

of fortifications, sieges, and battles, as well as plans for maneuvering, review, and battle order; more regional maps for tracking winter quarters, mobilization, and campaigns; and regional maps of border defenses and topography. To these may be added certain thematic maps, such as maps of military district classifications. All these maps were in manuscript and were not generally intended for publication. Map publishers sometimes printed simplified military maps prepared by military engineers for the news-hungry public when secrecy was no longer paramount after an event or when it could not be enforced. Publishers also compiled their own general maps of theaters of war for public consumption and planning commissions.

Most surviving military maps in Germany from be-

fore 1800 are engineers' plans of fortifications, the environs of fortresses and fortified cities, and siege and battle maps (fig. 560). However, despite a long history of fortress construction in Germany, engineers remained a relatively small and unorganized element within German armies for much of the eighteenth century. The key engineers who imported the new techniques of Menno van Coehoorn and Sébastien Le Prestre, maréchal de Vauban, were mostly trained in France, Italy, or the Netherlands. In Brandenburg-Prussia, the Dutch-born Gerhard Cornelius von Walrave organized the scattered Prussian military engineers in 1729, but Friedrich II (r. 1740–86) set aside the hierarchy to work directly with a small number of field engineers before each in turn fell out of favor. Indeed, Friedrich II did not wel-

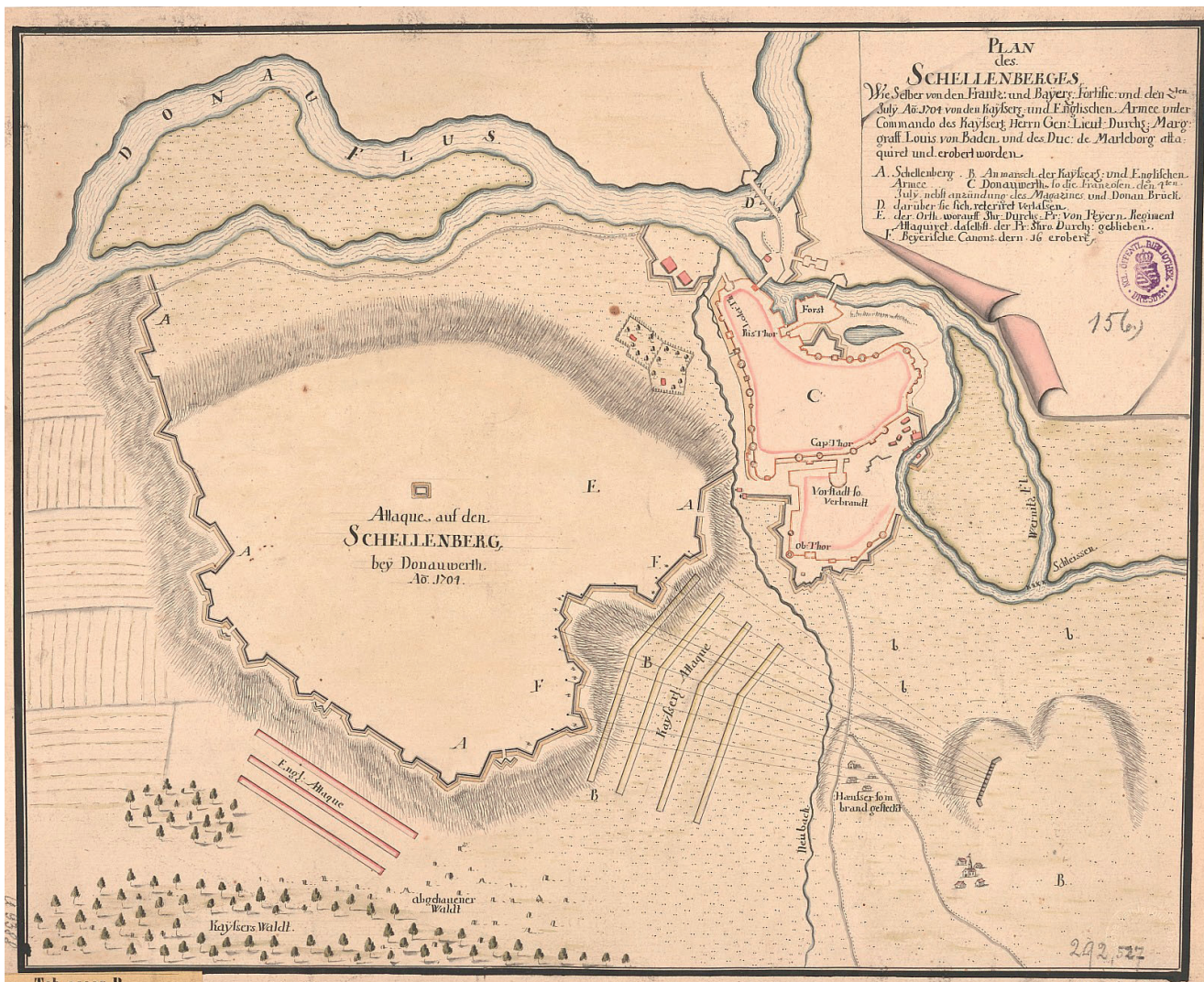


FIG. 560. "PLAN DES SCHELLENBERGES," 2 JULY 1704, DURING THE WAR OF THE SPANISH SUCCESSION. The modern hilltop fortifications, protecting the bridge at Donauwörth across the Danube, were held by the French and Bavarians, against an army of Imperial and English troops led by

the duke of Marlborough. This anonymous manuscript is a fair copy made some time after the battle; south is at the top. Size of the original: 30 × 36 cm. Image courtesy of the Sächsische Landesbibliothek—Staats- und Universitätsbibliothek, Dresden/Deutsche Fotothek (Kartensammlung, KS A9388).

come theoretical expertise or innovations on the part of nonaristocratic engineers and refused to provide a coherent system of pay and promotion. He did establish, in 1765, an Académie des Nobles in Berlin for a few aristocratic infantry and cavalry cadets to learn the principles of warfare, which included fortifications and geography, and in 1779 he created five more *Inspectionsschulen* (military district schools) in which young officers could enroll during the winter months; yet the numbers educated were small and seem to have had little effect on the army as a whole. In 1788, shortly after Friedrich's death, Friedrich Wilhelm II (r. 1786–97) created an Ingenieur-Akademie in Potsdam for both civil and military engineers; Friedrich Wilhelm III (r. 1797–1840), however, distrusted education as a source of social unrest and disbanded the academy during the reforms of 1806. Only in 1809 would a formal corps of engineers be created in Prussia (Duffy 1974, 110–11, 123–25; 1985, 134–37; White 1988, 35–36, 87).

Other German states also established academies for military engineers: Saxony in 1743, Bavaria in 1752, and Hanover in 1782 (Gat 1989, 60). It was in the Saxon academy, at the very end of the century, that Johann Georg Lehmann would develop his systematic method for relief shading (see fig. 356). German military texts, such as Friedrich II's own "Principes généraux de la guerre" (1748, later published), stressed issues of leadership, morale, and strategy. Nonetheless, many textbooks about fortifications were published, mainly in southern and eastern Germany, from which officers might learn field mapping. These works include Christoph Nottmangel, *Manuale fortificatorium* (1659), Leonhard Christoph Sturm, *Teutsch-Redender Vauban* (1702), and Johann Gottlieb Tielke, *Unterricht für die Officiers, die sich zu Feld-Ingenieurs bilden* (1769). Instructions were also included in the widely circulated basic work, *Der vollkommene teutsche Soldat* by Hanns Friedrich von Fleming (1726) (fig. 561). Also, a series of technical works were published in Prussia after 1760, notably the *Essai sur la maniere de faire les cartes* (1762), by Simon Lefebvre, a French engineer in Frederick II's service, and J. C. G. Hayne's *Deutliche und ausführliche Anweisung, wie man das militairische Aufnehmen nach dem Augenmaas ohne Lehrmeister erlernen könne* (1782). Johann Ludewig Hogrewe, the Hanoverian engineer who tutored the sons of George III in cartography (Barber 2014, 157–58), wrote several important works, including *Praktische Anweisung zur topographischen Vermessung eines ganzen Landes* (1773).

Beyond the particular arena of engineering works, German military commanders recognized the value of maps as tactical and strategic tools. In all the German armies, the *Generalquartiermeister* was the staff officer in charge of the quartering and movement of troops, which made the position responsible for the produc-

tion of regional military maps (Duffy 1974, 143). In line with the increasing strategic complexity of European warfare, such mapping became increasingly intense after the 1740s. The development is clearest in the case of Brandenburg-Prussia. Dutchman Gerhard von Belkum became the first *Generalquartiermeister* in 1655, and in 1673 the Plankammer (map office) was founded to store and produce maps. Overview maps of Prussia were produced under the supervision of Peter von Montargues around 1720 for administrative purposes and were partially revised in 1748 by the Italian engineer Giovanni de Balbi. In 1740, Friedrich II's preliminary invasion of Silesia was hindered by a lack of detailed maps, so in 1741 he commissioned a general map at 1:200,000; this ultimately did not meet his needs, so he commissioned still more detailed surveys from the engineer Carl Friedrich von Wrede from 1747 to 1753. During the Seven Years' War, Friedrich II was accompanied on campaign by a traveling Plankammer (Duffy 1974, 146–47). The Polish acquisitions were mapped repeatedly—for example, in 1772–73 by Levin von Geusau and Theodor Philipp von Pfau and in 1796–1802 by Johann Samuel Ferdinand von Brodowski and Christian Wilhelm von Chlebowski (Albrecht 2001). Samuel von Schmettau began a triangulation-based survey of Brandenburg itself in 1750, but Friedrich II discouraged this work in case the maps should fall into enemy hands. The military survey of the electorate of Saxony, undertaken during the Seven Years' War by Isaac Jacob von Petri, was published because it was part of a foreign country. After Friedrich II's death in 1786, secrecy provisions were relaxed; for example, Karl Ludwig von Le Coq's 1795 survey of northwest Germany at 1:864,000 appeared in print in 1805 (Scharfe 1986; Lindner 1990).

The theater of war with France was southwestern Germany, encompassing Swabia and three other *Kreise*, as well as the medium-sized estates of Baden and Württemberg. Swabia was thus well mapped, starting with Cyriak Blödner, who prepared a twenty-sheet manuscript survey of the region in 1713–15 (fig. 562), which survives in multiple manuscript copies (Musall and Sperling 2010); some of the later surveys by Jacques Michal were incorporated into published maps, including Matthäus Seutter's *Suevia universa* (1725) (see fig. 747) (Neumann 1990).

After 1763, military mapmakers were used in regional surveys intended to aid civilian administration, such as Jakob Friedrich Schmauß, his English-born successor Peter Perez Burdett, and Carl Christian Vierordt (who died a major general in 1812) in Baden. Toward the end of the eighteenth century and during the years of Coalition Wars with revolutionary France, printed military maps appeared, such as the six-sheet theater of war map between the Rhine and Mosel at 1:864,000. Published at Rheinwald in Mannheim, this work was created by



FIG. 561. STUDENTS IN A MILITARY ACADEMY LEARNING HOW TO USE MAPS FOR MILITARY PURPOSES. From Hanns Friedrich von Fleming, *Der vollkommene teutsche Soldat, welcher die gantze Kriegs-Wissenschaft, insonderheit was*

*bey der Infanterie vorkommt, ordentlich und deutlich vorträgt* (Leipzig: Johann Christian Martini, 1726), pl. D. Size of the original: ca. 28 × 35 cm. Image courtesy of the Koninklijke Bibliotheek, The Hague (KW 509 B 12).

Palatinate general surveyor Peter Dewarat and was intended for the public at large as well as for use in battle (Salaba 2001).

JOACHIM NEUMANN

SEE ALSO: German States

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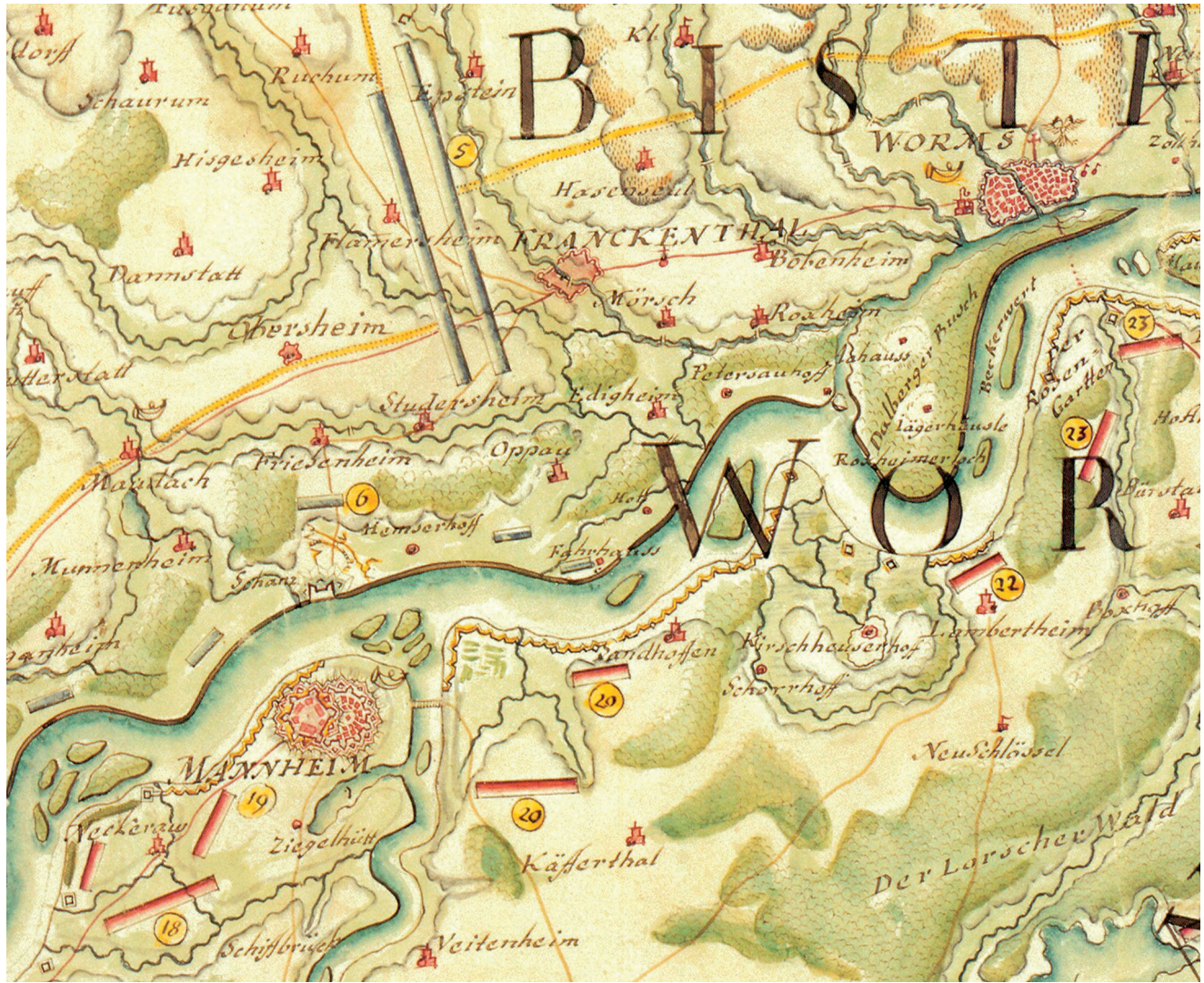


FIG. 562. DETAIL OF WORMS AND MANNHEIM FROM CYRIAK BLÖDNER'S "THEATRUM BELLI RHENANI," SHEET 9 (1713–15). The map shows the distribution of numbered units of infantry and cavalry.

Size of the entire original: 44 × 61 cm; size of detail: ca. 14 × 17 cm. Image courtesy of the Kriegsarchiv, Österreichisches Staatsarchiv, Vienna (Kartensammlung KA KPS KS H III d 344).

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**Military Cartography by Great Britain.** British military cartography in the period 1650–1800 was the product of artillery and engineer officers under the Board

of Ordnance and, to a lesser extent, officers of the line regiments, both British and Hanoverian (see Harley, Petchenik, and Towner 1978). Many of the officers responsible for mapping activities were recruited on the Continent, so there was great stylistic variation in maps produced on behalf of the British military. This entry first describes the institutionalization of mapping within the Board of Ordnance (Harley 1980a, 1980b; Harley and O'Donoghue 1980) before reviewing the broader cartographic work of military officers. The 1740s stand as a threshold: thereafter, Britain's competition with France became increasingly global, the military became increasingly map-minded (Edney 1994), military surveys proliferated, and officials sought to standardize mapping activities.



By 1660, the civilian Board of Ordnance, whose headquarters were in the Tower of London, was responsible for preserving old fortifications and building new ones; for supplying the army and navy with arms, armor, munitions, and all the equipment needed to wage war and to quarter troops; and for providing artillery and engineer personnel. The task of carefully measuring army encampments fell mostly to the engineers, whose experience led to their frequently being appointed as quartermasters, with all the associated mapping that that entailed. The Board developed two sets of mapmakers: the surveying officers themselves, mostly engineers, who were organized in 1714 as the uniformed Corps of Engineers (from 1787, Corps of Royal Engineers) (Porter 1889; Marshall 1976); and the draftsmen who were attached to the Drawing Room in the Tower of London (Marshall 1980).

The Board's role in producing and systematizing military cartography began in the late seventeenth century, through the work of the Dutch-born engineer Sir Bernard de Gomme. De Gomme's work and ideas underpinned the theory, practice, and policy of British military survey and cartography for the next century. With extensive experience in mapping and building fortifications, first in the Netherlands and then with the Royalists during the English Civil Wars (1642–51), De Gomme was in 1661 appointed engineer-in-charge of all the king's fortifications in England and Wales and of a new fortress-building program along the south coast of England (fig. 563). From 1682 until his death in 1685 he was also surveyor general, one of the principal officials of the Board of Ordnance. (Note that in this context, "surveyor" meant supervisor or inspector, not mapmaker: Willmoth 1993, 138–47.) De Gomme used this position to shape the conduct and training of the engineers. He undoubtedly framed the "Instructions to Our Principal Engineer" (in the "Rule, Orders and Instructions for the Government of the Office of Ordnance") of 1683, regarded as the basic charter for the professionalization of engineers. These instructions outlined the necessity for a detailed knowledge of the geographical environment; the requirement to map, or to acquire mapping of, the locations and environs of fortifications under siege; and the training of new entrants to the engineers by requiring them to gain experience through foreign travel and the observation of military practice in Europe (Saunders 2004, 244–46).

Between 1717 and 1723, the Board regularized its various civilian draftsmen within a Drawing Room in the Tower of London with three functions: to act as a repository for the maps and plans of all sorts that were made or acquired by Ordnance officers; to provide copies of these maps and plans whenever they were required by other officers, government officials, or the king; and to train draftsmen for service in Ordnance depots at

home and abroad. The Drawing Room fostered a distinctive house style (fig. 564). The particular style of lettering, map design, and use of color wash techniques appears to have been initiated by Clement Lempriere, who was already a draftsman in 1716 and who had become chief draftsman by 1741 (Christian 1990; Hodson 1991a). Lempriere's style was still apparent in engineers' maps in the 1780s and 1790s, such as those by William Test and Thomas Chamberlain.

In 1741 a military academy for Ordnance engineering and artillery officers was founded and established at Woolwich (Harley and O'Donoghue 1980, 3). Prior to its foundation, engineers had a basic, sometimes an advanced, grasp of the theory and practice of military survey and cartography, as evidenced by the mapping of Gibraltar by Sir Martin Beckman (chief engineer, 1685–1702) and Talbot Edwards (chief engineer to the garrison, 1705), and by the surveys of John Armstrong (chief engineer, 1712; major general in 1739) for the campaigns of John Churchill, first duke of Marlborough, during the War of the Spanish Succession (1701–14). The "General Instructions for the Engineers, to be sent to the several Garrisons" of 1740 specified seven scales to be used for maps, from 1:19,200 for the "General Map of a Coast or small Island," through 1:2,400 for the survey of a town, to 1:60 for a "Draw-Bridge, Gun Carriage, or any other Carpenter's Work" (Porter 1889, 1:149–50). Despite these recommendations, a large proportion of surveys and maps made after this time were based on different scales.

From 1776, the more able of the Drawing Room draftsmen began to receive the same training in surveying as the engineer cadets from Woolwich, supervised by the mathematics professor Reuben Burrow (Kew, The National Archives of the U.K. [TNA] WO46/10 "Regulations for the Drawing Room," ff. 156–57 [17 May 1776] and ff. 158–60 [12 June 1776]; Royal Military Academy 1851, 28). The Board formally recognized the significance of survey duties when it formed a dedicated surveying company of engineers in 1784, in the wake of the American Revolutionary War. A set of surveying instructions presumably devised for this new company constituted the most comprehensive English account of military survey practice to date. It made no reference to triangulation but concentrated on the quicker road traverses that would better suit operational conditions. In 1787, a new class of draftsmen in the Drawing Room was created, and William Gardner was appointed as first chief surveying draftsman (Harley 1980a, 44–45). Gardner imposed a new standard style of draftsmanship on the next generation of surveying draftsmen, such as Robert Dawson, who in turn was to train cadets at Woolwich and the Royal Military College at High Wycombe. Such stylistic similarities were advantageous for joining together the work of a number of surveyors. In



FIG. 563. SEVENTEENTH-CENTURY STYLE OF DRAFTSMANSHIP BY BRITISH ENGINEERS. The seventeenth-century style is exemplified by this plan of “The Bounds of the Fortification of Gosport” (ca. 1678), drawn by Bernard de Gomme to show proposed fortifications. Pencil, pen and ink,

and watercolor on paper; ca. 1:1,250. Compare figure 564 of the same area.

Size of the entire original: 74 × 93 cm. Image courtesy of the Yale Center for British Art, New Haven (Octavo Room/De Gomme).

December 1800, the Tower draftsmen were absorbed into the uniformed Corps of Royal Military Surveyors and Draftsmen and made subject to military discipline (Jones 1974; Hodson 1991b).

By contrast, army officers in the line regiments who made maps had little formal cartographic training and were largely self-taught. Only at the very end of the century, in 1799, was John Gaspard Le Marchant able to establish a Royal Military College for line officers, directed by the French émigré General François Jarry. Military survey and topography—not of the precise engineer species, but of the rapid reconnaissance variety that was essential in war—were integral to its curriculum, both for the “senior department” of experienced officers

and for the “junior department” of new cadets. Along with mathematics and geometry, mapping was taught by Isaac Dalby, formerly of the Board of Ordnance’s trigonometrical survey. Between 1799 and 1811, over 200 senior officers and 1,500 new officers graduated from the college (Le Marchant 1841, 150–51); together they had a noticeable effect on the mapping of the Napoleonic Wars (Clark and Jones 1974; Thoumine 1968, 72–73; Edney 1994, 17).

The British army was deployed repeatedly after 1650, both in local conflicts and in a series of increasingly global wars in Great Britain, continental Europe, North America and the Caribbean, and South Asia. During these wars, and in periods of peace, engineers and line



FIG. 564. BOARD OF ORDNANCE HOUSE STYLE OF DRAFTSMANSHIP BY BRITISH ENGINEERS. The Board of Ordnance developed a distinctive house style, as in this detail from the anonymous “Plan of the Town and Fortifications of Gosport, Together with the Crown Lands thereunto Belonging, and Forts Adjacent” (1742); proposed new outworks are

shown in yellow. Ink on parchment; 1:2,400. Compare figure 563.

Size of the entire original: 53.3 × 74.9 cm; size of detail: ca. 40 × 57 cm. Image courtesy of The National Archives of the U.K. (TNA), Kew (MPE 1/386).

officers engaged in a variety of cartographic endeavors. In addition to engineers’ detailed architectural plans, military officers made battle plans (including orders of battle), maps of fortifications and encampments, and reconnaissance and route surveys that encompassed many types of areas, from the local environs of fortresses to extensive regions. These categories follow contemporary descriptions found in eighteenth-century textbooks of the different activities in which officers were expected to be proficient.

The prevalence of fortification plans stemmed from the preeminence of the principles and practice of the attack and defense of fortified places in the education of Ordnance and army officers alike. In spite of the “military revolution” (Parker 1988), in which siege warfare gave way to greater movement of larger armies and more pitched battles, sieges of fortified places contin-

ued to be common throughout the eighteenth century, although they were not as long in duration. The great fortifications of Portsmouth, Plymouth, Edinburgh, and Gibraltar (after its capture by the British in 1704) are represented by continuous sequences of large-scale mapping throughout the period (Hodson 1978; Stuart 1991; Anderson 2010). All available printed plans of fortified places and towns in foreign theaters of operations were also collected; these could form the basis for field observations, as when engineer Patrick Mackellar “enlarged” his plan of Quebec (ca. 1757) “from Bellin’s plan with additions” (London, British Library, Cartographic Items Maps K.Top.119.34).

Reconnaissance mapping, including the production of accompanying written reports, was practiced from at least the second half of the seventeenth century, when the focus of this genre of mapping was the immediate

hinterland of an existing fort or of a potential fortified site. For example, the mathematician Sir Jonas Moore, surveyor general of Ordnance, 1669–79, was commissioned in 1662 to map the Thames estuary; this survey was extended in 1667 to include a “description of all castles, forts, batteries, creeks, &c.” in the area as well as to provide valuations of lands to be purchased for military use (Willmoth 1993, 128–30, quote on 142). Smaller-scale maps were commonly made to show the distribution of harbors, towns, and fortifications, but fortification and environs maps remained the primary activity of Ordnance officers throughout the eighteenth century (Anderson 2009).

Route surveys were a common task for military surveyors, complete with written commentaries on the quality of existing roads and their capacity for military traffic. Such work is exemplified by the “A Sketch of General Braddock’s March” to the River Monongahela in Pennsylvania in 1755, with its accompanying account of “Work done to the Road”: “a great deal of cutting, digging and Bridging” (London, Royal Collection, Inventory Number 731062). Other route surveys of note include those of the marches by the army in Flanders between 1740 and 1748 (also in the Royal Collection).

Starting in the 1740s, these topographical surveys began to be carried on over much larger areas (Harley and O’Donoghue 1980, 5–6). In Scotland, David Watson needed a general map to organize the construction of new roads and fortresses for the pacification of the Highlands after the Jacobite rebellion of 1745–46, leading to the famous Military Survey of Scotland (1747–55) by William Roy. The extensive surveys in North America and India led to several regional surveys, as much for administrative as military purposes, including the so-called Murray Map of the St. Lawrence River valley in Quebec (see fig. 838), other surveys that would eventually be published, in part, as *The Atlantic Neptune* (1774–82) (see fig. 502), James Rennell’s survey of Bengal (1765–77) (see fig. 708), and Charles Vallancey’s surveys of Ireland (1778–90) (see fig. 836).

The threat of French invasion led to detailed surveys of southern England, first by Watson, Roy, and David Dundas during the Seven Years’ War, and by a variety of engineers and officers during the Revolutionary and Napoleonic Wars (fig. 565). A key figure in the later surveys was Charles Lennox, third duke of Richmond, master general of Ordnance (1782–95). In the 1760s, Richmond had employed commercial surveyors Thomas Yeakell and William Gardner to survey his estate at Goodwood in Sussex; he recruited them in 1782–84 for the Tower Drawing Room, where they used their survey and drafting skills to make six-inch (1:10,560) surveys of Plymouth, Guernsey, Jersey, Kent,

and the Isle of Wight. Richmond championed Roy’s ideas for comprehensive surveys, leading to the creation in 1787 of the permanent cadre of topographical surveyors (Harley 1980a, 44–45, appendix I [363–65]). In 1791, building on Roy’s triangulation between the royal observatories of Greenwich and Paris, Richmond also approved the use of engineer and artillery officers to carry on a national geodetic and topographic survey that became known as the Ordnance Survey of Great Britain (Hodson 1991c).

The greater part of the extant cartographic materials generated by British military survey is in manuscript. Little survives of operational mapping in the field, and for the most part the manuscript maps are finished copies. The major collections are those of George III, now the King’s Topographical Collection in the British Library, and the King’s Military Collection, which includes that of his uncle, William Augustus, duke of Cumberland, now in the Royal Collection. Printed mapping of military events was largely left to private publishers, who were allowed to use official military manuscript source material. Commercial mapmakers were not slow to maximize the business potential that conflict offered (Pedley 2005, 118–55). The seventeenth-century media saw the rise of the broadsheet news coverage of war, in which engraved maps were combined with letterpress text to give the public graphic and written accounts of the progress of military events, such as the *Particular Relation of the Great Victory Obtained by Their Majesties Forces over the Irish Army, at Aghrim in Ireland, on the 12th of July, 1691*, which was printed alongside a *Draught of the Incampment of the Irish Army at the Battel near Aghrim . . . by Colonel Richards, First Engineer of Ireland* and published “by Authority” (London, Royal Collection, Inventory Number 724051). This practice became particularly prevalent in the eighteenth century, when maps by engineers in the service of the British monarch formed the basis of commercial maps of battles such as Henry Overton’s of Culloden (1746), taken from a plan by the engineer Dugal Campbell; Minden (1759), published by Thomas Major in 1760 from Roy’s manuscripts; Quebec (1759), published by Thomas Jefferys from original material by the engineers Samuel Holland, Hugh Debbieg, and J. F. W. Des Barres; and Boston, with its entrenchments, published in 1775 “from the Observations of Lieut. Page” by William Faden, to give a few examples. The production of printed mapping of military events by the military itself had to wait until new technology emerged during the Peninsular War, when the quartermaster general’s department set up a lithographic printing press at the Horseguards in the first decade of the nineteenth century. The first map to be printed in Britain by this means



FIG. 565. DETAIL FROM A MAP OF THE COAST OF EAST ANGLIA BETWEEN WINTERTON NESS AND FELIXSTOWE, TOGETHER WITH A DEEP HINTERLAND, ENDORSED BY GEORGE PINK, CHIEF MILITARY SURVEYOR, 1798. Although based on existing published commercial mapping by William Faden and Joseph Hodkinson, the landscape is shown in a style that represents the terrain from a military point of view in such a way that the eye can instantly grasp the minutiae of hills, marshes, and coastal dunes and cliffs. Roads are classified according to their passability

by heavy artillery at different times of the year, and possible landing places along the coast are indicated. It was accompanied by a series of reports by an engineer officer that detailed the positions to be taken up by the defending army and plans for the evacuation of the local population in case of invasion. Pencil, pen and ink, and watercolor on paper; 1:63,360. Size of the entire original: 72 × 157 cm; size of detail: ca. 30 × 38 cm. Image courtesy of The National Archives of the U.K. (TNA), Kew (MR 1/1415).

at the Horseguards was of Bantry Bay, dated 7 May 1808 (Ristow 1975).

YOLANDE HODSON

SEE ALSO: Education and Cartography; Great Britain; Roy, William  
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**Military Cartography and Topographical Surveying by the Netherlands.** Military and topographical cartography in the Netherlands in the sixteenth and seventeenth centuries has been explored in volume three of *The History of Cartography* (Koeman and Van Egmond 2007, 1271–90). Among the most important developments treated there were the availability of training for engi-

neers as well as private surveyors in the program called *Nederduytsche Mathematicque* (Dutch mathematics) at the University of Leiden after 1600 and the establishment of a corps of military engineers under the aegis of Prince Maurits van Nassau in 1604. But the *Nederduytsche Mathematicque*, though it created many surveyors, did not transform the field of military engineering as its founders had hoped, and it ceased operations in 1681. By the time of the *Rampjaar* (disaster year) of 1672, when the Dutch Republic had been attacked by England, France, and a coalition of German princes, the engineering arm of the Dutch army was decimated, and only eight engineers were available. After 1660, courses in surveying and fortification engineering were offered in ’s Hertogenbosch, Utrecht, and, especially, at the Frisian Academy of Franeker, which offered a course in “*geometria en militaire architectuur*” (Scholten 1989, 28). Still, most engineers got their training on the job, from mentors and textbooks. The number of engineering officers, both *ordinaris* and *extraordinaris*, fluctuated drastically with the highest staffing during times of war. Both the War of the Spanish Succession (1701–14) and the War of the Austrian Succession (1740–48) contributed to spikes in enrollment, but the number of engineers stabilized between sixty and seventy in the latter part of the century. Throughout the period, maps used by the military were not invariably the work of military engineers; there are numerous examples of private surveyors being employed by governments.

The two main types of maps produced for military purposes were town plans that highlighted fortifications and military topographical maps. F. W. J. Scholten (1989, 203–25) provides a list of 410 town plans and 176 topographical maps made between 1579 and 1795 in Dutch archives, plus many more copies, tracings, and adaptations. Cornelis Koeman (1963, 95–108) lists both manuscript and printed topographical maps made between 1750 and 1850. For most of this period, medium-scale topographical maps were produced in smaller numbers primarily because military operations usually were sieges of fortified places, which required very large-scale plans. The characteristics of Dutch fortification plans are addressed in the entry on urban mapping in the Netherlands; this entry focuses on military topographical maps.

For most of the Enlightenment, the province of Holland (the largest and most populous in the northern Netherlands) maintained its own institution for military engineering, the *Departement der Hollandsche Fortificatiën*, under the control of the States General of Holland. Its most influential controllers general were Genesis Paen (1647–79), his son Willem Paen (1679–1707), and Jan Philip Prevost (1737–62). In 1688, the States General of the Republic embarked on an unprecedented

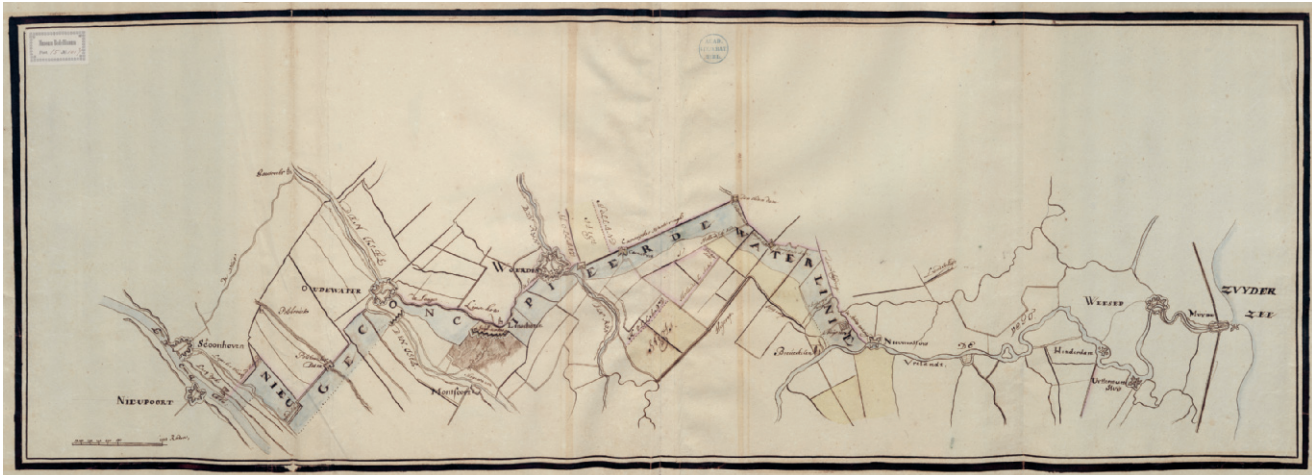


FIG. 566. MENNO VAN COEHOORN, WATERLINIE. Manuscript, ink and watercolor on paper, late seventeenth century; ca. 1:53,500. Van Coehoorn's proposal for a defensive water-line between Nieuwpoort on the Lek (at the southern, left side of the map) and Muiden on the Zuiderzee (at the northern,

right side). The wide blue band between the Lek and the Vecht near Breukelen represents the lands that would be intentionally flooded.

Size of original: 41.2 × 106.2 cm. Image courtesy of the Universiteitsbibliotheek Leiden (COLLBN Port 15 N 101: 2).

effort to upgrade the country's system of fortifications. At the urging of the Stadtholder William III, a director general of fortifications was appointed. The first two incumbents were French, and they began the transition to the French system of fortifications popularized by Sébastien Le Prestre, marquis de Vauban, a shift completed by the third director general, Baron Menno van Coehoorn. Obsessed with keeping the sea at bay, preventing flooding, and reclaiming land, the Dutch were also acutely aware of the strategic value of intentional flooding for defensive purposes. From 1681 to 1688 the engineer Johan van Alberding proposed a system of small dikes to be constructed in Friesland, Groningen, and Drenthe to keep the moorlands as wet as possible. Van Alberding made a series of maps showing more than 200 kilometers of these dikes, known as *leidijken*. Van Coehoorn, who became director general in 1695, oversaw a major restructuring of the corps. His 1685 book, *Nieuwe vestingbouw, op een natte of lage horisont*, demonstrated the superiority of the French system and also highlighted his emphasis on using strategic inundation (fig. 566). Under Van Coehoorn's leadership, topographic maps of the Rhine and its tributaries, Gelderland, and Utrecht were made; some of these formed the basis of the *Tabula nova provinciae Ultrajectinae* published by Nicolaas II Visscher in 1680 (Scholten 1989, 37–40).

During the War of the Spanish Succession, strategic flooding was employed, but was not as effective as had been hoped; the method caused a lot of unnecessary damage and was opposed by local populations. These experiences led engineers to try to plan inundations involving smaller, more suitable areas. This required ever

more detailed knowledge of the terrain and hence more and better topographic maps, a number of which were produced during the relatively long period of peace between the War of the Spanish Succession and the War of the Austrian Succession. Of particular importance were maps by Pieter de la Rive (Westerwolde and Overijsselse Vecht, 1717–31), Bernard II de Roij (Gelderse IJssel, 1736–41), his son Bernard Jacob de Roij (Gelderse Vallei, 1741–44), and Cornelis Draeck (Noord-Brabant, 1739–44) (Scholten 1989, 53–69, 73–75).

Although a civilian and a commercial mapmaker, Willem Tiberius Hattinga had a profound impact on military topographical mapping in midcentury. He began his career as an army doctor in Staats-Vlaanderen and began to compile, on his own initiative, a detailed topographic map of the area from his own surveys based on triangulation, the *Kaarte van Staats Vlaanderen met de oude en nieuwe limiten* (1745, 1:30,000) (Donkersloot-de Vrij 1995, 161). With the French army attacking from the south, he began, at the behest of the States General, to bring together all available maps of the southern flanks of the Republic. He was granted open access to the map collections of the States General and the private map collection of the Stadholder Willem IV, who was very interested in cartography. With the greatest collection of military maps in the Republic at his disposal, Hattinga, assisted by his sons, David Willem Coutry and Anthony, compiled over the next decade four enormous atlases of manuscript maps (both from their original surveys and maps copied from the archives) that covered the Staats-Vlaanderen, Staats-Brabant, the islands of Zeeland, and frontiers of Gelderland, Overijssel, and



FIG. 567. DETAIL OF NIJMEGEN FROM MAP OF THE IJSSEL AND ITS ENVIRONS BY HERMANUS VAN HOOFF, J. A. VAN KESTEREN, AND M. A. SNOECK, SURVEYED BETWEEN 1773 AND 1779. This second fair copy, completed in 1783 and signed by Van Kesteren, was included in what has become known as the Hottinger Atlas. Manuscript, ink and watercolor on paper, 1:14,400. Cultivated land,

moorlands, woodlands, and even trees lining the roads are all carefully delineated, and hachuring is used to indicate (very slight) relief to the southeast of the city (north is toward the left). Outside urban areas, individual buildings are shown. Van Hooft served as director general of the corps of engineers in 1795–1803.

Image © Nationaal Archief, The Hague (4.OSK, Y11Y2).



Groningen (Scholten 1989, 69–73, 91–96). Altogether some 1,000 manuscript maps can be traced to the Hattingas, a number of which were later published (such as those in Isaak Tirion's *Atlas van Zeeland*, 1760). The private/public relationship of the Hattinga family with military authorities was cemented even further when David Willem Coutry and Anthony joined the corps as *ingenieurs extraordinaris* in 1748 and 1751. Eighty manuscript maps by the Hattingas have been reproduced at full size (Hattinga 1977–[82?]), and plans are under way to publish full-size facsimiles of the atlases of Staats-Vlaanderen and Staats-Brabant housed in the Zeeuws Archief, Middelburg.

From 1748 to 1773, the Republic's corps of engineers was without a director general, but the next incumbent, Carel Diederik du Moulin (director 1774–92), played a crucial role. Despite much stalling by the states council, he managed to raise the salaries of engineers, reorganize the divisions, and begin work on a comprehensive defense plan. He was especially keen to form a corps of *ingénieurs géographes* on the French model that would make uniform maps of all strategic points at the very large scale of 1:14,400 (1,200 rods to the inch). Slowly, such an organization, and such maps, began to emerge (Scholten 1989, 78–86). An early contributor to this effort was Pieter Andriaansz. Ketelaar, a private surveyor employed by the province of Holland, whose ten-sheet map of the Holland-Utrecht border (*Kaarte van een gedeelte van de provincie van Holland*, 1:14,400) made over the course of a decade (1769–79) had clear military uses, including the planning of inundations (Scholten 1989, 112–15). Johan Frederik Schouster, an *ingenieur extraordinaris* in Du Moulin's corps, brought military topographical mapping in the Netherlands to the highest level with a consistent system of symbols and refined topographical representation. He was responsible for dozens of large-scale maps, and his sophisticated style can be said to have engendered a "school" (Scholten 1989, 84–86).

Another *ingenieur extraordinaris* who had studied with Schouster was Johann Heinrich Hottinger. A number of engineers under his direction made detailed surveys and maps of the eastern and northeastern parts of the country that make up what is now known as the Hottinger Atlas (fig. 567) (although he himself did not work on the westernmost section that showed the course of the IJssel). All 118 sheets (at 1:14,400) have been reproduced at a reduced scale but in full color (Versfelt 2003). A small part of what is now the Netherlands along the border with Belgium and part of the present-day Dutch province of Limburg were included in the survey of the Austrian Netherlands made by Joseph Jean François de Ferraris from 1770–78 (ca. 1:11,520).

Ironically, the French occupation of the Netherlands provided the centralization of the government that was needed to realize Du Moulin's dreams of a modernized and revitalized engineering corps. An engineering school, through which every engineer officer had to pass, was founded in 1800 in Zutphen, and in 1806 a special brigade of *ingénieurs géographes* was established under the direction of Cornelis Rudolphus Theodorus Krayenhoff, who would produce the first countrywide, uniform topographical survey of the Netherlands in 1822 (Scholten 1989, 153).

MARTIJN STORMS AND ELGER HEERE

SEE ALSO: Netherlands, Republic of the United; Urban Mapping; Netherlands

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**Military Cartography by the Ottoman Empire.** For Ottoman military cartography, the eighteenth century saw the transition from traditional mapmaking to modern surveying practices, as evidenced by surviving maps, plans, and draft sketches. Only a few Ottoman siege plans have survived owing to excessive use; among the extant works, a certain number comprise maps originally prepared for presentation purposes rather than for military planning. The number of illustrative maps depicting Ottoman military engagements in the seventeenth and eighteenth centuries declined considerably, explained by the sultan's only occasional participation and the consequent absence of artists accompanying the campaigns. By the latter half of the eighteenth century, under Western influence, Ottoman military maps assumed a more sophisticated form in their technical and quantitative details. Still, the overall picture of disorganized troops in Ottoman maps reflects the Ottoman practice of granting considerable freedom to its military units on the field.

Some examples of Ottoman military mapping from the seventeenth century have been illustrated and de-

scribed briefly in the *History of Cartography*, volume 2.1 (Karamustafa 1992, esp. 210–15); in them, one may see the influence of both the Ottoman art of illustration and foreign cartographers. The continuation, side by side, of two styles of depiction—the pictorial approach in keeping with Ottoman illustration norms and the scaled drawing reflecting a European influence—would continue throughout the eighteenth century until the military reforms of the 1790s. An increasing reliance on the translation, copying, and distribution of non-Ottoman works led to further institutionalization of European norms of military cartography.

The anonymous translated map delineating the Transylvanian, Walachian, and Bessarabian lands (Istanbul, Başbakanlık Osmanlı Arşivi [BOA] Haritalar Kataloğu 37) can be dated to the 1663 Érsekújvár campaign, based on the remarks concerning military initiatives on the Hungarian border in the previous years (e.g., listing Hotin and Giurgiu as the newly conquered castles but omitting Kamianets-Podilskiyi), and longitude and latitude are shown with Latin numbers. By contrast, the plan of the second siege of Vienna by the Ottomans in 1683 (Museen der Stadt Wien, I. N. 52.816/1; Karamustafa 1992, 213, fig. 11.4), which has yet to be analyzed thoroughly, is a fine example of the influence of Ottoman conventions of spatial representation on cartography.

There are two maps related to the Prut campaign of 1123/1711 between the Ottoman army and Russian troops under the command of Peter I. The colored manuscript siege plan by treasurer Aḥmed ibn Maḥmūd, who was also the official chronicler of the campaign, has no scale (Staatsbibliothek zu Berlin–Preußischer Kulturbesitz, Orientabteilung, no. 1209; Kurat 1968; Karamustafa 1992, 213, pl. 15). It marks the deployment of Ottoman troops and artillery units, intentionally ignoring human figures, and locates the trenches, newly constructed bridges, and the headquarters of the grand vizier with remarkable detail. The second plan of the Prut campaign, dated 1123/1711, is an anonymous piece and presumably translated from a French original (Istanbul, Topkapı Sarayı Müzesi Arşivi [TSMA] E. 1551/1; Karamustafa 1992, 215–16, fig. 11.8). Its scale as stated on the map is based on the pace, that is 2.5 ells/cubits (1.895 m). Similarly the notations adjacent to the frame clarify the deployment of Turkish and Russian armies over fourteen days.

A number of colored drawings with striking visual features relate to the Ottoman-Russian naval clashes of 1737–39 in the sea of Azov. Those belonging to el-Ḥācc Feyzullāh (TSMA E. 9401; Istanbul, Topkapı Sarayı Müzesi Kütüphanesi [TSMK], “Keyfiyyet-i Rüşsiyye der-sāl-i 1122,” TSMK H. 1627, f. 71b–72a) show the deployment of Ottoman ships, military facilities, bombing areas of each side, and the ongoing combat on

land. They also identify the classes of the ships as well as ships’ and commanders’ names. The colored manuscript with notations depicting the sea battle of Lori Burnu in 1737 (TSMK Y. 4524) shares features in common with el-Ḥācc Feyzullāh’s drawings. The colored siege plan of the small Danubian island of Adakale (TSMA E. 9439; Karamustafa 1992, 213–14, fig. 11.6) also functions as a topographical map of the town and surrounding area, marking religious and civil structures in addition to strongholds, *palankas* (a type of wooden fort), other fortifications, and trenches. The map describes the course of action during the siege prior to the surrender of the fortress to Ottoman forces on 15 August 1738. Thus, it represents the deployment of Ottoman troops, showing the headquarters of the grand vizier at the rear and the course of the Ottoman fleet; the amount of ammunition used in the campaign and certain military units and commanders with numbers and human figures are also depicted.

A growing number of Ottoman manuscripts concerning the art of war in the eighteenth century led to the production of particular drawings related to contemporary military techniques. The “Mi’yāru’d-düvel” (Istanbul, Süleymaniye Yazma Eser Kütüphanesi, Hekimoğlu Ali Paşa 803), composed of translations compiled by the high-ranking military officer Esīrī Ḥasan ibn Ḥüseyin, who was taken captive at the second siege of Vienna in 1683, contains one scroll map (f. 393a–396a) on which he fixed the ideal battle order for Ottoman troops facing the enemy. “Ümmü’l-gazā,” written by Bayrāmoğlu ‘Alī Ağa in the reign of Aḥmed III (r. 1718–30), includes some sketches defining the functions of canons and mortars (TSMK B. 368, f. 44b–45a, 48b–49a). In addition, the military man Muṣṭafā ibn İbrāhīm composed “Fenn-i ḥumbara ve şānāyi’-i āteşbāzi” (Istanbul, Büyükşehir Belediyesi Atatürk Kitaplığı, Muallim Cevdet Yazmaları, K. 439), in which he included many sketches explaining the operation of different mortars and pumps and how to lay a proper mine.

Some works support the idea that in their military campaigns the Ottomans used certain European maps with the signs and labels translated into Turkish. Ottoman translations of the *Atlas curieux oder Neuer und compendieuse Atlas* (1704) of Gabriel Bodenehr and of the *Atlas geographicus, oder Accurate vorstellung der ganzen Welt* (1720) of Matthäus Seutter support this view (Istanbul, Köprülü Yazma Eser Kütüphanesi, II. B. 367, 370). The data on the maps were translated into Ottoman Turkish, including the distances. The positions of urban settlements and military installations are shown and sometimes colored; additional information supplements the maps of Hungarian lands and Venice.

The translation of the work of the distinguished Italian general Raimondo Montecuccoli in service to the Habs-

burgs under the title “Fününü’l-ḥarb,” presumably prepared by İbrāhīm Müteferriḳa in the reign of Maḥmūd I (r. 1730–54), marked the first wide-ranging attempt to bring Western and middle European military developments into Ottoman warfare (Sarıcaoğlu and Yılmaz 2008). In the same period, the term *fünün-i ḥarb*/*fenn-i ḥarb* seemed to correspond to the notion of “art of war,” and a relatively vast literature began to emerge with numerous manuscripts titled with this term. These translations appeared in various versions and supplements and included military sketches. In the “Fününü’l-ḥarb” sketches show the battle order of infantry troops, military installations and arsenals, fortifications and sieges, and cannons and hand-grenades with descriptive explanations (Istanbul, Nuruosmaniye Yazma Eser Kütüphanesi, 3237, f. 9a, 11a, 13a, 15a, 33a, 37a, 39a, 55a).

By the middle of the eighteenth century, the Ottoman state employed foreign experts to fill the knowledge gap in contemporary military affairs and to overcome deficiencies in engineering. They contributed to Ottoman cartographic training and map collections. Claude-Alexandre, comte de Bonneval, who later became known as Ḥumbaracı Aḥmed Paşa and sought Ottoman protection and converted to the Muslim faith in 1729, brought many maps with him, probably from the Habsburg Empire, where he had served. The Marquis de Mornai served under de Bonneval, later taking the name Mühendis Selīm, attended the ‘Ulūfeli ḥumbaracı ocağı in 1735, and three years later was appointed military engineer (*ceng mi’ mārbaşısı*) and draftsman. In 1772 another French officer, François baron de Tott, surveyed an area in the Bosphorus to prepare for the construction of two fortresses and submitted his plans to the sultan. The manuscript maps produced by French experts in the eighteenth century are presently archived according to their language: those in Ottoman Turkish are in Istanbul and the French originals or copies reside mainly in French and Russian archives.

Enderūnlu Muştafā (also known as İngiltereī Muştafā Ağa) used translations of a number of operational maps of the 1768–74 Russo-Turkish wars to prepare his multicopy map of the campaign of 1768. His map delineates Ottoman, Habsburg, and Russian lands from the Black Sea to the Danube, by placing Habsburg and Russian Empire in the center of the map (TSMK E.H. 1454, title: “Macaristān ve Moskof Dāru’l-ḥarekātı ḥarīḫası”; Karatay 1961, 1:475). He also prepared a map centered on the Danube (1768) that depicted military theaters of Hungary, Russia, Poland, Moldavia, and Walachia in order, as he said on the map, to expose Russian concentrations along the frontier (TSMK A. 3625; TSMA E. 1551/2; Karamustafa 1992, 215, 217, fig. 11.9). Enderūnlu Muştafā’s 1773 translated map of military areas in the Black Sea and Crimea includes

Polish and Russian borders and southern Russian territory. Completed under the supervision of army translator Mikelzāde Yorgaki (TSMK E.H. 1450; TSMA E. 8410/2), it was hand colored and drawn on silk. The notes on the map suggest it was translated from a map published by the Seutter-Lotter-Probst firm in Augsburg in 1769, but the original work must have been the map compiled by Andrew Dury (. . . *Map of the Present Seat of War between Russians, Poles, and Turks*, 1769, ca. 1:170,000). The 1773 map of Belgrade and Poland prepared by Enderūnlu Muştafā was compiled in a similar way (TSMK E.H. 1451). Enderūnlu Muştafā mostly reproduced at the original scale from these translated works, adding some symbolic figures and informational data to his maps while benefiting from local craftsmen especially skilled in Ottoman calligraphy.

Maps of naval warfare may also be numbered among the maps that depicted military operations. Mühendis Aḥmed Rāsim’s map of the siege and bombardment of the city of Algiers by the Spanish navy commanded by Antonio Barceló in August 1783 (TSMK H. 1851) was presented to and appreciated by Abdülḥamīd I. Its legend identifies each ship or ship’s commander, with their Turkish equivalents in some cases, and names the different types of ships as well as including some topographical features. A hand-colored map from 1788 covers the Ottoman naval campaign against the castle of Kılburun (Qılburun) and the battles around the castle of Ōzi (Ochakiv) with vivid illustrations of the naval and land combat set against a topographically rich and detailed background. The images of fortresses in the area add to its importance (fig. 568).

The handbooks written by French military experts for the imperial naval engineering school, Mühendishāne-i Baḥrī-i ḥümāyūn, included several military sketches and drawings. The *Elémens de castramétation et de fortification passagère* of André-Joseph Lafitte-Clavé, translated by Kaşşābbaşızāde İbrāhīm under the title *Uşūlü ma’ārif fī tertibi’l-ordu ve taḥşīnihī muvaḳḳaten* (1787), provided twelve sketches related to the arrangement of trenches and parapets; the construction of fortresses, bridges, *palankas*, and protected emplacements; as well as the deployment of troops and heavy guns. The Turkish translation of Admiral Laurent-Jean-François Truguet’s *Traité de manoeuvre pratique*, titled *Uşūlü’l-ma’ārif fī vech-i taşfif-i sefāyin-i donānmā ve fenn-i tedbīr-i ḥarekātihā* (1788), also contained many plans and sketches on naval operations and maneuvers. The *Tableau des nouveaux reglemens de l’empire Ottoman* of Maḥmūd Rā’if Efendi (1798) embraced a plan of a five-bastion fortress (pl. 17) and some encampment plans (pl. 18). In addition to these printed materials, some manuscripts of this period contain plans and sketches about war tactics, techniques, and materials.



FIG. 568. OTTOMAN NAVAL OPERATION OF KILBURUN AND THE CONFLICTS IN FRONT OF THE FORTRESS OF ÖZİ, 1202/1788. Hand-drawn map by el-Hâcc Feyzullah.

Image courtesy of Topkapı Sarayı Müzesi Arşivi, Istanbul (E. 9403/1).

There were a large number of plans of Ottoman fortresses, beginning with the seventeenth-century plan of the castle of Van (TSMA E. 9487; Karamustafa 1992, 213–14, fig. 11.5), representing a continuity in the Ottoman art of illustration. The anonymous plan of the castle of Buda dated after 1686 (Bologna, Biblioteca Universitaria, Marsigli 8; Karamustafa 1992, 215, fig. 11.7) marks the inner and outer walls, the Kızilelma Sarayı, and the arsenal and gives the number of guards at each of the defense towers. An Ottoman depiction of the city of Buda in the Marsigli collection in Bologna shows the town during the 1684 siege of the Christian forces and has recently been reevaluated (Molnár 2006).

Fierce wars and the increasing employment of European experts by the Ottomans during the reigns of Abdülhamîd I (r. 1774–89) and Selîm III (r. 1789–1807) led to great progress in the development of fortifications and the related practices of surveying and drafting. During this period, French engineers and cartographers and their Ottoman students prepared many maps and plans of military fortresses and harbors along the coasts of the Bosphorus, the Black Sea, and the Aegean Sea using European drafting principles. At the same time, the Ottoman administration undertook extensive reconnaissance work, initiating castle construction and repair to which they applied contemporary innovations. This effort resulted in the design plans for newly built or planned fortifications or draft plans of buildings supplementary to existing structures, such as the plans of the fortress of Ochakiv (1737) (BOA, Plan, Proje ve Krokiler Kataloğu, no. 857) and the fortress of Anapa (1793) (fig. 569). Among the maps housed in BOA and TSMA the plans for the fortresses of Yenikale, Berat, Avlona, Izmail, Măcin, Kherson, Kılburun, and Al-Iskandariyah (Alexandria) are typical. The manuscript regional maps that depict the fortresses in the area north of the Black Sea, particularly those on the River of Ochakiv and its branches (BOA, Haritalar Kataloğu, no. 90–92) also come from this period. After legislation in 1794, a self-contained building situated in the barracks of the 'Ulûfeli ħumbaracı ocağı within the Mühendishâne was allocated for the preservation of the fortress plans and maps. The 1794 regulation further stipulated that all fortress plans and maps should be inventoried and duplicated, and the terms for using the maps were fixed.

After 1791 several translations were published by the state press under the titles *Fenn-i ħarb*, *Fenn-i lağım*, or *Uşûl-i ħarbiye/Fenn-i muħâşara*; they included many plans and drafts related to military tactics, army mobilization, and deployment. Almost all of them, with a single exception, were translated into Turkish by Konstantin İpsilanti, with *Fenn-i ħarb*, the *Traité de l'attaque et de la défense des places* of Sébastien Le Prestre, maréchal de Vauban, being the first (1791). İpsilanti copied the

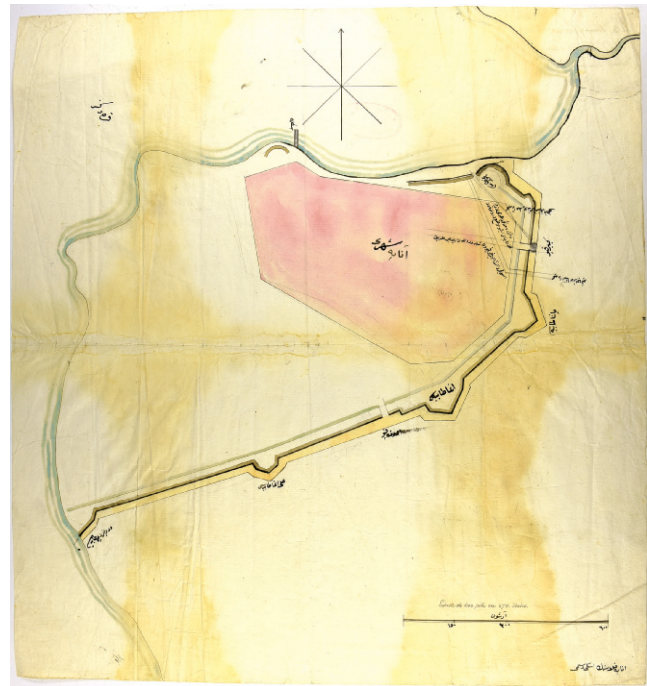


FIG. 569. PLAN OF THE FORTRESS OF ANAPA, 1207/1793. Manuscript plan, cartographer unknown. Size of the original: 51 × 50 cm. Image courtesy of the Başbakanlık Osmanlı Arşivi, Istanbul (Plan, Proje ve Krokiler Kataloğu, nr. 829).

figures and the illustrations himself with Meħmed Emîn, Kapril Efendi, and İstefan Efendi participating in this effort (fig. 570).

Three colored maps and plans come from the period of Russian-Turkish-British alliance that responded to the French occupation of Egypt and the island of Corfu in 1797–98 (TSMK H. 1847, 1848 and 1849). Most probably prepared by the French engineer François Kauffer, whose signature appears on the last map, they depict the Turkish-British allied siege of Alexandria in 1798–1801 and the Abū Qîr (Ebūhūr) landing on 25 July 1799 and provide an account of the events below the maps. There is another colored military plan with a distance scale of six hours (TSMA E. 6200/32; see fig. 521). The English version of this map (TSMA E. 6200/27; see fig. 522), presumably also drawn by Kauffer, shows the operational area from Abū Qîr and Rashîd (Rosetta) to Raħmāniyye and the siege and bombardment of Turkish-British joint fleet of Alexandria in March 1801. It also marks the dates of deployment of the military units and shows the initial positions and subsequent movements of the troops. Maħmūd Rā'if Efendi, the naval secretary of the period, left some maps on the naval operation against Corfu that compelled the surrender of the island to Turkish-Russian forces on 3 March 1799. Maħmūd



FIG. 570. ŞAHRĀ-YI ĠAYR-I MÜSTEVIYYEDE METRIS-LENMIŞ ORDUNUN BİR KİTASI (ENTRENCHMENT OF TROOPS ON OPEN FIELD). From *Ḍarben ve def'an muḥāşara ve muḥārese-i kılā' ve ḥuşūn*, translated by Kostan-

tin İpsilanti, 1206/1792, the Turkish translation of Vauban's *Traité de l'attaque et de la défense des places*. Size of the original: 33 × 27 cm. Image courtesy of the Special Collections Library, University of Michigan, Ann Arbor.

Rā'if's siege plan of the island of Vido adjacent to Corfu (TSMa E. 4004/5) is a translation of a Russian map. The descriptive notes above and below the map provide day-to-day information about the progress of the battle. Another colored and scaled map by Maḥmūd Rā'if that depicted the siege of Corfu, this time entirely by Ottoman means, has been lost.

By the end of the eighteenth century, as the military reforms were under way within the empire, the Ottoman state had made progress toward a military cartography based on scale, observation, measurement, and institutional map collecting. By employing a pragmatic approach and foreign cartographers when necessary, the Ottoman government without hesitation translated and used military maps and plans produced in Western Europe.

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SEE ALSO: Ottoman Empire, Geographical Mapping and the Visualization of Space in the

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*Military Cartography by Portugal*. The period between 1650 and 1800 corresponds to what might be called the "golden age" of military cartography in Portugal. Following an interlude of sixty years under the rule of the Spanish Crown, Portugal regained its autonomy in 1640. The separation from Spain compelled Portugal not only to invest in the immediate defense of its European borders but also to strengthen its imperial activities, which lasted from the middle of the seventeenth century throughout the entire eighteenth century. Portuguese lines of demarcation were in discussion in South America, and its sphere of influence fluctuated in Africa and the Far East. To maintain defenses, consolidate borders, and expand trade, the Portuguese relied heavily on military cartography.

To respond to the wartime urgency of the Portuguese Restoration War (1640-68), various foreign specialists were hired to rebuild the obsolete fortifications along the land border (especially in the Alentejo) and also to take care of the maritime border. Holland and France supplied both theoretical works as well as engineers for hire, definitively supplanting Italian influence in royal affairs, which dated back to the sixteenth century. War with Spain also raised the awareness of the need to create Portuguese specialists to avoid reliance on foreign mercenaries, always seen as dangerous.

One route to cartographic independence was to reestablish the educational institutions that had first been introduced in the sixteenth century. The Aula de Fortificação e Arquitectura Militar was formally instituted in 1647 in Lisbon, one of the first of its kind in Europe. The first director was Luís Serrão Pimentel, who had studied mathematics at the Jesuit college of Santo Antão. Subsequently nominated as *cosmógrafo-mor* (1671) and *engenheiro-mor* (1676), Pimentel wrote the *Methodo Lusitanico de desenhar as fortificaçoens das praças regulares, & irregulares*, published posthumously in 1680. His book synthesized the principal schools of European fortifications with an eclectic method, taking the best from each. Designed as a practical fortifications handbook, it provided the basic curriculum for the first generation of engineers trained at the Aula. Thereafter, similar institutions were created in Portugal (Viana, 1701; Peniche, 1719; Almeida and Elvas, 1732) as well as in the principal cities of the empire, above all in Brazil (Salvador, 1696; Rio de Janeiro, 1698; São Luís, 1699; Recife, 1701; Belém, 1757). Although the operation of these *aulas* was not constant, with some becoming truly effective only in the second half of the eighteenth century, the result was a considerable increase in the number of educated specialists who could meet the demands for boundary surveying in Portuguese America, especially after the Treaty of San Ildefonso (1777) (Conceição 2000; Bueno 2011).

These schools were defended staunchly by the *enge-*

*nheiro-mor* of the kingdom, Manoel de Azevedo Fortes (appointed in 1719). A graduate in philosophy and mathematics from Madrid and Paris who helped introduce Cartesian thought to Portugal, Azevedo Fortes authored several books including *O engenheiro portuguez: Divido em dous tratados* (1728–29), which synthesized his pedagogy and methodology. His work significantly influenced the development of military cartography in Portugal. Engineers assigned to the principal cities of the empire had a contractual obligation to teach as part of their work. Some treatises on fortification were produced by these teachers but remained in manuscript. Students emerging from these schools had a solid theoretical foundation that was also extremely practical, emphasizing mathematics (geometry) and drafting. These methodological bases for instruction and theoretical principles were constantly updated. Albums of drawings exist from the fortification classes in Bahia, including illustrations of various treatises that were used as student exercises (fig. 571).

The cartographic production of Portuguese engineers shows the indissoluble relationship between teaching and building practices, as the images nearly always corresponded to a project under construction. Once an engineer had received training in one of the *aulas* he entered the military in the infantry corps, officially ready to practice the “exercise of engineer” (as it was called in the contemporary documentation). It was up to the *engenheiro-mor* of the kingdom to approve or disapprove of all projects carried out by officers in all parts of the empire. Many drawings exist in manuscript, but few were engraved. Although no policy of secrecy was maintained, there were neither the means nor the interest to reproduce these maps in print. Whenever necessary, manuscript copies of the drawings were sent to the overseas council, the Conselho Ultramarino. Their designs served different purposes: to plan, to discuss, and to implement projects and to represent completed works. They were produced in the workspace of the teaching academies or in the fortifications themselves (fig. 572), and while varying aesthetically, they generally used similar materials. Beginning in the eighteenth century, color was used with greater frequency, often following the rubrics established by the *Tratado do modo o mais facil, e o mais exacto de fazer as cartas geograficas* (1722) of Azevedo Fortes.

The collections that today belong primarily to the cartographic archives of the Portuguese and Brazilian armies include examples of every type of design and drawing necessary for the maintenance of the empire: additions to existing fortifications; plans for new projects; geographic, topographic, and hydrographic surveys; and studies of civil and religious architecture—all completed by military engineers. The techniques used

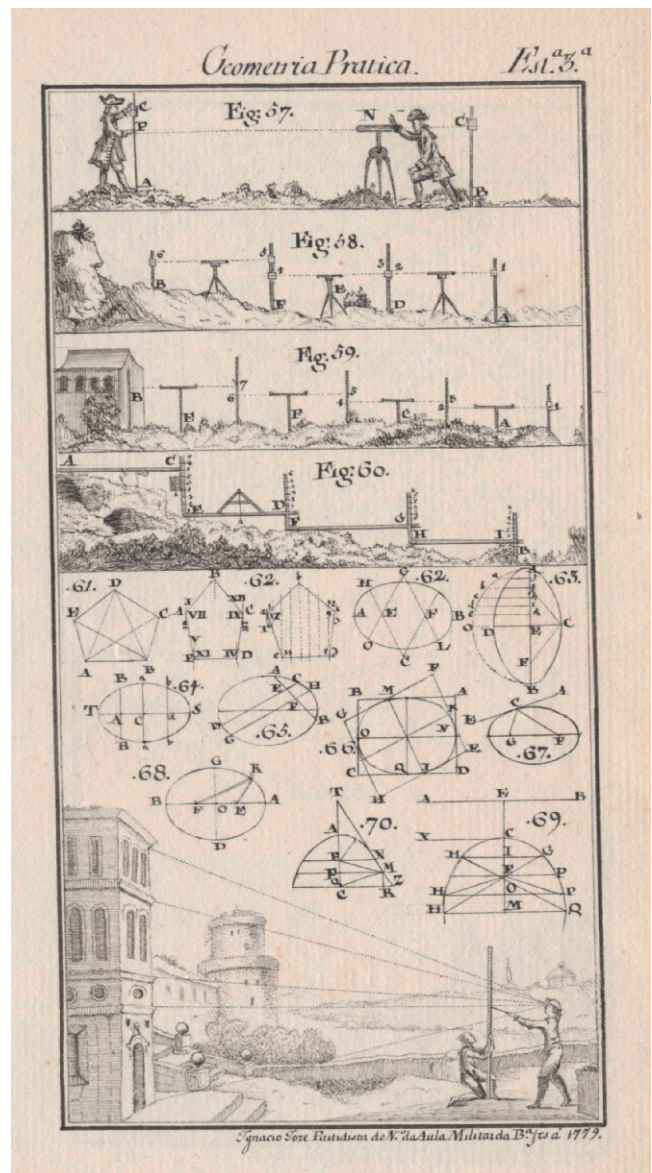


FIG. 571. DRAWING BY STUDENT FROM THE MILITARY SCHOOL. An illustration from the manuscript notebook of “Ignacio Joze,” a student in the Aula Militar da Bahia, made in 1779, showing different steps in surveying, leveling, and triangulation necessary for the creation of military maps. Size of the original: 33.3 × 21.7 cm. Image courtesy of the Arquivo Histórico Ultramarino, Lisbon (AHU\_CARTm\_005, D. 990-1028-1028A).

reveal a significant French influence, especially in the eighteenth century. In his *Tratado*, Azevedo Fortes laid out a method of mapmaking and fought for the standardization of signs to be utilized in all Portuguese military cartography, but this result was never completely accomplished. Following this example, António José Moreira published *Regras de desenho para a delineação das plantas, perfis e prespectivas pertencentes à*





FIG. 572. "PLANTA DA PRAÇA DE ALMEIDA & SEUS ATAQUES," 1764, BY MIGUEL LUÍS JACOB. Jacob, an infantry sargent and staff engineer, drew the map on site at the request of the commander of the fort. It shows both the potential ballistic range and topography surrounding the fort.

Size of the original: 94 × 81 cm. Image courtesy of Portugal/ Gabinete de Estudos Arqueológicos da Engenharia Militar/ Direção de Infraestruturas do Exército, Lisbon (14-1-2-2).

*arquitectura militar, e civil* (1793), designed for students in the Academia Real de Fortificação, Artilharia e Desenho (created in 1790 in Lisbon) to better consolidate and reinforce the continuity of the former framework used to educate an elite group of specialists within Portugal in the seventeenth and eighteenth centuries.

The privileged relationship between military engineering and urban planning in the context of the Portuguese culture of this period is shown significantly in the role played by military engineers in the reconstruction of Lisbon after the 1755 earthquake. Under the authority of the *engenheiro-mor* Manuel da Maia, work teams were formed that were responsible for rebuilding the city. Similarly in Brazil, military engineers were also called to design new towns, particularly in the second half of the eighteenth century.

In spite of a reluctance to rely on foreign mercenaries, some nonnative engineers worked in Portugal, especially during the war with Spain and France (1762–63). Some also were sent to Brazil, and their work was incorporated into the military production by indigenously trained Portuguese engineers.

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SEE ALSO: Portugal

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**Military Cartography by Spain.** During the sixteenth century, the Spanish monarchy was aware of the need for accurate information for control of its kingdom, and the cartography of military engineers and mathematicians

at its service was excellent. In the seventeenth century, cartography continued to have military objectives in the different kingdoms of the monarchy (Cámara 2005, 15–20), exemplified by the work of the Portuguese military engineer and cosmographer Pedro Teixeira Albernaz. The second half of the seventeenth century is noteworthy for the precipitous decline in cartographic production despite the fact that military engineers continued their well-established and respected tradition of military cartography, such as Ambrosio Borsano's manuscript map of Catalonia, "El Principado de Cattalvña y condados de Rossellon y Cerdaña" (1687) (Líter Mayayo, Martín-Merás, and Sanchis Ballester 2001, 133–35; Buisseret 2007, 1079–1081, 1090–91, fig. 39.21).

When the new dynasty of Bourbons came to power in the eighteenth century, they adopted the French system for organizing a corps of military engineers. This system definitively incorporated the engineers in the army with military grades and formal *ordenanzas* (ordinances or official instructions) that defined their functions. The ordinances described the production of maps necessary for understanding the nature of the king's territories and for administrative planning, as well as for military goals of defense and information on fortifications, fortresses, battles, and everything to do with war.

The Jesuits played a major role throughout the seventeenth century by teaching mathematics and allied sciences and embracing geography within their sphere of influence. Even well into the eighteenth century, Felipe V commissioned the Jesuits Carlos Martínez and Claudio de la Vega to produce a map of Spain, which was never finished. Toward the end of the seventeenth century, courses in map reading, map drawing, and geography were offered to military engineers by the Academia Real y Militar del Ejército de los Países Bajos (also known as the Academia Real y Militar de Bruselas), established in Brussels by the Spanish Habsburg monarchy in 1675 and directed by Sebastián Fernández de Medrano (Cámara 2013). This academy was the model for the Real Academia Militar de Matemáticas de Barcelona, created by the Bourbon dynasty in 1716 and opened in 1720, for the education of military engineers; it was directed by the Flemish *ingeniero general* Jorge Próspero de Verboom, a student of Fernández de Medrano (Capel, Sánchez, and Moncada 1988; Muñoz Corbalán 2004, 2015; Galland Seguela 2008, 55). In the Barcelona institution, scientific cartography for military purposes was reclaimed, with production focused on large-scale maps: the environs of a fortification, for example, Gibraltar (fig. 573); a boundary or frontier; and political borders.

To a larger extent, cartographic works by naval officers and military engineers working for the Spanish monarchy, many of whom were of Flemish or Italian

origin, developed in America, which was an excellent venue for experimentation, as is illustrated by the numerous maps conserved. One of the functions of the military engineers was the production of maps, as well as urban cartography with military goals, such as the preserved plans of Manila in the Philippines, Orán in Algeria, and Havana in Cuba. The movement of engineers through all the lands of the monarchy was a constant from the sixteenth century; their better organization in the eighteenth century can be credited to the rules regulating the functioning of the *Cuerpo de Ingenieros*, which spent much time in America. Thanks to them we have topographic urban studies of places of strategic value to the monarchy, especially of large ports and their fortifications.

Those who made the most accurate geographic and topographic maps, even if partial, based on field surveying, continued to be the military engineers. In 1796, the army's *Cuerpo de Ingenieros Cosmógrafos de Estado* was created. One of the goals of this organization was to produce a "Carta Geométrica del Reyno," but the corps was dismissed in 1804 before such a map could be realized (Silva Suárez 2005, 223–28).

The process of teaching cartography to military engineers is well known and explains the accuracy of their works. Throughout the eighteenth century, students in the *Academia de Matemáticas de Barcelona* learned the use of geographic and topographic maps and plans in addition to other subjects such as astronomy and topography. In the drawing course, future engineers were taught how to make maps and plans, how to use color, and how to write the *memorias* to accompany the graphic information. The production of geographic maps was taught in the last course. Not all military engineers were able to make maps, but they all had to be able to read them and know how to use them.

The *ordenanzas* for surveying maps and plans by engineers—the earliest one dating to 1718—also established the scales at which maps were to be drawn; scales were to be in proportion to the information that was being presented, and the possibility of different scales was further elaborated in later *ordenanzas*. The compass rose was to indicate the orientation, and numbers, lines, and colors helped make the information clearer. Text was commonly added to the map image that explained each of the elements and circumstances on the map. Maps had to have greater width than height with the top oriented north. If the scale employed was excessively large, the map was to be divided into sheets, all preserving the same scale. Military engineers had to take particular care in placing boundary lines on the maps as well as roads and other indications of transportation and communication. In the case of areas belonging to other countries

included in boundary maps, engineers could use only measurements that could be obtained within the territories of the king of Spain and from maps already published. Marine charts had to include all characteristics of the coasts—tides, reefs, rocks, obstacles, harbors, and water depths. Under orders from the ministry of war, engineers had to produce three copies from each original map. One copy was to be used on the spot where it had been made and two were to be archived, one in the *Secretaría del Despacho de la Guerra* and the other in the *Dirección General de Ingenieros* (Galland Seguela 2008, 37–43). Of the hundreds of maps extant in Spanish archives, no military map could fall into the hands of foreigners. Military cartography, most of it hand drawn, was not intended to be printed. It remained in manuscript for restricted use—the experience of three centuries demonstrated that it was absolutely necessary for the knowledge, defense, and protection of the territories of the Spanish monarchy. This secretive character contributed to the excellence of the cartography of military engineers because only a description that represented the territory with absolute fidelity, its fortifications, cities, coasts, and ports, would serve the exercise of power.

ALICIA CÁMARA

SEE ALSO: Spain

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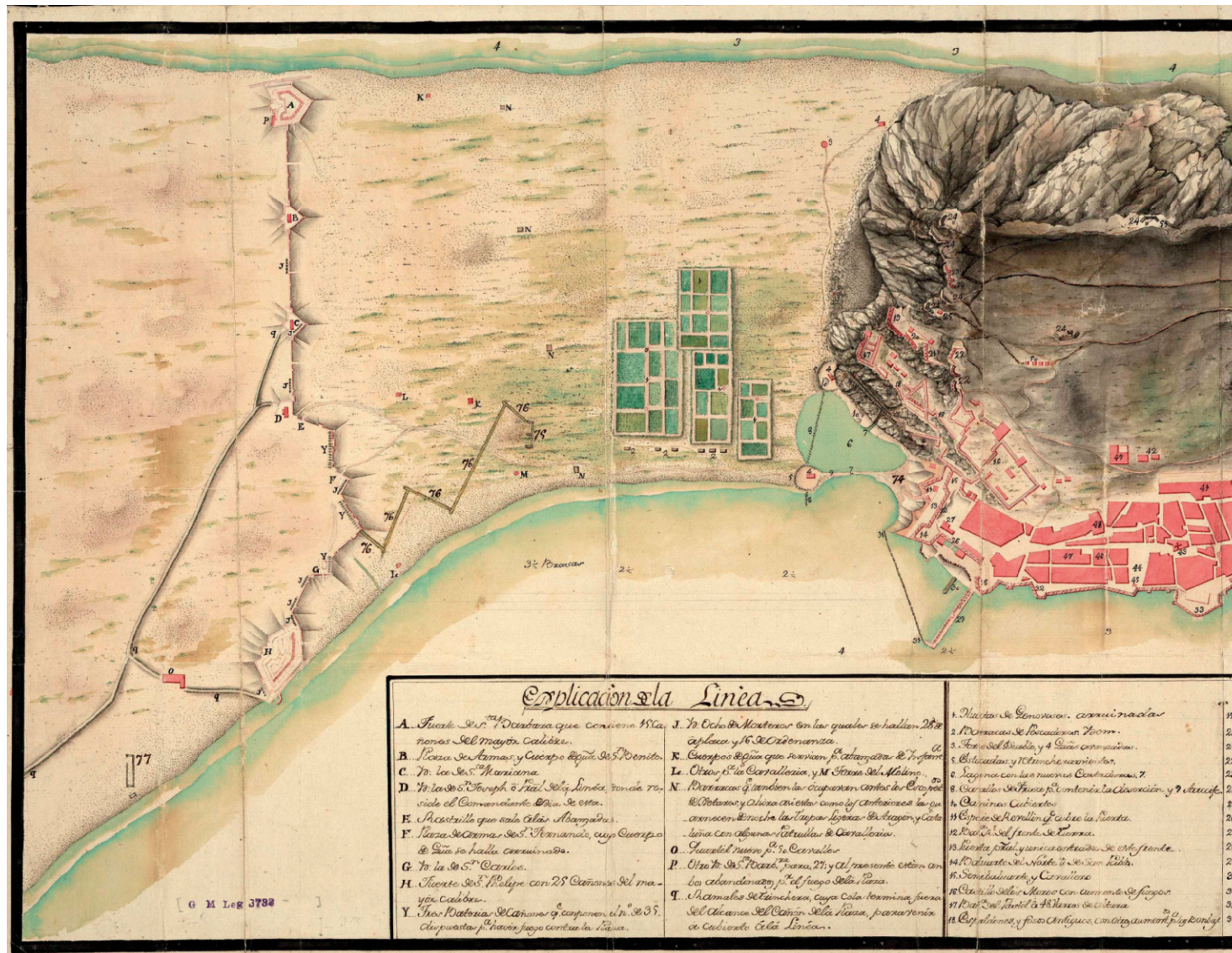


FIG. 573. JUAN CABALLERO, PLAN OF GIBRALTAR, 1780. Manuscript; hand colored. In this plan some characteristics of Spanish military cartography of the eighteenth century are found, including the wind rose indicating orientation, the width being much greater than the height (as ordered by the *ordenanza* of 4 July 1718), the use of color to make information clearer, the incorporation of written text on the plan, and

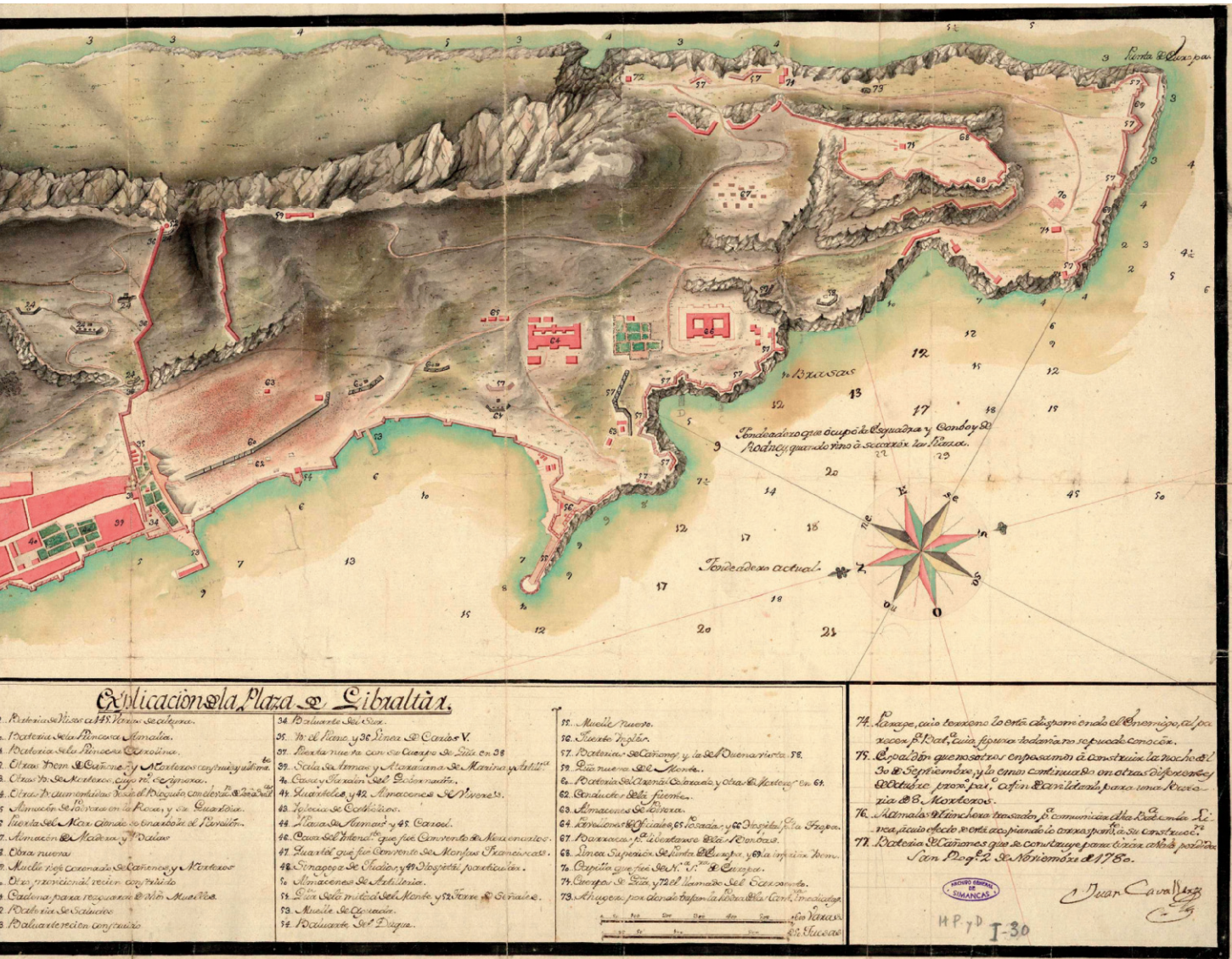
the relationship between the development of cartography and defensive tactics. Scale: 8.3 cm = 600 varas (Castilian measure of length) and 8 cm = 250 toesas (equivalent to French toises). Size of the original: 42.0 × 107.8 cm. Image courtesy España, Ministerio de Cultura, Archivo General de Simancas, Valladolid (MPD,01,030).

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*Military Cartography by Sweden-Finland*. Sweden had been a major military power since the reign of Gustavus Vasa (1523–60), and by the time of the Treaty of Ros-

kilde, which concluded the Dano-Swedish War (1657–58), controlled not only the modern areas of Sweden and Finland, but also the Baltic regions of Kexholm län (part of Karelia), Ingria, Estonia, and Livonia, as well as parts of Pomerania, Wismar, and Bremen-Verden.

Military engineering and mapping took place within the Fortifikationen (fortifications administration), organized in 1635. The leading figure in the second half of the seventeenth century was Erik Dahlbergh, who has been called the "Vauban of Sweden." Dahlbergh had gradu-



ally acquired a thorough theoretical and practical training in fortification design, beginning in 1647 as *konduktör* (leader of construction work) to Conrad Maesberg (ennobled von Mardefelt), commander of the Swedish fortifications in Germany. In 1650–54, Dahlbergh lived in Frankfurt am Main, where he became acquainted with Matthäus Merian, and some of his drawings of cities and fortifications were engraved and printed in Merian's *Theatrum Europæum* in 1657. Over the following two years he undertook study tours in Central

Europe and Italy. In this period, Dahlbergh mainly studied drawing and architecture. However, his focus was on fortifications, and in 1656, during the war with Poland, he was employed by the Swedish army. His drawings of the campaigns of Karl X Gustav were later published in Samuel Pufendorf's *De rebus a Carolo Gustavo Sveciæ rege gestis commentariorum libri septem* (1696). In 1674, Dahlbergh was appointed quartermaster general and stayed in this office until his death in 1703. During this period the permanent staff rose from about 50 to



FIG. 574. ERIK DAHLBERGH, "GEOMETRISCH DELINEATION AF CHRISTIANSTAD SAMPT DES SITUATION OCH HURULEDES DET AN. 1677 OCH 1678." Manuscript map showing the Swedish siege of the Danish town Kristianstad 1677 to 5 August 1678.

Size of the original: 30 × 38 cm. Image courtesy of Krigsarkivet, Stockholm (SE/KrA/0425/08/002).

almost 450 men. In 1680, he also received full responsibility for the Baltic provinces and the following year the German provinces. Parallel to this, he was entrusted with many other commissions. He traveled extensively and made a great many fortification plans (fig. 574). From 1661, Dahlbergh worked on *Suecia antiqua et hodierna* (published in 1716), which contains the most ambitious architectural and topographical documentation of Sweden during its age of imperial greatness. The 353 pictures depict the architectural achievements, cities, and towns, as well as ancient history, with the express purpose of enhancing the glory of Sweden.

Dahlbergh's strength was constructing fortresses, not being a cartographer per se, but as head of Fortifikationen, he had access to two skillful cartographers: Ger-

hard von Buhrman and Carl Magnus Stuart. Buhrman's manuscript maps of Skåne (Scania) (fig. 575) would be copied for several decades. Stuart would make his principal contribution to the military mapping of the Baltic possessions of Kexholm län, Ingria, and Livonia, culminating in a large map probably compiled in 1699 (Krigsarkivet, Stockholm, SE/KrA/0403/32/048 00–33). In the same year, Stuart drew up an ambitious educational program in Fortifikationen in which cadets and officers were trained in all aspects of fortification work, one of the earliest such programs in Europe. Among Stuart's goals was the normalization of drawing styles (Nisser 1986, 150–52).

On Dahlbergh's death in 1703, Stuart succeeded him as head of Fortifikationen, and during the Great North-



FIG. 575. GERHARD VON BUHRMAN, “SCHOONEN,” MANUSCRIPT, 1687. This map of Skåne (Scania) is based on an inventory of all residences of military potential, which was commissioned in 1681.

Size of the original: 124 × 119 cm. Image courtesy of Krigsarkivet, Stockholm (SE/KrA/0400/17A/004).

ern War (1700–1721), he and his successor engineers carefully documented the army’s progress. A special field unit consisting of twenty-five officers and twelve artisans was created in 1700. Under the direction of Quartermaster General Gerhart Ehrenschantz, the unit

played an important role in Karl XII’s victory in the Battle of Klissow (1702). Altogether, the main collection (Sveriges krig) in Krigsarkivet contains 699 manuscript maps and plans relating to the Great Northern War, including orders of battle; fortification plans; siege

plans; road maps; reconnaissance, artillery, and hydrographic maps; city plans; and plans of encampments (SE/KrA/0425/09/016–SE/KrA/0425/14/123).

After the Battle of Poltava (1709), where the Swedish army was defeated by Czar Peter I, most of the Swedish prisoners of war were taken to Tobolsk. While in Siberia, one of the fortification officers, Philipp Johan Tabbert (ennobled von Strahlenberg), and fellow prisoner, Johan Anton Matérn, managed to gather information for a large and important map of all of eastern Russia. After returning to Stockholm as a free man, Strahlenberg had the map (*Nova descriptio geographica Tattariæ magnæ*) engraved in 1730 by Philipp J. Frisch in Berlin.

In the peace agreements of 1719–21, Sweden lost Bremen-Verden to Hannover, parts of Pomerania and Stettin to Prussia, and the Baltic provinces and the southeast part of Finland to Russia. The position of Sweden's military strategy changed; its time of great power was gone. Fortifikationen, too, ceased to be an independent body and was subsumed by the Krigskollegium (war board), the number of staff declining to ninety-five by 1721.

Beginning in 1738, Swedish foreign policy was aligned with France. It was ruled by the so-called Hat party, made up of a coalition of officers, public officials, and big businessmen. Their increased antagonism toward Russia and desire for revenge led to the war of 1741–43. The war generated 143 manuscript maps in the Sveriges krig collection (SE/KrA/0425/15/005–120) but ended badly for Sweden, which had to cede the land east of the Kymmene (Kymi) River and Lake Saimaa in southeast Finland to Russia.

In June 1757, the Swedish council of state, Riksrådet, decided to take part in the war against Prussia, in alliance with France and Austria. When the Swedish army landed in Pomerania, the only map available was Eilhard Lubin's map from 1618. To rectify this lacuna, Axel Magnus von Arbin, a major with the Fortifikationen, set energetically to work in a manner that would come to set the standard. In 1751, he had traveled through Holland, Brabant, and Flanders in order to study both fortifications and new French methods of mapping.

In 1759, Arbin issued a manuscript instruction manual describing the principles that should be applied to the mapping work. He divided the area up into twelve reconnaissance districts based on land cover and mainly using natural boundaries in the form of waterways and marshland. These principles, later elaborated in a printed book (Arbin 1761), would provide the basis for Swedish military mapping well into the nineteenth century. The first sections of the military map of Pomerania were produced at a scale of 1:40,000 during the winter of 1758. In March 1764, the work was completed mainly by Cap-

tain Samuel Conrad Kempfe, along with separate maps of more than five hundred villages at a scale of 1:4,000. Copies of these maps can be found in several archives, among them Krigsarkivet (under the title "Svenska Pommern och Rügen," SE/KrA/0402/19/A/001–037) and the Staatsbibliothek, Berlin (Kartenabteilung 2° Kart. N 7517) (Ehrensverd 1995).

The buffer function of Finland had been clearly demonstrated during the Russian war of 1742–43, and between 1748 and 1774 a sound triangulation network covering southern Finland was built up. In 1773, the general in chief in Finland, Berndt Otto Stackelberg, pointed out that there was no "military map of Finland." He argued that a map of this type could be drawn up on the basis of the maps on which "land surveyors previously have divided up and described the land," and Arbin suggested that the model for the work should be the Pomeranian military map from the 1760s (Alanen and Kepsu 1989, 5–7).

In August 1776, the first directions for Finska Rekognoseringsverket (Finnish reconnaissance authority) were drawn up. The country was to be divided into two units: a southern one, with its drawing office in Helsingfors (Helsinki) and a northern one, based in Sankt Michel (Mikkeli) and led by Göran Magnus Sprengtporten (see fig. 860), who had taken part in the mapping of Pomerania. The southern unit would be responsible for the mapping of southern Finland west of the Kymmene River, while the northern one would deal with Savolax, Carelia, and Österbotten. In 1780, a major in the Army's fleet, Carl Nathanael af Klercker, became head of Finska Rekognoseringsverket, and—since Sprengtporten had resigned—the northern area was also assigned to him (fig. 576).

The ultimate objective of the reconnaissance was to prepare a series of maps on a scale of 1:40,000, but this was not achieved. The result was maps of three principal types: (1) *koncept* maps of a general character (1:20,000), hachured to show relief; (2) maps of strategic localities (1:4,000), showing the principal highways, byways, bridle paths, quartering sites, etc.; and (3) maps of strategic sites on much larger scales, showing ridges capable of supporting defense, intervisible hills where beacons could be burned, and eminences where cannons could be placed (the series SE/KrA/0411/A and SE/KrA/0411/B). Another important function was to map and measure water routes and identify lock sites for possible canalization. A by-product of this detailed mapping was the recording of an immense number of local place-names in the Finnish languages, which are of considerable value for ethnographers and toponomists.

In Sweden, a field-surveying corps was set up in 1805, and the reconnaissance work in Finland then ceased. By





FIG. 576. CARL NATHANAEL AF KLERCKER, MANUSCRIPT RECONNAISSANCE SURVEY MAP, 1776. One of the 329 sheets of the southern district of the Finnish reconnaissance survey; sheet 74 showing Loviisa (Loviisa), scale 1:20,000. See also fig. 860.

Size of the original: 72 × 112 cm. Image courtesy of Krigsarkivet, Stockholm (SE/KrA/0411A/09/5 o).

1809, the end of its Swedish period, no fewer than five million hectares of Finland had been subjected to reorganization with associated maps on varying scales.

ULLA EHRENSVÄRD

SEE ALSO: Sweden-Finland

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**Military Cartography by Switzerland.** There was no uniform Swiss army before 1798, since Switzerland was only a loose formation of practically independent states. Cooperation only took place according to the agreements, or *Defensionale*, of Wil (1647) and Baden (1668) for a collective Swiss national defense. The two most powerful cantons of Bern and Zurich took the lead

militarily. The results of military mapping are accordingly distributed across multiple archives and libraries. By contrast, throughout the seventeenth and eighteenth centuries, the Swiss cantons were a major supplier of mercenaries for the armies primarily of France but also of the Netherlands, Piedmont, Britain, and Spain.

The Swiss cantons were largely spared wars. The only armed conflict with a foreign power occurred during the Thirty Years' War when the French, Austrians, and Spanish contested the Grisons (1620–37), which then included Valtellina. At that time, Swiss and foreign authors produced numerous maps of the Grisons and Valtellina, which included depictions of forts and troop positions (Bianchi 2007, e.g., 154 [no. 57]). The Swiss Diet issued the first declaration of neutrality in 1674, and henceforth the Swiss stayed out of European wars. Consequently, until the Napoleonic invasion of 1798, the only wars were civil in nature: the Peasant War of 1653 and the two Villmergen Wars of 1656 and 1712 between individual Reformed and Catholic cantons.

The threat in the Thirty Years' War led the Confederation to reorganize its defense forces. For the first time, military engineers were appointed, first in Bern in 1610 (Valentin Friderich), then in Zurich, Basel, and Geneva (Peter 1907, 16). Important military engineers in Bern were Wolf Friedrich Löscher, Johannes Willading, and Pierre Willommet the Elder. Military engineers were also active in other cities, such as Jakob Meyer in Basel and Heinrich Peyer in Schaffhausen.

In Zurich, officers were instructed by the authorities to draft a military map of northeast Switzerland, drawn by Hans Conrad Gyger in 1620. At that time, the mobilization and alert systems (*Hochwachten*, or signal towers) were reorganized, particularly in Bern and Zurich. In 1643, Gyger drew a *Hochwachten* map of the Zurich region, joining the individual *Hochwachten* by lines that formed the basis of a triangulation network (fig. 577). Although all of Switzerland from Lake Constance to Lake Geneva was covered by a system of *Hochwachten*, only the *Hochwachten* maps of Zurich are known. Maps of Zurich were also produced to show the new military districts (*Militärquartierkarten*) created in the event of a mobilization, such as Gyger's manuscript maps from 1644–60 (Dürst 1977).

In the latter half of the seventeenth century, various cities considered renewing, reinforcing, or rebuilding their fortifications. Only a few of these projects, however, were either partially or completely brought to fruition. The largest project was the new fortification of Zurich, 1642–78, according to plans by Hans Georg Werdmüller. Solothurn was likewise fortified from 1667 until about 1727 according to the plans of Francesco Polatta and Jacques Tarade in consultation with Sébastien Le Prestre, maréchal de Vauban, as an expert. Between

1663 and 1686, Maximilien d'Yvoy updated the ramparts of Geneva, a city that implemented the last large fortification construction plan in Switzerland, produced between 1716 and 1750 at the order of Guillaume Le Vasseur des Rocques and realized by Pierre Pradès de la Ramière. New ramparts were established in Bern from 1622 to 1634 according to plans by Théodore Agrippa d'Aubigné. Aarburg was enlarged into a fortress from 1659 to 1673. Pietro Morettini, of Ticino, was municipal engineer in Lucerne and planned fortifications in Fribourg, Solothurn, and other Catholic cities from 1707 to 1712. These military engineers were usually active in several countries and traveled to where their commissions took them. Plans of projected fortifications have often not survived or exist only as copies, often anonymous or undated. The Bern fortress plans were bound in four atlases (Bern, Staatsarchiv, Festungsatlas, Atlanten 6, 6a, 7, 8), of which 6a is now part of the so-called Schauenburg Collection (Engelberts 1989). Wooden models of the fortification projects of Zurich (1628 and 1640) are held at the Landesmuseum, Zurich.

Johann Ardüser was the sole Swiss author of a treatise on fortress building: *Architectura von Vestungen* (1651). He collected and elaborated fortress plans in all of Europe (in total 230 plans in manuscript, especially from the Netherlands, Germany, France, and Italy; Zurich, Zentralbibliothek, Ms. B 81 "Vestungs Bau").

In 1672 in Bern a permanent artillery corps was founded under the command of Johannes Willading (Grosjean 1978, 15). For the first time, artillery officers received training in measurement and plan drawing. In 1783, an actual artillery school came into existence, of which Andreas Lanz was appointed director. In Zurich, officer training was provided by private companies. The Militärische Gesellschaft der Pörtner, founded in 1713, orchestrated maneuvers that were recorded between 1754 and 1798 on printed maneuver maps (e.g., *Zürcher Neujaarsblätter* 1971, 59–62). Handwritten and printed maneuver maps were also produced in Basel and Bern. The Mathematisch-Militärische Gesellschaft, founded in Zurich in 1765, compiled and recorded the boundaries of the canton and created an unofficial manuscript border atlas in 1795 (Zurich, Zentralbibliothek, Sign.: MK 503 + MK 503 Erl). The school's efforts to create a new canton map remained incomplete and limited to the repeated measurement of a baseline (first in 1791).

The battles of the Swiss Civil Wars are documented in plans and drawings. A manuscript plan of the Battle at Herzogenbuchsee of the Peasant War of 1653 by Johannes Willading in 1654 is preserved in the Zentralbibliothek Zurich. Manuscript and printed drawings of the first Battle of Villmergen and the siege of Rapperswil are known from the first Villmergen War of 1656. The



FIG. 577. DETAIL FROM HANS CONRAD GYGER'S 1643 MANUSCRIPT MAP OF THE SIGNAL TOWERS OF THE CANTON OF ZÜRICH (ZÜRCHER HOCHWACHTEN-KARTE). The map shows the ten military districts for mobilization (*Militärquartiere*) and twenty-one signal towers (*Hochwachten*) with lines of mutual sight, which could be used later

for triangulation. The black grid was made later. Colored pen-and-ink drawing on paper.

Size of the entire original: 42.0 × 55.7 cm; size of detail: ca. 19.5 × 28.0 cm. Image courtesy of the Staatsarchiv des Kantons Zürich (PLAN O 113).

battles and sieges of the second Villmergen War of 1712 (the so-called *Staudenschlacht* near Bremgarten [Aargau] and the second Battle of Villmergen, the skirmish at Hütten, sieges of Baden and Wil) were recorded in numerous manuscript or printed plans, among others, by Johann Adam Riediger. In response to the growing threat to Switzerland presented by France after the French Revolution, the Bern Council of War had its territory reconnoitered, recorded, and drawn to plan defense positions in 1794, under the leadership of French engineer Lambert-Fidèle-Amable Roush, sieur de Vari-court, who resided in the territory of Bern as a Royalist immigrant.

HANS-PETER HÖHENER

SEE ALSO: Switzerland

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**Military Map.**

BATTLE MAP  
 FORTIFICATION PLAN  
 PLAN-RELIEF

**Battle Map.** The ultimate purpose of armies is to engage and defeat opposing military forces. The eighteenth century was a time of nearly continuous warfare between the nations of Europe, both on the Continent and in their overseas possessions. Each campaigning season saw numerous examples of two types of battle: sieges of fortified places and open-field actions of fire and maneuver. Both forms of combat were relatively slow-moving and were fought with much smaller numbers of participants and in much more limited areas than battles of the late nineteenth and twentieth centuries. Battle maps, both manuscript and printed, preserved a record of the progress and outcome of many of these military encounters.

Battle maps of the eighteenth century were essentially topographical maps on which were projected the composition, positions, fortifications, and movements of military forces before, during, or after a martial action. They provided a useful graphic account of a battle or siege and could be used to analyze the action or to justify the conduct and skill of officers in positions of responsibility. Battle maps are often found in the manuscript archives of prominent military figures. They were

usually drawn by military officers who were engineers or artillerymen, though they were sometimes drawn by officers from other branches. The creators of most battle maps had either witnessed the fighting or had an opportunity to survey the field on which it was fought. The majority of such maps remained in manuscript form, but those depicting significant actions were sometimes engraved and printed.

Maps of field actions generally identify the specific units or types of units present using rectangular symbols, sometimes further identified as to their type—in infantry, cavalry, or artillery. In some colored compositions, individual units are rendered in the colors of their uniforms or labeled with their name or title. Unit symbols were used to show the movements and maneuvers of a battle in a variety of ways. Dotted or solid lines showed the track of individual units. Other maps presented movement and the passage of time by identifying the initial and later positions of units on the field of battle (fig. 578). Occasionally, the situation before or after the fighting was shown by the use of small overlay flaps glued to the print. The flaps cover part of the print but could be drawn back to reveal an earlier or later situation on the same ground. Significant details or events of the battle or siege were often identified or explained by means of a table of references (fig. 579).

Maps of sieges represent a more static type of battle



FIG. 579. DETAIL FROM THE “BATTLE OF MONMOUTH, 28<sup>TH</sup> JUNE 1778.” From the collection of Sir Henry Clinton, this finished manuscript topographical map shows the positions and movements of the British and American troops in New Jersey; the various units are identified in a table of references. Clinton added some annotations.

Size of the entire original: 39 × 55 cm; size of detail: ca. 17.0 × 38.5 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (Maps 6-A-1778 Ba).

that might have taken weeks or even months to resolve. These maps are dominated by the fortifications under attack and by the trenches (also called approaches) and artillery batteries constructed by the besiegers. The movements of individual units are not often shown, but the progress of digging trenches toward the target fortress can sometimes be traced by date.

Maps of battle enjoyed growing commercial appeal in Europe from the end of the seventeenth century and particularly in Britain during the American Revolutionary War. British engravers, most notably William Faden, produced representations of almost every important battle fought in North America between 1775 and 1781. Postwar histories, most published in the 1780s, frequently included maps of American battles as well.

Eighteenth-century battle maps document maneuvers of hard-fought engagements between opposing armies. They record battle events in relation to the topography over which they were fought and record military actions that often affected the history of the era.

BRIAN LEIGH DUNNIGAN

SEE ALSO: Military and Topographical Surveys; Military Cartography; Public Sphere, Cartography and the

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**Fortification Plan.** European warfare of the seventeenth and eighteenth centuries was dominated by the influence of the “place,” a fortified position ranging in complexity from a walled city with its citadel to a simple wooden fort protecting a strategic pass or transportation route. The chief purposes of a fortified place were to occupy important territory, to provide a secure depot and refuge for armies and their provisions, and to force an enemy to squander time and resources in besieging such positions, which could not safely be bypassed or ignored by an advancing army. The positional warfare that developed around the numerous fortified places in Europe and its colonies required the skills of military engineers, who produced large numbers of plans detailing fortifications and the siege tactics used to conquer them.

Fortification plans were formal architectural renderings of military defenses, often carefully measured and frequently colored to identify or highlight certain details (fig. 580). They usually took the form of ground plans, often enhanced by cross sections and occasionally by elevation drawings. Most included a table of references that identified important features of the defenses or the buildings within them. Other conventions of drawing and coloring practiced by engineers gave plans of

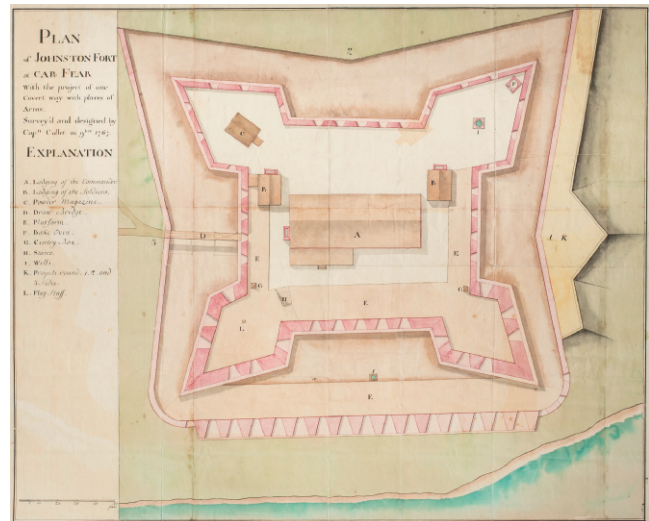


FIG. 580. “PLAN OF JOHNSTON FORT AT CAPE FEAR,” 1767. Manuscript plan surveyed and designed by Captain John Abraham Collet in North Carolina.

Size of the original: 58.7 × 72.0 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (Maps 6-H-1767 Co).

fortifications a uniform appearance that could be read and understood by their peers in the service of other nations. While a few fortification plans were engraved and printed commercially, most remained in manuscript, from which they were copied as needed.

Fortification plans were created for a variety of purposes, some of which influenced the style in which they were drawn. Those showing existing conditions were useful for reporting or planning purposes; some plans were used to design new works or to represent their form on the ground in relation to topographical or architectural features; still others depicted details needed to guide construction or to show its progress. The completion of new defenses or the repair of existing ones often inspired a plan intended to display for higher authority the results of often-considerable expenditures of labor and treasure. Larger-scale plans included renderings of forts in relation to nearby topography to show the absence (or presence) of higher ground within cannon range that might present an attacker with an advantage. Another aspect of fortification plans was the representation of siege operations or assaults that threatened or captured fortified places. The same general rules and conventions applied to renderings ranging from simple wooden stockades in North America to the complex masonry defenses of fortified towns in Europe.

Creating understandable fortification plans required great detail, including the depiction of walls, ditches, and other features, all of which were laid out according

to strict geometrical principles that ensured that no part of the land surrounding a fortified place was sheltered from the musket and cannon fire of its defenders. Likewise, deep ditches and earthen outer defenses shielded the walls of fortified places from the cannon fire of besieging forces. Plans used strong lines to represent the abrupt changes in elevation of parapets and other features. The form of the defenses was often further revealed by inset cross sections that sometimes identified the material—earth, log, or masonry—from which they were constructed.

Color was often used in conventional ways to enlighten readers of the plan. Although exceptions were common, certain information could be conveyed at a glance: carmine or red usually identified masonry components; green depicted turf, which covered earthen walls to impede erosion; brown or burnt umber usually showed the dry ditch that surrounded most fortifications of any size, while blue-greens indicated water. Yellow generally showed projected or unfinished features. Additional details—embrasures for cannon; the guns themselves; flagpoles, wells, and buildings—were included according to the purpose of the plan or the inclination of the draftsman. Fortification plans documented important man-made features that influenced military events, the growth and change of cities, and the events of warfare that had a significant influence on the life of eighteenth-century Europe and her colonies.

BRIAN LEIGH DUNNIGAN

SEE ALSO: Engineers and Topographical Surveys; Military and Topographical Surveys; Military Cartography; Topographical Survey Map; Urban Map; Urban Plan

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**Plan-relief.** The phrase *plan-relief* first appeared in the nineteenth century, a contraction of the term *plan en relief* (plan in relief), which had been used throughout the seventeenth and eighteenth centuries, concurrently with the words “model,” “relief,” or even “plan,” all used to designate the three-dimensional scale models of fortified cities created under Louis XIV, a collection that continued to be expanded and enriched until 1870.

The collection of Louis XIV was started in 1668, at the behest of François-Michel Le Tellier, marquis de Louvois, minister of war, who ordered a relief plan of Dunkerque from Sébastien Le Prestre, marquis de Vauban. The first relief plans were conceived to accompany the fortification works managed by the *ingénieurs du*

*roi* (the king’s engineers) in the strongholds of recently conquered Spanish Flanders. The models, initially simple working instruments quickly executed, evocatively represented the evolving state of a stronghold: the projects, the progress of their execution, and the final fortifications.

As veritable long-distance assessment and valuation tools for the king and his headquarters, these *plans en relief* revealed in a very immediate way both the details of the fortifications and the imprint of each stronghold on the territory. This easy means for understanding complex sites enjoyed great success, and the collection grew rapidly. An inventory prepared by Vauban in 1697 shows that in less than thirty years 144 models were created, representing 101 fortified sites (Warmoes 1997, 8).

From 1684 the purpose of the *plans-reliefs* was modified, and they were henceforth designed to represent strongholds built in the decade after the completion of the fortification campaigns. The *plans-reliefs* thus became the memory of works completed, tools representing the mastery of the territory.

From then on, engineers who specialized in the creation of *plans-reliefs* codified the construction techniques, and the scale of 1 pied per 100 toises (i.e., 1:600) was imposed as the most suitable for the representation of fortifications, for building inside the cities, and for the surrounding countryside (fig. 581). Increasing attention to detail was brought to bear on the models, which were made of wood, silk, metal, and painted and engraved papers; they soon acquired the status of art objects. The prestige of the *plans-reliefs* increased until 1700, when Louis XIV decided to install his models in Galerie du Bord-de-l’Eau in the Louvre (fig. 582).

During the first half of the eighteenth century, the collection was still being developed, keeping pace with the rhythm of territorial conquests and the building of fortification works. The end of the Seven Years’ War in 1763 marked a cessation of conflicts on European soil until the end of the Ancien Régime. The defensive border of the kingdom remained stable, and no need was felt to create new *plans-reliefs* of the strongholds; at that point the collection was complete. At the same time, techniques for conducting terrestrial surveys improved from 1749, and the systematic creation of atlases of the kingdom’s fortifications increased from 1774, both of which reduced the need for further model building.

From then on, the gallery of *plans-reliefs* was the site of a program for restoration of the old models, begun in 1754 by Charles Louis Auguste Fouquet, maréchal de Belle-Isle, minister of war. However, the utility of the *plans-reliefs* suffered a setback, and the fate of the entire collection was threatened during the reign of Louis XVI. Ultimately it was preserved but transferred from the Louvre to Les Invalides in 1777.



FIG. 581. *PLAN-RELIEF OF NEUF-BRISACH (1703–6)*. Built under the direction of the engineer Jean-François de Montagu to represent the fortified town on the border between France and the German States. It is constructed of wood, painted pa-

per, silk, and metal at a scale of 1:600, in five layers covering 15.3 square meters.

Size of the original: 3.4 × 4.5 m. © Réunion des musées nationaux—Grand Palais/Art Resource, New York.





FIG. 582. GALLERY OF PLANS-RELIEFS AT THE LOUVRE. From volume 4 of the “État des ingénieurs,” 1749, fol. 2. Manuscript design, ink and wash on paper. Size of the original: 16.5 × 10.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Bibliothèque de l’Arsenal, Archives et manuscrits, ms-4426).

The construction of *plans-reliefs* was resurrected during the Revolution with an order for a relief plan of Toulon, and modelmaking continued in an important way until 1870. Between 1668 and 1870, 260 *plans-reliefs* were created, representing 150 sites (Roux, Faucherre, and Monsaingeon 1989, 154). Today the models are conserved in the collections of the Musée des Plans-reliefs (Hôtel des Invalides, Paris); fifteen of the models are on deposit at the Musée des Beaux-Arts in Lille.

ISABELLE WARMOES

SEE ALSO: Heights and Depths, Mapping of: Relief Map; Topographical Surveying; Urban Mapping: (1) France, (2) Switzerland

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*Modes of Cartographic Practice*. A cartographic mode comprises a distinctive suite of practices whereby maps are produced, circulated, and consumed within discourses that share a particular scale-dependent spatial conception. Each mode is part of a larger arena of activity within which humans conceptualize the world in certain ways in order to understand, organize, and modify it. Identification of particular modes, and of their internal changes and external interactions, is an empirically driven process (Edney 1993; 2011b; 2019, 9–49). The concept of cartographic mode is thus a heuristic device that aids in both the synchronic (comparative) study of early mapping and the diachronic study of mapping activities over time (e.g., Edney 2007, 2011a). As such, the concept serves as the intellectual foundation for the design of volumes 4 through 6 of *The History of Cartography* (Edney 2015).

As a first example, the creation, regulation, and preservation of real property sustain multiple discourses (legislative, judicial, cadastral, managerial, commercial, communal), all of which treat landscape as being fragmented into discrete parcels. These discourses have used various strategies to delimit and represent those parcels, at very large scales, from the physical marking of the land and often ritualized inspections of boundary marks, through oral description and written metes-and-bounds descriptions, to graphic plans. The cartographic mode of *property mapping* is accordingly the set of practices for producing, circulating, and consuming property plans across the several discourses in conjunction with the other representational strategies.

By contrast, *topographical mapping* is the mode associated with discourses of landscape and the character of places. This mode conceptualizes the world at small-to-medium scales within the various civil and military discourses concerning landscape and territory; it is intertwined with the practices of landscape art and poetry and of architecture and engineering. Property and topographical mapping might have a common foundation

in the observation and measurement of land and share some of the technology for surveying and drafting, but they are otherwise distinct in their spatial conceptions and in the functions and institutions that defined their production and consumption.

Both property and topographical mapping are distinct from *geographical mapping*, which is the representation of the world and its regions at small scales. Intertwined with written accounts, geographical mapping contributed in the eighteenth century to a variety of discourses that shared an interest in the nature and organization of the wide world, whether scholarly (geography *per se*), educated (politics, religion, economics, commerce, history, science), administrative, military, or for popular consumption. Although historians have privileged this mode and have often written the history of cartography as if it comprised solely the history of geographical mapping, it is essential to realize that geographical mapping is just one mode among several.

Overall, we can identify nine modes within the long Enlightenment (table 4). They were by no means dis-

crete and independent. At an institutional level, government agencies and the marketplace mixed cartographic practices within four broad endeavors that require historical attention (table 5). Moreover, the Enlightenment witnessed an intensification of geography's omnivorous approach to sources. In addition to the long-standing appropriation of marine charts and logs, geographical mapping began after 1650 to appropriate property and topographical plans as they were increasingly extended across large regions in the Americas and Europe, respectively. Although this blurring of source materials would later contribute, in the 1800s, to the modern idealization of cartography as a singular practice (Edney 2019), it did not actually entail any merger of modes. The discourses of property and landscape remained as distinct from those of geographical knowledge as they all did from those of marine mapping.

Furthermore, new modes developed after 1650. The rise of public discourse and the collection of statistics both led to the formation of *thematic mapping* to show the spatial distribution of natural and human phenom-

TABLE 4. The cartographic modes pursued in modern Europe as applied in this volume. In these descriptions, large-scale is defined as larger than ca. 1:100,000, small-scale as smaller than ca. 1:1,000,000, and medium-scale in between.

boundary mapping	medium-scale or small-scale mapping of boundaries between polities such as states and provinces (not properties); in many respects a hybrid of geographical and topographical mapping
celestial mapping	small-scale mapping of the heavens: the celestial vault (stars); the tracks of comets; orbits of the moon and planets; the sun, moon, and individual planets
geodetic mapping	measurement of the size and shape of the earth through high-level triangulation
geographical mapping	small-scale mapping of regions or of the entire world, including road maps, generally associated with a wide variety of institutions concerned with knowledge (states, general public)
marine charting	large- to small-scale mapping of seas, coasts, and harbors, undertaken by and for marine institutions; harbor charting pragmatically associated with topographical mapping
property mapping	large-scale mapping of parcels of property for creating, regulating, and preserving property rights and use
thematic mapping	mapping of the distribution of natural or social phenomena from small to large scales; not the same as special-purpose maps, which are precise manifestations of other modes
topographic mapping	large- to medium-scale mapping of places and by extension of the earth's surface generally, allied to the representation of landscapes by various institutions including engineers (civil and military) and antiquarians
urban mapping	large- to medium-scale mapping of urban places

TABLE 5. Modern European cartographic endeavors, or institutional groupings, within which multiple cartographic modes are pursued, as applied in this volume.

administrative cartography	the commissioning and use of maps of all sorts within agencies of civil government (central and local)
map trade	the sale and dissemination of maps through the public marketplace, mostly geographical but also marine, urban, and thematic
map collecting	the conscious effort to collect and consume maps across all modes but generally emphasizing geographical and printed maps, whether in small or large quantities
military cartography	the commissioning and use of maps of all sorts within military organizations, not only topographical (tactics) but geographical (logistics, strategy) and marine as well

ena. State sponsorship of the natural sciences and extensive surveys together encouraged the new mode of *geodetic surveying* to flourish by century's end. These developments have traditionally been seen as marking cartography's "scientific turn" in the Enlightenment. Yet by understanding these new cartographic activities as constituting discrete modes, and not as establishing a new character for cartography as a whole, we can be properly precise in exploring and explaining the relationships between Enlightenment's cartographies and the sciences.

MATTHEW H. EDNEY

SEE ALSO: Administrative Cartography; Boundary Surveying; Celestial Mapping; Geodetic Surveying; Geographical Mapping; Map Collecting; Map Trade; Marine Charting; Military Cartography; Property Mapping; Thematic Mapping; Topographical Surveying; Urban Mapping

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**Moon Globe.** See Globe: Lunar Globe

**Mortier Family.** See Covens & Mortier (Netherlands)

**Mountains, Representation of.** See Heights and Depths, Mapping of: Relief Depiction

**Müller, Johann Christoph.** Born in Wehrd (Wöhrd, Germany) on 15 March 1673, and died in Vienna, 21 June 1721, Müller "in early childhood . . . showed evidence of his strong inclination toward science and art, and he acquired a thorough education in Latin and the humanities" (Doppelmayer 1730, 138). Presumably he attended the University of Altdorf and later studied mathematics, practical astronomy, engraving, and drafting with the renowned Nuremberg astronomer and engraver Georg Christoph Eimmart. Eimmart's acquaintance with Luigi Ferdinando Marsigli resulted in the latter's invitation to Müller to come to Hungary at the age of twenty-three, where he worked until 1704 as Marsigli's assistant making astronomical observations and drafting maps of the Carpathian Basin, along the

Danube. He also assisted in the establishment and mapping of the Austro-Turkish border after the Treaty of Karlowitz (1699), for which Marsigli was the chief commissioner for the Austrian monarchy. Müller drafted the maps as supplements to the border reports sent by Marsigli to Vienna (see fig. 101). In 1704, after Marsigli's disgrace, Müller was named Austrian imperial cartographer and commissioned with the task of surveying the Austrian Hereditary Lands—Bohemia and Moravia. He completely dedicated his life to cartography until his death in 1721.

Müller's first systematic astronomical observations for cartographic purposes were made in the Carpathian Basin. In 1696 he established the latitude of seven locations in Hungary through astronomical observations using a quadrant, a sextant, a telescope, a precise clock, and astronomical charts. He made drawings recording the occurrence of shadows on the moon from these locations (figs. 583 and 584) to determine their longitude, later used by his daughter Maria Clara Eimmart for her own lunar drawings (see fig. 159). He recorded directions using a compass. Because he used rivers as a framework for his maps, he placed great emphasis on the correct depiction of their courses. The revised cartographic route of the Danube River affected the cartographic appearance of the Kingdom of Hungary—by correcting errors in earlier maps, Müller revised the generally west to east course of the Danube to make a sharp turn south just beyond Esztergom (see fig. 530). The sectional maps of the Danube published in Marsigli's *Danubius Pannonico-Mysicus* (1726) and in *La Hongrie et le Danube* (1741) were forerunners of topographical hydrographic maps in their rich detail and three-dimensional rendering.

During the Austro-Turkish boundary surveys, Müller kept a cartographic journal ("Notitiae geographicae originales circa lineam limitanema . . . sive diaria") containing more than four hundred sketch maps and his triangulation notes (now in the Fondo Marsili in the Biblioteca Universitaria di Bologna). Using these sketches, he drafted regional maps of the Kingdom of Hungary (Croatia, Bosnia, Herzegovina, Serbia, Bulgaria, the Banat, Transylvania, Walachia, and Moldova), containing numerous new details, and several hundred boundary maps rich in topographic detail that served as models for later maps. Of these, the most famous is the large boundary map of thirty-nine sections, along with two additional pages of the site plans of the ninety-six border markers, made under Marsigli's supervision at a scale of ca. 1:37,500, now in the Österreichische Nationalbibliothek in Vienna (see figs. 426 and 427).

Essentially all of the areas depicted on contemporary maps of the region were based on the sketches from his field surveys, for example Guillaume Delisle's map of Hungary (*Carte particulière de la Hongrie*, 1717). His

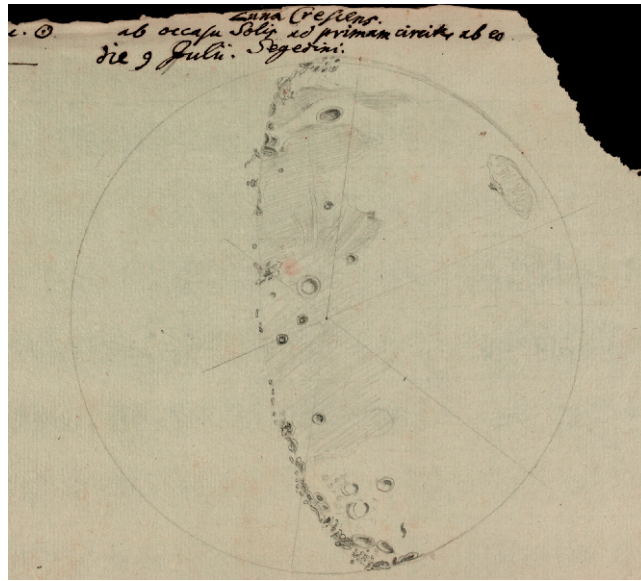


FIG. 583. MANUSCRIPT IMAGE OF THE MOON. This sketch of the moon is a pen and ink drawing from Johann Christoph Müller's journal, kept during his field observations and astronomical measurements in Hungary in 1699 during the boundary survey for the Treaty of Karlowitz. The image formed the basis of a later publication, figure 584.

Size of the original: 21.5 × 32.4 cm. Image courtesy of the Biblioteca Universitaria, Bologna (Mss di Marsigli Vol. 100. I. 1-47. *Observationes Astronomicae*).



FIG. 584. PRINTED IMAGE OF THE MOON. The sketch of the moon in figure 583 was the basis for this image in Luigi Ferdinando Marsigli's *Danubius Pannonico-Mysicus, observationibus geographicis, astronomicis, hydrographicis, historicis, physicis perlustratus*, 6 vols. (The Hague: P. Gosse, R. Chr. Alberts, P. de Hondt, 1726), vol. 1, pl. 28. The plate was engraved in Nuremberg by Georg Christian Eimmart, who completed the missing portions from the drawings of his astronomer daughter, Maria Clara Eimmart.

Courtesy of Special Collections, Kenneth Spencer Research Library, University of Kansas Libraries, Lawrence (Ellis Aves H115).

own map of Hungary (*Mappa regni Hungariae*, 1709), as published by Johann Baptist Homann, became the model for Western European cartographic depictions of the region for a century.

Significant among his thematic maps, produced jointly with Marsigli, were Hungary's first postal map ("Mappa geograph: facta in usum officialum," 1700) and the "Mappa geographica, facta in usum commerciorum" (1699), which may be considered the world's first thematic commercial map. The latter outlines every commercial land and water route in the Kingdom of Hungary, both existing and planned, indicating their points of departure (*terminus a quo*) and where they end (*terminus ad quem*). He prepared the maps of Moravia (*Tabula generalis Marchionatus Moraviae*, 1716) and Bohemia (*Mappa geographica regni Bohemiae*, 1720; published 1722) through careful field surveys, using compasses and distance recording tools. Müller's maps

are notable for their aesthetic beauty and his method of rendering that clearly portrays the essential elements.

ANTAL ANDRÁS DEÁK

SEE ALSO: Boundary Surveying: Austrian Monarchy; Karlowitz, Treaty of (1699); Marsigli, Luigi Ferdinando; Military Cartography: Austrian Monarchy, with Topographical Surveying

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