A

Académie de marine (Academy of Naval Affairs; France). Around 1749, Sébastien-François Bigot de Morogues, a marine artillery captain from Brest, and Henri-Louis Duhamel du Monceau, engineer and *inspecteur général de la Marine*, began gathering with other naval officers who shared their passion for science and technology with the goal of compiling a nautical dictionary. On 30 July 1752, the *ministre de la Marine*, Antoine-Louis Rouillé, comte de Jouy, officially established the assembly at Brest as the Académie de marine with its inaugural meeting on 31 August 1752. Joining theory to practice, the Académie members assembled a substantial library and collection of instruments and discussed everything related to the navy; thus its members embodied the model of learned officers in the century of Enlightenment. While most of the naval elite were Académie members, officers of the Dépôt des cartes et plans de la Marine among them (Chapuis 1999, 154–58), membership was not limited to established figures. Initial regulations planned for seventy-five members, not counting correspondents: ten honorary, ten independent, thirty ordinary, and twenty-five adjunct (Junges and Niderlinder 2002, 6). Pierre Bouguer was notable among the honorary members; Jean-Baptiste-Nicolas-Denis d'Après de Mannevillette and Jacques-Nicolas Bellin, both responsible for preparing most of the navigational charts edited in France at this time, were among the independent members. Certain ordinary members were also producing marine charts, among them the *lieutenant de vaisseau* Gabriel de Bory at Brest and the *enseigne de vaisseau* Joseph-Bernard, marquis de Chabert at Toulon. Thus young officers worked side-by-side with great scholars.

The Seven Years' War (1756–63) greatly disrupted the Académie de marine, which was reorganized as the Académie royale de marine on 24 April 1769. Among the new members who were linked to the science of navigation and marine cartography, most notable were scientists Étienne Bézout, Jean-Charles Borda, Joseph-Jérôme Lefrançais de Lalande, Pierre-Charles Le Monnier, Alexandre-Gui Pingré, and Alexis-Marie Rochon, as well as learned officers like Charles-Pierre Claret de Fleurieu. Besides constructing or examining numerous instruments and methods of navigation, the new academy, more focused and more active, concentrated on the question of longitude, playing a decisive role in publishing the *Connoissance des temps* while editing its own ephemeris (published only once, in the *Mémoires de l'Académie de Marine*, 1773, Brest). In subsequent years, other officers who were involved in hydrography entered the Académie, including Guillaume-Jacques Liberge de Granchain, Jean-René-Antoine Verdun de La Crenne, and François-Étienne de Rosily. As with the Académie des sciences, to which it was affiliated in 1771 and with which it shared ten members, the approval of the Académie royale de marine was sought by authors for works intended for navigators in all domains, including nautical documents by reputable hydrographers like Bellin and d'Après de Mannevillette, as well as by private cartographers who sought the map-selling power of such approbation (fig. 3) (Chapuis 1999, 205).

Paradoxically, at the very moment when the question of longitude was resolved, the Académie de marine witnessed the greatest conflict with those officers who valued combat over science. This "antisavant" movement peaked around 1775–80, just before France's entry into the American Revolutionary War. At the same time, the Académie in Brest vigorously criticized the Dépôt des cartes et plans de la Marine for being too Parisian, too theoretical, and too far removed from maritime practices (Chapuis 1999, 155–56). However, after the Treaty of Paris (3 September 1783), the Académie enjoyed a certain renewal, manifest in the partial fruition of the assembly's initial project.

A true marine dictionary was not in fact edited by the Académie. Yet after an initial refusal (Henwood 1987, 134), the famous publisher Charles-Joseph Panckoucke


Ire. Feuille
Longitude Occidentale de Londres
Longitude Orientale de Londres
Remarque Essentielle
Plan des Sorlingues
Suivant les Observations les plus récentes
Colchester
Londres
Douvres
Calais
Boulogne
Abbeville
Côtes d'Angleterre
France
Chichester
Observation
Sur la Variation de la Boussole
Caudebec
Rouen
Valogne
Caen
Côtes de France
Plimouth
Plan
Du Port et de la Rade
de Plimouth
Dressé d'après les dernieres Observations
Paris
Nouvelle Carte
Reduite
de la Manche
de Bretagne
En trois Feuilles
Contenant toutes les Côtes de France depuis Dunquerk jusqu'à Ouessant ; Et les Côtes d'Angleterre depuis Colchester qui est au Nord de la Tamise, jusqu'au Cap Clare en Irlande :
Les Brasseiages et qualités des Fonds tant en dedans qu'en dehors de la Manche. Le nombre de Pieds que la Mer monte et baisse perpendiculairement, les jours de nouvelle et pleine Lune. Les Vuës des Terres ;
Et plusieurs autres Utilités essentielles qui n'ont jamais paru sur aucune Carte de Navigation.
Publiée sous l'Aprobation de l'Académie Royale des Sciences
Dédiée
au Commerce
Par le Sr. Degaulle
Premier Pilote des Vaisseaux du Roi et Maitre d'Hidrographie au Havre.
1773.
Perier et J. Dezauche
Sculpsit.

allowed the significant involvement of the Académie in the maritime portion of his encyclopedia. Incorporating material already written for the dictionary of the Académie, Panckoucke's *Encyclopédie méthodique: Marine*, published in three volumes (1783–87), was superior to the maritime articles of Bellin in the *Encyclopédie* of Denis Diderot and Jean Le Rond d'Alembert. Étienne-Nicolas Blondeau, a professor of mathematics and hydrography, supervised its publication until his death and was succeeded by the *ingénieur constructeur* Honoré-Sébastien Vial du Clairbois. The Convention suppressed the Académie royale de marine, along with all other *académies*, on 8 August 1793; reestablished in 1921 (Taillemite 2002, 41), it still exists.

OLIVIER CHAPUIS

SEE ALSO: Academies of Science: Académie des sciences (Academy of Sciences; France); *Connoissance des temps*; Marine Charting: France

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Academies of Science.

Académie des sciences (Academy of Sciences; France). The Académie des sciences emerged as the heir to the scholarly circles that surrounded a specific patron or particular scholar at the beginning of the seventeenth century. Its origin may be found in Jean-Baptiste Colbert's plan to create a general *académie*. On 22 December 1666, a small group of scholars convened for the first time in the Bibliothèque du Roi, ready to work collectively toward the construction of scientific knowledge. Although they met regularly from 1666, it was only on 20 January 1699 that the Académie des sciences acquired a formal set of rules and became an official institution, receiving the title of "Académie royale" and meeting rooms in the Louvre.

Seventy members were named by Louis XIV to run this scholarly institution: ten honorary members, twenty pensioners, twenty associates, and, from 1716, twenty students designated as assistants. All were required to attend Académie meetings regularly. As patron of the body, the king financed both its experiments and the pensions of academy members. In the eighteenth century, the Académie des sciences became one of the principal protagonists of the scientific movement both through its publications and the advisory role played by its members so close to power. In August 1793, in the wake of the Revolution, the Académie des sciences was dissolved along with its sister organizations; it wasn't until 25 October 1795 that the Institut national des sciences et des arts was created, bringing together the former scientific, literary, and artistic académies. The new organization differed from its predecessors because until 1803 geography fell within the domain of moral and political science; however, the cartographic objective was still to produce the most exact representation of the known world possible.

(*facing page*)
FIG. 3. JEAN-BAPTISTE DEGAULLE, *NOUVELLE CARTE REDUITE DE LA MANCHE DE BRETAGNE* ([LE HAVRE: L'AUTEUR; PARIS: DEZAUCHE], 1773). Degaulle is a perfect example of a navigator who published privately, within the framework of the law, while seeking support from learned societies such as the Académie de marine. In 1772 he prepared a map of the English Channel, which he had engraved in three sheets at ca. 1:475,000 by Perier and Jean-Claude Dezauche the following year with the approbation of the Académie des sciences (sheet 1 is shown here). On the 10 January 1775 he asked the Académie de marine for their opinion on his map. On 9 March, the Académie asked him for his justificatory *memoires*, which he quickly provided. On 27 April, the Académie was able to bestow their praises on the cartographer from Le Havre. The edition of 1778 thus carries the approbation of both academies and the map was regularly updated until 1788.
Size of the original (each sheet): 93 × 60 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge AF PF 35 [73]).

When the Académie des sciences was created in 1666, one of its unique features was its endowment for an observatory that was intended to become a workplace for its members by providing meeting rooms and laboratories as well as storage for astronomical instruments. Construction of the Paris Observatory began in 1667 under the guidance of Claude Perrault: on 21 June, the summer solstice, mathematicians from the Académie plotted the line of the meridian and other cardinal points necessary for the accurate placement of the edifice. The observatory's meridian continues to be the "Paris meridian" and the prime meridian of France. The observatory was largely completed in 1672, but did not become the research center envisioned by Colbert. Apart from a Cabinet des machines used by the Académie as a repository until 1740, the observatory remained devoted to astronomical activities only. As such it became a particularly important center of activity for the Académie's cartographic contribution.

At the beginning of the eighteenth century, in his memoir "Réflexions sur l'utilité dont l'Académie des sciences" (no date), René Antoine Ferchault de Réaumur emphasized the bonds uniting astronomy and cartography: "Without these [astronomic] observations, there would be no geography on which one can rely; one would not travel at all, or one would only travel aimlessly. . . . It is thanks to this work that the meridian line has been drawn across the kingdom; if these maps have attained perfection, it is due to their observations, and it is only through continued observations that one can hope to have maps of all of France, as exact as one should have" (Brian 1994, 185). Thanks to the work done at the observatory, the Académie contributed to more reliable cartographic methods; this produced maps capable of settling concrete issues related to the administration of territory. With this spirit of reform initiated by Colbert, the Académie undertook its cartographic work.

On 30 May 1668, the geographer Guillaume Sanson was invited to present his working methods to the Académie des sciences in order to stimulate the use of techniques to achieve cartographic exactitude. To evaluate the feasibility of his suggestions, the Académie decided immediately to have a map drawn of the Paris region. This project, executed by David Vivier, was placed under the supervision of Gilles Personne de Roberval and abbé Jean Picard. The map of the environs of Paris was published in 1678 on a scale of one ligne for one hundred toises, ca. 1:86,400—which would be later used for the Cassini map of France. Shading gave a rough idea of the relief; no altitude measurements were indicated (fig. 4). The map's primary objective was to ensure the accurate position of locations determined by triangulation. The Académie's second cartographic work was carried out by Picard and Philippe de La Hire, the *Carte de France corrigee* (see fig. 625), presented in 1684 and published in 1693. This project required extensive measurements of France, and the resulting outline was compared to an earlier outline taken from maps by Guillaume Sanson. The difference between them was striking.

In 1681, Picard, who had participated in the two projects discussed above, read a report concerning the "map of the kingdom" to the Académie des sciences, in which he pronounced his lack of faith in the rapid production of maps of the provinces executed on the same model as those of Île-de-France (Pelletier 2013, 63–64). Instead, he proposed establishing a more general framework and thus began, under his direction, the triangulation of France. This enormous undertaking was financed by the Académie and completed under the direction of César-François Cassini (III) de Thury in 1744. Using a network of triangles, the triangulation of France linked points on both sides of the observatory's meridian and its perpendiculars. The triangulation was endorsed by Académie authorities and thus became the model and methodological reference, as had been championed by Picard during the 1680s, that allowed each province to draw maps of greater detail. In 1747, Louis XV entrusted the responsibility of this complete and detailed cartography to Cassini III. But in 1756, when the monarchy stopped financing this operation, the Cassini map left the control of the Académie des sciences and became a private enterprise managed by the Société de la carte de France.

The example of the Cassini map is emblematic of the Académie's involvement in cartography: the institution did not introduce a new cartography to the kingdom, it established a method of surveying and recommended that cartographers make use of the basic documents that it drafted regularly. At the same time, the Académie was not concerned with mapping only the monarchy's territory. Through the use of astronomical observations, it was also able to reach a greater degree of accuracy in depicting the known world. In order to reconcile data provided by various observers, over the course of the 1670s Jean-Dominique Cassini (I) wrote his "Instruction generale pour les observations geographiques & astronomiques à faire dans les voyages" (published in his *Les élémens de l'astronomie vérifiez*, 1684, 52–58). In 1682, Varin, Jean Deshayes, and Guillaume de Glos were sent to the Antilles and to Cape Verde; their observations allowed Sédileau and Jean-Mathieu de Chazelles to draw a planisphere under Cassini's supervision. Drawn on the observatory floor, a reduced version by Jacques Cassini (II) was published in 1696 by Jean-Baptiste Nolin and republished numerous times (see fig. 147). However, in these undertakings, the quantity of usable measurements was much less important than those gathered on French territory, and it was the compilation of data that led to the construction of the

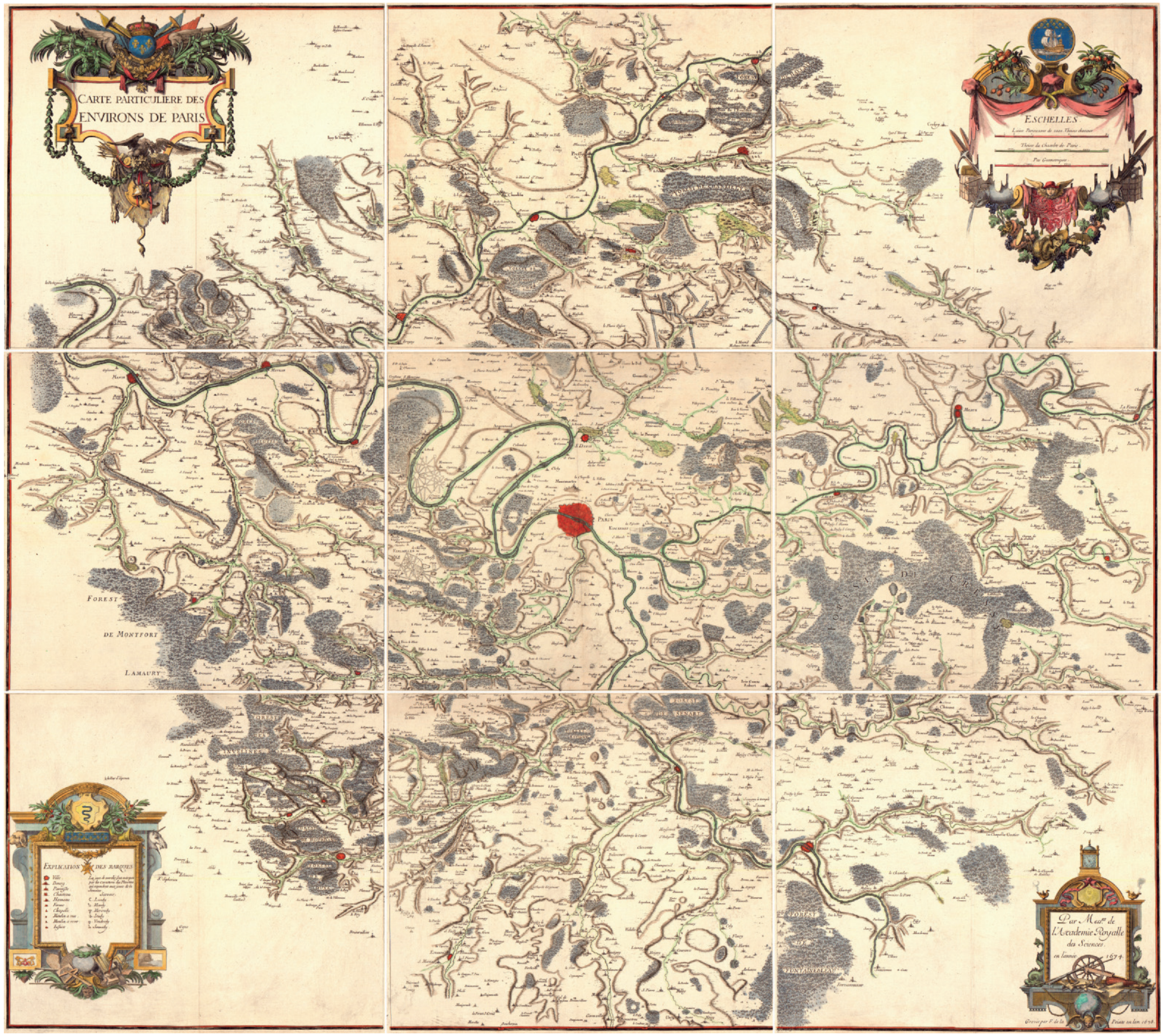

FIG. 4. *CARTE PARTICULIERE DES ENVIRONS DE PARIS* (PARIS, 1678). Map in nine sheets. Size of the original: 41.5 × 45.0 cm. Image courtesy of the Stephen S. Clark Library, University of Michigan, Ann Arbor (G 5834 P3 1678 A25).

map. The scholarly methods of the *géographe de cabinet* were therefore employed in order to compile the results of astronomical observations and to produce the most homogeneous maps possible. Guillaume Delisle, elected to the Académie in 1702 as an astronomer, probably brought this method to its apogee, especially with the construction of his twelve-inch (32.5 cm) terrestrial globe of 1700 (see fig. 331). His son-in-law, Philippe Buache, would eventually suggest another cartographic method to the Académie.

When Buache received the title of *adjoint géographe* (assistant geographer) of the Académie on 10 June 1730, geography seemed to increase its visibility. However, no geography section ever existed within the Académie royale des sciences, not even after the reorganization of 1785, which was supposed to embrace the universality of the sciences. At that time, only agriculture, natural history, mineralogy, and physics constituted sections of the Académie. If the appointment of Buache seemed to confer a new status on geography, it was still the only science to be represented only by an "assistant" and not by a section. The office of assistant geographer was created on 11 May 1726 and first assigned to the astronomer Giacomo Filippo Maraldi. After his death in 1729, it was conferred upon Buache, who fulfilled his functions dutifully, both by presenting reports to the Académie relating to geographical knowledge and by preparing maps to accompany the presentations of colleagues such as Nicolas Desmarest and Jean-Étienne Guettard. Yet, within his abundant body of work, his "Essai de géographie physique," presented on 15 November 1752, suggested an entirely different approach to cartography. This report theorized methods adopted by Buache for preparing maps already presented to the members of the Académie. He proposed a general theory to explain the relief of the globe, designated by him as a "system of fluvial basins," and presented the structure of a "framework of the globe" (Buache 1756). The framework relied on underwater mountain ranges as the fundamental feature supporting his geographical deductions and providing the starting point of his system (fig. 5). Buache did not use the map to show the current state of geographical knowledge, but rather as a tool to show areas for which observations were lacking. Buache thus gave the impression to his readers that future discoveries would confirm the general framework he proposed. And whenever he could, he would cite the discoveries of individual navigators corroborating what he had suspected or deduced.

In the face of Buache's speculative approach, the members of the Académie des sciences stuck to their own empirical geographical reasoning. Here one sees two different ways to interpret a system: Buache saw observations as a means of filling in the structure of the globe a posteriori—for him it was the hypothetical system that makes the science; for the members of the Académie, one started with the observations in order to extract certain truths and produce sound knowledge. At the time of Buache's death, these approaches vanished and the cartographic output supported by the Académie returned to classic means of validation: resorting to field observations and compilation scholarship. Jean-Baptiste Bourguignon d'Anville succeeded Buache and, like Delisle, published a map of the world in two hemispheres using twice as many astronomical positions as his predecessor. He updated this map three times, notably to integrate observations collected on several expeditions: after Louis-Antoine de Bougainville's voyage in 1772, after James Cook's in 1777, and in 1778 modifying the coastline representing the strait between Asia and America to resemble Russian maps. Even if it was only in vogue for a short period of time, Buache's method fully reflects a period in which cartography was drawn by two contradictory goals, both characteristic of the Enlightenment spirit: an aspiration for universal truths and the resort, however ambiguous, to a system.

Although geography enjoyed only a modest status in the Académie hierarchy, cartography played a major role in its work. Throughout the Enlightenment, numerous maps were published under the authority of its members and a greater number of maps accompanied the Académie's published *Mémoires*. The institution also became a forum for ideas where cartographic behavior was often discussed, even though the published volumes do not include the entirety of these exchanges. Fuller exploration of the proceedings of the Académie meetings (now preserved in the Archives de l'Académie des sciences) will offer even more insights into the history of French cartography during the eighteenth century.

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SEE ALSO: Cassini Family; Colbert, Jean-Baptiste; Geodesy and the Size and Shape of the Earth; Geodetic Surveying: France; Longitude and Latitude; Paris Observatory (France); Science and Cartography

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FIG. 5. PHILIPPE BUACHE, *CARTE PHYSIQUE DE L'OCEAN OÙ L'ON VOIT DES GRANDES CHAÎNES DE MONTAGNES QUI TRAVERSENT LES CONTINENTS D'EUROPE, D'AFRIQUE ET D'AMÉRIQUE*, 1754. Published under privilege of the Académie royale des sciences, 4 September 1754. From *Cartes et tables de la géographie physique ou naturelle, présentées au roi le 15. mai 1757* (Paris, 1770), 43.
Size of the original: 30 × 36 cm. Image courtesy of the David Rumsey Map Collection.

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Academies of Science in the German States. The academy movement during the Enlightenment in the Holy Roman Empire envisioned universally oriented research institutions. That idea seldom competed with the universities since the latter concentrated on education. Members of the academies were to be selected regardless of their religious, social, or national affiliations. Nonetheless, the academies were closely linked to the sovereigns, who were entrusted with promotion of the sciences. This resulted in a heavy dependence of the academies on the personal interests of princes both with regard to content and modus operandi as well as financial constraints. In principle, the academies were to focus their research on topics that could serve the sovereigns and their territories, such as projects on regional history, but also on geographic, statistical, or topographical surveys. Academy members could also be called on to advise in government affairs. The research results were typically published in a scientific journal.

The Academia Naturae Curiosorum (later the Sacri Romani Imperii Academia Caesareo-Leopoldina Naturae Curiosorum or Leopoldino-Carolina), which specialized in natural science, was established in Schweinfurt in 1652, even before more influential academies involved with cartography were founded in London (Royal Society, 1660) and Paris (Académie des sciences, 1666). It is unknown whether this academy was involved in geodesy or cartography, but certainly Johann Gabriel Doppelmayr, who was active in cartography, was a member.

In 1700 the Kurfürstlich Brandenburgische Societät der Wissenschaften was founded in Berlin (later known as the Königlich Preußische Akademie der Wissenschaften, and Berlin-Brandenburgische Akademie der Wissenschaften, among others). From its inception, possible involvement in the mapping of central Germany was discussed, a reasonable proposition since there were no good maps of Brandenburg on the market and few manuscript maps of individual parts of the region available. At the same time, the academy expected to improve its finances by map production of its own, evidenced by the inclusion of Johann Baptist Homann in the academy as a corresponding member as of 1715 and a proposal in 1717 to bring his publishing house to Berlin. King Friedrich Wilhelm I (r. 1713–40) circumscribed the sphere of action of the academy so severely that it was not until 1746, under his successor Friedrich II (r. 1740–86), that a discussion of establishing a cartographic monopoly at the academy was resuscitated. In accordance with the decree by Friedrich II of 7 April 1748, the academy was determined to manufacture its own maps in order to prevent the import of poor maps as well as to review and stamp imported maps for a fee. While import limitations explicitly targeted Augsburg and Nuremberg products or those by Homann Heirs publishing house, negotiations were simultaneously taking place to bring Homann's firm to the Berlin academy to acquire the capacity for creating the required maps. Implementation of the import control, however, ran up against considerable practical problems and resistance.

In 1744 Samuel von Schmettau was appointed as the academy's first curator. He brought copious cartographic knowledge from his time in the emperor's employ—from, for example, his 1719–20 topographical survey and 1721 map of Sicily (see fig. 305), which he immediately put to good use in a city map of Berlin. His other project proposals—a survey of Berlin's environs and the triangulation and topographical survey of all the territories of Brandenburg and Prussia on the French model—were rigorously opposed by Friedrich II. The king claimed a lack of funds but especially feared that reliable maps of his lands could serve his numerous enemies better than himself. Not even Pierre Louis Moreau de Maupertuis was able to secure support in Berlin for geodetic work while he was academy president (1746–50).

A further project, for which Schmettau furnished his contacts at the academy, additional source material, and funds, was the *Nouvel atlas de Marine* (1749) prepared by the Swiss globemaker Isaak Bruckner, *géographe du roi* of France, who also used material from the Dépôt de la Marine (Paris). The atlas was not a great success since it competed with more elegant French products.

The most successful cartographic project of the Berlin Akademie der Wissenschaften was the school atlas *Atlas geographicus omnes orbis terrarum regiones* (1753), supervised by Leonhard Euler between 1748 and 1751. Its maps were on a small format and its content specifically geared to school curricula (fig. 6).

After Schmettau's death in 1751 two of his colleagues, the brothers Johann Christoph Rhode and Andreas August Rhode remained affiliated with the academy; Johann Christoph earned the title of *Geograph der Akademie* in 1752 but only received modest and belated (by twenty years) remuneration. In 1787 Daniel Friedrich Sotzmann assumed this position, incorporating it into his multiple commitments as a Prussian civil servant at the Oberkriegskollegium. He published at least seven multisheet maps, a school atlas, and several other maps under academy auspices. There is no indication, however, that the academy planned or coordinated these cartographic activities although it welcomed them as a source of revenue. Johann Elert Bode became director of the academy's astronomic observatory in 1786. Yet he published his celestial maps and his celestial globe independently of the academy.

The cartographic activities of the academy in Berlin, to the extent that they were not discouraged by Friedrich II, did not focus on the advancement of Enlightenment science and provided only limited benefit to Prussia. Indeed, any mapping activities were geared much more to funding the academy's emulation of the major cartographic publishing houses in Augsburg and Nuremberg.

In Nuremberg, Johann Michael Franz, head of Homann Heirs publishing house, wanted to establish a state

FIG. 6. *TABULA GEOGRAPHICA UTRIUSQUE HEMISPHÆRII TERRESTRIS EXHIBENS DECLINATIONEM ACUS MAGNETICÆ*, 1744. From *Atlas geographicus omnes orbis terrarum regiones* (Berlin, 1760; under the title *Geographischer Atlas*). Copper engraving. Leonhard Euler stressed the importance of physical geography and noted global magnetic declination with curved isolines on the map. To the right of the title is the stamp of the academy.
Size of the original: 32 × 37 cm. Image courtesy of the Staatsbibliothek zu Berlin–Preußischer Kulturbesitz; Kartenabteilung (2° Kart. B 730–2).

academy for geography and cartography. His inspiration derived from the successes of the Académie des sciences in Paris as well as his contacts with Johann Matthias Hase and Eberhard David Hauber, who as early as 1730 had proposed collaboration among active researchers in geodesy and cartography. To that end, Franz established the private Kosmographische Gesellschaft (also known as the Societas Cosmographica, Société Cosmographique, or Geographische Gesellschaft), which by documenting programs and accomplishments aimed to convince the sovereigns of the Holy Roman Empire of the utility of the proposed Kosmographische Akademie and the necessity of financing it. The society and its goals were first publicly proposed in 1746 with the announcement of the manufacture of a pair of globes by Georg Moritz Lowitz (fig. 7). One year later the members of the society, largely consisting of the scientific collaborators of the Homann publishing house, outlined the academy structure in the *Homannische Vorschläge…und einer disfals bey der Homannischen Handlung zu errichtenden neuen Akademie* (1747). They planned three categories of activity: the first, to deal with mathematical geogra-

phy, survey, and cartographic instruments; the second, to gather historical, geographic, and cartographic sources as well as manuscript maps; and the third, to encourage correspondents to submit information for which they would be remunerated. In addition to the lengthy large globe project (promoted in 1747 by a small pair of globes), two further announcements, and requests for subscriptions, the *Gesellschaffts Atlas* was compiled in 1747–48. It contained the twenty best maps by members of the society, published by Homann Heirs, intending to demonstrate the utility of the proposed maps by the future academy. While dedicated to Friedrich II of Prussia, the atlas was also sent to the emperor and other sovereigns in order to secure funding for the academy. This venture did not bear fruit, and the members published the first and only volume of the society's journal, *Kosmographische Nachrichten und Sammlungen auf das Jahr 1748*, in 1750, with essays on astronomy, the society's plans, and the newest maps. In further attempts to secure funding, Tobias Mayer elaborated the *Germania . . . Mappa critica* (1750), which demonstrated the insufficiency of the data available by comparing the coordinates and borders of the Holy Roman Empire using data from Homann, Guillaume Delisle, and Mayer's own figures (see fig. 532). In 1753 Franz published *Der deutsche Staatsgeographus*, which stressed how future scholars could potentially advise princes. The fact that the academy had reached a point of being funded by a lottery shows the precarious financial situation of Franz, who had financed the initiatives by taking out personal loans. Although every attempt to finance the Kosmographische Akademie failed, the efforts in Nuremberg were appreciated in scientific circles, such as those in France and St. Petersburg. Taking advantage of this renown, Mayer, in 1751, and Lowitz, in 1755, left Nuremberg for the University of Göttingen, where Franz too hoped for a new beginning of the society since there was an initial willingness to invest funds in the cosmographic enterprise. Franz, however, was prevented from relocating to Göttingen by his inheritance of half of the Homann publishing house, which he was not allowed to move to Göttingen as he had planned, and the seemingly

FIG. 7. GEORG MORITZ LOWITZ, *SPECIMEN TRIGESIMAE SEXTAE PARTIS EX GLOBO TERRESTRI*, 1749. This broadside of one globe gore was printed to accompany Lowitz's *Description complete ou second avertissement sur les grands globes terrestres et celestes* (Nuremberg, 1749), the second advertisement for the large globes (91 cm), as an example of how the globes would look.
Size of the original: 86 × 17 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (Maps 1-A-1749 Lo).

endless work on the large globes. In the end it was not possible to revive the society in Göttingen.

It is unclear why sustainable funding of the Nuremberg academy did not eventually materialize. Princes and regional governments apparently had more urgent matters to address directly after the end of the War of the Austrian Succession (1740–48). For reasons unknown, the most promising patron, Emperor Francis I, who had a personal interest in the field of work, unfortunately gave only a onetime monetary donation (Franz 1753, 14).

The planned renewal of the Kosmographische Gesellschaft in Göttingen occurred simultaneously with the founding of the Göttingische Gelehrte Gesellschaft (later Gesellschaft der Wissenschaften zu Göttingen) in 1751, of which no significant activity in the field of cartography is known. Only its academic journal, *Göttingischen Zeitungen von gelehrten Sachen* (from 1739), contained references to new geographic discoveries by Europeans as well as maps.

After the mid-eighteenth century, a series of other German states founded academies, specifically: Kayserlich Franciscische Akademie Freier Künste in Augsburg (1755), Kurfürstlich Mainzische Akademie der nützlicher Wissenschaften in Erfurt (1754), and [Königlich] Böhmische Gesellschaft der Wissenschaften in Prague (ca. 1780). Research into the extent to which they dealt with surveying and cartography has not yet been undertaken.

In Munich, however, the Churfürstlich baierische Akademie der Wissenschaften (1759), focused on the research and the historical and geographical description of Bavaria as one of its founding objectives. Under the rubric of philosophy, the study of Bavaria aimed to provide a basis for developing domestic and economic policy, with the participation of an accomplished practitioner in Castulus Riedl. Just two years after its founding, it hoped that the collaboration of César-François Cassini (III) de Thury and participation in his project of triangulating the perpendicular to the Paris meridian from Brest to the Donau estuary would lead to major advances in geodetic survey of the region. The academy was actively involved in observing the transit of Venus of 6 June 1761 and in a triangulation of the Munich area, and it appointed Cassini III as an honorary member. On his second trip to Germany in 1762, Cassini III completed the triangulation chain from Strasburg to Vienna and surveyed an additional baseline between Munich and Dachau. However, a rapid methodology and insufficiently trained staff led to worse results than expected. In the following years, several academy members were involved in trigonometrically based topographical survey projects, but they failed in their practical implementation. There was a new attempt between 1765 and 1769 by the French military geographer Claude-Sidoine Michel (also known as St. Michel) (Schlögl 2002, 117–27), financed by the provincial governments and backed by the academy. By 1768 Michel had completed two map sheets on the scale of the *Carte de France* (1:86,400), which were initially well received (fig. 8), but the collaboration ended in 1769 due to high costs, slow progress, and criticism of the place-names. Under the aegis of the academy, Wunibald von Widmer and, after his death, Peter von Osterwald continued the project, with completion expected in four years. Lack of progress prompted the appointment of Giovanni Antonio Rizzi Zannoni as the new director. He proposed a tripartite plan—astronomic-trigonometric survey, recording of topographical details, and engraving the maps—to be accomplished in five years, with an estimated budget of ca. 60,000 guilders. When this amount could not be raised by subscriptions, the topographical survey also failed. The academy's cartographic activity was then limited to printing individual copperplate maps on demand.

The Kurpfälzische Akademie der Wissenschaften in Mannheim was founded in 1763. Although it was in contact with astronomer Christian Mayer, he did not become an academy member until 1773. He worked on a trigonometrically based topographical survey from approximately 1760 until his death in 1783. The academy's active contribution consisted of its critique of the slow progress of the work. In addition, academy members Christoph Jakob Kremer and Johann Daniel Flad submitted expert opinions in 1774 for a topographical survey to be undertaken by the academy itself (Moutchnik 2006, 385–88).

Besides these most prominent academies of science, a large number of economic societies as well as specialized academies played somewhat significant roles for cartography, as in the case of the art academies that trained capable copper engravers. A comprehensive study of the cartographic activities of the academies of the Holy Roman Empire does not yet exist. Even though the foremost academies (in Berlin, Nuremberg, and Munich) were chiefly focused on publishing maps, contributions to cartography as a science were rare, and geodetic or cartographic initiatives aimed at comprehensive topographical surveys failed for practical and financial reasons.

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SEE ALSO: Euler, Leonhard; Mayer, Tobias; Science and Cartography; Topographical Surveying: Topographical and Geodetic Surveying in the German States

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fig. 8. CLAUDE-SIDOINE MICHEL, MAP OF MUNICH AND ITS SURROUNDINGS, 1768. This map was one of the two printed maps that resulted from Michel's survey of Bavaria, following the Cassini model.

Size of the original: 56 × 89 cm. Image courtesy of the Staatsbibliothek zu Berlin–Preußischer Kulturbesitz; Kartenabteilung (Kart. M 8704).

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Academies of Science in Great Britain. Inspired by Francis Bacon's lofty ambition of bringing about "the relief of man's estate" through the ordering of knowledge of nature (1891, 42–43), the Royal Society, from its foundation in 1660 (Royal Charter in 1662), was devoted to the task of mapping the natural world. This activity, however, only occasionally resulted in actual maps; more often the mapping took the form of tables of data that brought precision and system to the task of comprehending the laws of nature. Members of the early Royal Society strongly urged the collection of detailed information about localities whether at home or abroad and disseminated such findings through the *Philosophical Transactions* from 1665 onward. Indeed, in the first volume of this pioneering journal (1665–66) Robert Boyle outlined an agenda for such studies in his "General Heads for a Natural History of a Countrey, Great or Small."

The early Society also sought to acquire useful knowledge of the globe that would promote both science and the nation's imperial and commercial ambitions—hence the first volume of the *Philosophical Transactions* also included "Directions for Sea-Men, Bound for Far Voyages," which prescribed a formidable inventory of observations that the Royal Society wished to see carried out. The Royal Society's finances were dependent on the dues paid by its gentlemen members rather than on funding by the state; nonetheless, one of its major functions was to advise government on scientific matters. A nation as dependent on seaborne commerce as Great Britain took particular interest in improving navigation, an area where statecraft and mapping converged significantly. In this capacity, the Royal Society assembled a committee to advise on the construction and compilation of maps for the *English Atlas* of Moses Pitt, who proposed the project to the Society in 1678. In spite of the Society's support and specific advice from members Robert Hooke and John Pell, only three of the projected eleven volumes were published (Hildyard 2014). Better maps, it was hoped, would be promoted by better ways of determining latitude and longitude. In respect of latitude, the Society played an ancillary role, aiding the Royal Greenwich Observatory to produce better astral tables and maps of the sky. From 1710 it conducted formal visitations of the observatory and, after 1767, it published the observatory's reports. Similarly, in developing effective methods of determining longitude it was supportive through its representation on the Board of Longitude, established in 1714 with the advice of Sir Isaac Newton, then president of the Royal Society.

Such links between science and navigation formed the background to the Society's role in initiating James Cook's first Pacific voyage of 1768–71, one of the main purposes of which was to participate internationally in observing the transit of Venus of 1769. Similarly the attempt to discover the elusive Northwest Passage, which would enable navigation from either the Atlantic to the Pacific or vice versa, also led the Society to become directly involved in scientific exploration and mapping. It helped to establish both a £20,000 reward for the discovery of the passage and to launch Cook's third Pacific voyage of 1776–80. Such exploration became a well-established tradition thanks to the longest-serving of all presidents of the Society, Sir Joseph Banks (president 1778–1820). Although the resulting charts were published through the Admiralty, they represented an increasingly fruitful partnership between the Society and an ever more expansionist British state. Again this was reflected in Banks's close involvement in the early beginnings of the Ordnance Survey. Between 1783 and 1787 Banks supervised the expenditure of a royal grant of £3,000 on the triangulation between England and France that resulted eventually in the establishment in 1791 of a branch of the Board of Ordnance concerned with mapping.

Accurate mapping naturally meshed closely with the concerns of the landowning class, who formed the core of the Society and whose interest in local studies (or chorography) had been evident from its foundation. Many other similarly focused societies across the British Isles were established. During the eighteenth century a number of Scottish societies were founded to promote economic growth and agricultural improvement and thus more accurate mapping. Among these were the Honourable the Society of Improvers in the Knowledge of Agriculture in Scotland (founded 1723) and the Edinburgh Society for the Encouragement of Arts, Sciences, Manufactures, and Agriculture (founded 1755). Other bodies with more diverse functions such as the Society of Antiquaries of Scotland (founded 1780) and the Royal Society of Edinburgh (founded 1783) also promoted the same ends. In Ireland, the Dublin Society for Improving Husbandry, Manufactures and other Useful Arts (founded 1731) and the Royal Irish Academy (1786) did likewise. Such cartographic impulses fueled the growing determination of the academies and societies to bring not only the British Isles but the globe more generally into a rigorously structured network of latitude and longitude.

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SEE ALSO: Geodetic Surveying: Great Britain; Greenwich Observatory (Great Britain); Longitude and Latitude; Science and Cartography

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Academies of Science in the Italian States. The development of academies of science in Italy during the long eighteenth century may seem fragmented by contrast to the great national European monarchies whose public institutions were established by a centralized power.

The scattered initiatives and the structural impossibility of developing great central institutions deeply influenced the diffuse cultural and scientific policies of the Italian states, where intermittent initiatives were mostly subsidized by the high nobility promoting the new sciences. Joseph Ben-David's study, now accepted as a classic in the history of academies, has identified as many as 149 scientific academies, 90 of which were designated as "multipurpose" (i.e., academies that also included science among their various fields of interest), while 59 were defined as exclusively "scientific" (Ben-David 1971, 63). Many of these emerged in the large political and administrative centers (Bologna, Venice, Naples, Rome, Florence, Milan, and Turin) during the course of the seventeenth century, while similar academies developed throughout the country in the following century in even smaller centers. Because of this fragmented growth, it is difficult to draw a comprehensive picture of the role played by Italian academies in mapmaking and how their production of observations and studies affected both large-scale land surveying and the bigger questions about the size of the earth for which geodetic measurements were necessary.

In the course of the seventeenth century, Italy played a leading role in the rebirth of the scientific movement in Europe. Not only because of the contributions of the school of Galileo Galilei, but also, and above all, because of the unprecedented aggregations of scientists that took place throughout the country. Among these were the Accademia dei Lincei, founded in Rome at the beginning of the century (1603) by Federico Cesi, and the Accademia del Cimento (1657–67), promoted in Florence by Ferdinando II de' Medici and Leopoldo de' Medici, whose aims were to develop Galileo's experimental method in the field of natural science (Olmi 1981; Boschiero 2007). Particularly the Accademia dei Lincei, which counted Galileo among its members and purported to encourage people "to read well this great truthful and universal book of the world" (Cesi 1988, 114), asserted a certain geographical interest thanks to the works of humanists like Lucas Holstenius, peripatetic geographer and companion in the numerous excursions of the German geographer Philipp Clüver (Almagià 1942); Nicola Antonio Stigliola, author together with Mario Cartaro of an atlas of the Kingdom of Naples, which had been commissioned to him by the king's viceroy; and Pietro Della Valle, known for his travel accounts in the Eastern countries (Baldacci 1996).

Up until 1714, when the public Istituto delle Scienze in Bologna opened, all previously created scientific academies in Italy had been private. Thanks to the patronage of nobles, small groups driven by scientific interest spread and contributed to the astronomic and cartographic culture, as exemplified by the astronomical laboratory established in Venice by the Correr family, guided by the astronomer Geminiano Montanari.

One of the most notable initiatives linked to a cultural model possibly defined as a "private Renaissance academy" (McClellan 1985) was the Accademia Cosmografica degli Argonauti, founded by Vincenzo Coronelli in Venice around 1684. Closely entwined with its founder's vicissitudes (the academy was dissolved in 1718 after Coronelli's death), it was a sort of geographical society rather than an organization supporting original, repeatable research. Although the academy had no statutes, its main objective was to create a network of scholars who would apply cosmography to geography and promote the results (Milanesi 1998, 35). Its goals were typical of the seventeenth century: to gather and classify geographical knowledge in order to organize and establish hierarchies that would meet the challenges of an evolving world and make sense of new discoveries. The 261 members counted in 1693 (reported in the *Epitome cosmografica*) would gather in the monastery of the Conventual Minorities, the religious order to which Coronelli belonged and where the mapmaker taught Venetian elites to draw maps and build globes. Members of the academy were essentially subscribers, financially supporting Coronelli's intense editorial production in return for buying his published works at favorable prices. For Coronelli, the Accademia Cosmografica degli Argonauti was an important means of circulating his own work, far removed from new lines of astronomical and geodetic inquiry: Jean Picard's measurements, the Cassini family's work, the earth-sun distance determination, the obliquity of the ecliptic, as well as Isaac Newton's and Galileo's experiments were completely unrelated to the interests of the academy (Bònoli 1999, 150–51). They hardly bothered with a geography in which new science and tradition lived together; their didactic intentions prevailed over theoretical innovation.

From the second half of the seventeenth century, scientific gatherings followed Galilean teaching while keeping an eye on the new philosophical-scientific systems of René Descartes, Francis Bacon, Robert Boyle, and the newly established scientific academies in other European countries. Bologna, whose political milieu enjoyed some autonomy from church control, was the site of an academy based on Baconian ideals of experimentation and played a significant role in Italy's scientific environment. Heir to the Accademia del Cimento in Florence and enjoying a cultural climate similar to that of the Paris Académie des sciences and London's Royal Society, the Accademia degli Inquieti was founded in Bologna by Eustachio Manfredi in 1691 in an environment influenced by the work of Jean-Dominique Cassini (I) and the initiatives of Montanari. Housed in the palazzo given to the Inquieti by Luigi Ferdinando Marsigli, this was the first Italian group to undertake collective experimental research comparable to that of the academies in London and Paris (Cavazza 1988, 54), carried out in the observatory, the library, the botanical garden, and the private rooms of the palazzo. In 1714 this informal group received official recognition with the foundation of the Istituto delle Scienze ed Arti and the simultaneous transformation of the Accademia degli Inquieti into the Accademia delle Scienze dell'Istituto di Bologna. Financed by the Papal States, the Accademia delle Scienze focused on meeting the technical needs of the state and maintained a close relationship with the productive sectors of society. The scientific program of the Istituto, therefore, proposed astronomical research with cartographic applications. During his survey work in the Balkans as a member of the Austrian army in its struggle with the Ottoman Empire, Marsigli had determined astronomically the geographical coordinates of many sites of military campaigns and later for peace negotiations. His personal scientific interests encouraged the Accademia to move toward incorporating the natural sciences into geography in order to understand more effectively the earth's shape and its phenomena. He proposed that the Accademia first determine the exact difference of longitude between Bologna and Paris, then prepare new equipment for geodetic surveys, and finally publish a list of new geographical coordinates based on observation of lunar eclipses in the *Mémoires de l'Académie Royale des Sciences de Turin*. The Istituto delle Scienze di Bologna promoted reform in geography and practical cartographic representation based on the principle of direct observation of the earth, as opposed to the compilation work of cartographers who were skilled in drawing but whose work lacked accuracy. In a letter to Marsigli dated 30 August 1711, Manfredi pointed out the importance of establishing new cartographic activity in Italy: "The main fruit coming from the astronomic observations is the reform of geography. That of Italy is greatly needed. . . . The effort of emending the geography of Italy requires the permanent presence of an astronomer in the observatory . . . and requires moreover the trip of one or two other astronomers along the beaches and the most important places, which will be achieved in a couple of years" (Manfredi 1770, 319–20).

The work of the Istituto clearly contributed to a geography increasingly linked to the activity of natural philosophers, a development that became the norm from the second half of the eighteenth century (Farinelli 1992, 83–105). Its notable theoretical and cultural contributions contrasted to the lack of practical applications by the Bolognese Accademia; no new comprehensive survey of the region was made, and its cartographic image remained unchanged—according to Manfredi—since the time of Giovanni Antonio Magini (Manfredi 1770, 319). Nor were the academicians commissioned to make such a survey by the Papal States. Instead, the papal government employed the best mathematicians from the university to solve important hydrographic problems in the Papal lands, and the Camera Apostolica commissioned the Jesuit astronomers Christopher Maire and Ruggiero Giuseppe Boscovich to make the geodetic survey of the meridian from Rome to Rimini in order to provide data for a better understanding of the shape of the earth and the effects of gravitation (Pedley 1993, 62).

From the second half of the eighteenth century, as connections between the Italian states of the Ancien Régime and science increased, political powers intervened more directly into scientific and cultural activities. Thus, several local initiatives were conceived to carry out geodetic and trigonometric measurements, which became the basis for the geometrical representation of Italy, finally accomplished after national union (Lodovisi and Torresani 2005). In the second half of the eighteenth century, however, the academic movement—founded on creating organized research centers to look for new approaches to education and culture—became only partially relevant to the large-scale land surveying that had been carried out during the course of the century. The peculiar issue of the Italian academies was the fact that their geographical debates and proposals for mapmaking scarcely and rarely met the demands of public administration. Yet this perspective changes when one considers the role played by the academies and cultural circles in laying the foundations for theoretical principles and in preparing the cultural ground necessary to achieve the projects of geodetic surveying, which were often accomplished outside the academic purview, as the case of Rome demonstrates.

In the last quarter of the seventeenth century, Rome experienced a lively interest in the works of Galileo as well as the results of Newton's discoveries. The establishment of the Accademia Fisico-Matematica in 1677—founded on Giovanni Giustino Ciampini's initiative and modeled on Florence's Accademia del Cimento and the great academies beyond the Alps—combined with the diffusion of the *Giornale dei Letterati*, the Italian answer to the Parisian *Journal des Sçavans*, demonstrated the desire of Rome's cultural elite to actively nurture the sciences in order to keep abreast of other European developments. In the course of the first decades of the eighteenth century, favorable conditions existed for such pursuits. From the time of the pontificate of Giovanni Francesco Albani, Clement XI (1700–1721), patron of scientific and artistic institutions, Rome confirmed its singular role in the precocious reception of Newtonianism backed by a long tradition of historical and antiquarian studies. This period was marked by steady support for the sciences and arts through new academies, institutes for art education, and technical schools linked to the colleges of the religious orders and aristocratic courts (Bevilacqua 1998, 97). When Cardinal Prospero Lambertini became Pope Benedict XIV in 1740 with Cardinal Silvio Valenti Gonzaga as his secretary of state, conditions were ripe for the development of scientific research. Although the academies established by Benedict XIV were mainly concerned with theology and classical studies, the pope also promoted the study of chemistry and experimental sciences within the university. In the papal mansion he organized *conversazioni* among the Roman intellectuals and had an observatory installed on the towers of the Aurelian walls, which also bounded his mansion; it was used by Maire and Boscovich during their survey of the Rome meridian (Pedley 1993, 60). This abundant scientific zeal was further enhanced by Cardinal Alessandro Albani, nephew of Clemente XI, who encouraged the diffusion of Ferdinando Galiani's Newtonian ideas and ongoing mapmaking projects.

From 1736 to 1748, the new map of Rome by Giovanni Battista Nolli, which became a new source of knowledge about the territory of the capital city, together with the geodetic work of Maire and Boscovich, expressed a new zeal for science and the connection between mapmaking and enlightened reform sought by local governments (Pedley 1993). Such concerns took root in the numerous cultural debates that began in the intellectual circles of the cardinals and various nobles in the capital during the eighteenth century.

In the Duchy of Milan the debate about new developments in science and their applications took place especially in the Jesuit college of Brera. In fact, the need for new astronomical-geodetic data encouraged the construction of an observatory, which was built during the 1760s for astronomical and geographical research. After the suppression of the Jesuit order, direction of the observatory passed to the Austrian government. Between 1760 and 1765 using precise scientific equipment, the Brera astronomers determined the exact geodetic coordinates of Brera thanks to the simultaneous observations of Giuseppe Bovio, Domenico Gerra, Luigi Lagrange, and above all Boscovich. However, only in 1788, under the guidance of Barnaba Oriani, Giovanni Angelo de Cesaris, and Francesco Reggio, did the survey for a map of Lombardy begin, based on astronomical observations and geodetic calculations of the observatory as well as on updated cadastral maps (Signori 1984). The activity of the astronomers in the Brera Observatory continued under French occupation and expanded into the adjoining provinces until the creation by Napoleon Bonaparte in 1805 of a topographical mapping bureau in Milan.

In the Republic of Venice, as successor to the Accademia dei Ricovrati and the Accademia di Arte Agraria, the Accademia di Scienze Lettere e Arti of Padua was directly linked to the republic's political initiatives. Its foundation in 1779 emanated from the utilitarian desire to place scientific knowledge at the service of the economy and society. For about twenty years the academy undertook large studies and research commissioned by the Republic of Venice dealing with agriculture, hydraulics, and geography. The presence of the geographer Giovanni Antonio Rizzi Zannoni, who had returned to Padua from Paris, emphasized the geographical interests of the Paduan academy. As a member, Rizzi Zannoni read a memoir on Newtonian theories that refuted the spherical shape of the earth, and he proposed a new map of Paduan territory in twelve sheets, four sheets of which were published with collaborators as *La gran carta del Padovano* (1780) (see fig. 422). His previous field experience, skill in triangulation, and passion for new scientific theories defined this contribution to Paduan cartography. This phase of cooperation with local mapmakers and the Venetian publisher Antonio Zatta was short-lived, however. Differing views on local surveying priorities (whether to concentrate limited resources on the geodetic or the topographic) and on map compilation practices, as well as shortage of funds, made it easier for Rizzi Zannoni to accept the invitation to move to the Kingdom of Naples in 1781, where he ultimately led the kingdom's Reale Officio Topografico (Valerio 1993, 109–17; Mazzi 2015).

At the time of the accession of King Vittorio Amedeo III in 1773, the Kingdom of Sardinia enjoyed a period of intense political and cultural enthusiasms in which the sovereign joined forces with the aristocratic enlightened elite. Numerous scientific societies were founded in Turin, among them the Accademia di Agricoltura and the Reale Accademia delle Scienze. The latter represented the culmination of a process that had begun with a private scientific society established in 1757 by Giuseppe Angelo Saluzzo di Monesiglio along with Lagrange and Giovanni Francesco Cigna, who joined other scholars from Piedmont in the following years. The Reale Accademia soon became the center of the Piedmontese reform and a reference point for science applied to socioeconomic and military issues, with particular attention to technological experimentation in chemistry (especially metallurgy) and physical phenomena. In 1784 Spirito Benedetto Nicolis di Robilant wrote "Essai géographique suivi d'une topographie souterraine, minéralogique, et d'une docimasie" published in the *Mémoires de l'Académie Royale des Sciences* in 1786 in conjunction with a mineralogical map of Piedmont that was well appreciated by European geographers (Ferrone 1984, 489–91).

The efforts of the academies and the sovereign also focused on geodetic surveying. In 1759, Giovanni Battista Beccaria, director of the Turin Observatory, on the request of Carlo Emanuele III, began the operations to measure the arc of meridian between Mondovì and

Andrate. As described in the *Mémoires de l'Académie Royale des Sciences*, the works "have fully achieved their goal in correcting the geography of the region, providing new elements to the investigation of the figure of the earth, and adding new proofs to the general theory of attraction" (anonymous 1790, XXVIII). The survey continued in the first years of the nineteenth century without any geographic application.

In the Kingdom of Naples increased interest in economic reform, both in production and commerce, supported a better geographical understanding of the land for which preparing maps of the regions of the kingdom was a remarkable aspect. To this end, in 1778 Ferdinand IV established a public academy, the Reale Accademia delle Scienze e Belle Lettere of Naples, as well as provisions to allow for other scientific and cultural institutions: a university library open to the public, the creation of a natural history museum, a botanical garden, an astronomical observatory, and new university chairs of geography, agriculture, natural history, and architecture. The result of an extraordinary florescence of ideas and programs, the Accademia was on a par with similar European institutions and attracted the support of the court, which generously financed its members, who were considered celebrities within scientific culture. In this promising climate of reform and experimentation, the first section of the academy, comprising mathematical sciences, hosted debates on issues related to mapmaking. The protagonists were Felice Sabatelli, professor of astronomy, and Nicolò Fergola, a famous mathematician; they both espoused the need for better knowledge of the land in the kingdom. Sabatelli called for the precise determination of the geodetic coordinates of Naples, which had been measured several times over the course of the century with only approximate results (Napoli-Signorelli 1788, XXIII–XXIV). Fergola, on the other hand, insisted on improving mathematical methods to create a more precise topography of the kingdom, incorporating astronomic techniques. Notwithstanding its initial enthusiasm, the academy soon reached its limits, when several well-thought-out attempts failed to find financial and organizational support (Chiosi 1996, 548). The cartographic survey of the Kingdom of Naples, begun in 1781, was finally completed outside the Accademia's purview: it was not "a response by the institutions to the demands of the nation manifested by Neapolitan economists"; instead, it represented the fulfillment of objectives of a single individual, the abbé Ferdinando Galiani, with scientific and technical help from Rizzi Zannoni (Valerio 1996, 554).

The analysis of the Neapolitan case confirms this important aspect of the role of scientific academies in cartography in the eighteenth-century Italian states. Their direct interventions into cartographic projects seem heterogeneous and lacking in national coherence. But the social and intellectual bonds that were created and strengthened by academic associations created a greenhouse for mapping projects and fundamentally influenced the intellectual framework upon which many projects were designed.

MARCO PETRELLA

SEE ALSO: Coronelli, Vincenzo; Geodetic Surveying: Italian States; Geographical Mapping: Italian States; Topographical Surveying: Italian States; Science and Cartography

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Academies of Science in Portugal. Portugal's enduring conflict with Spain (1641–68) after the breakdown of the Union of the Crowns (1640) and the need to preserve commercial interests in the Atlantic and Indian Oceans led the Portuguese Crown to create institutions to provide training in navigation techniques, construction of fortifications, and mapmaking. The first was the Aula de Fortificação e Arquitectura Militar, founded in Lisbon in 1647; in lieu of a formal academy of science, the Aula served the practical scientific purpose of mapping Portuguese possessions at home and abroad. Subsequently, similar academies were created in Europe and overseas: Viana do Castelo (1701), Salvador (1696), Rio de Janeiro (1698), Goa (1699), Luanda (1699, expanded in 1764), São Luís do Maranhão (1699), Recife (1701), Elvas e Almeida (1732), Belém (1758), and Porto Alegre (1792).

Although they functioned only intermittently, these royal schools of military architecture became the principal vehicles for promoting cartographic culture in the Portuguese world as many became permanent centers of education and preparation for military engineers. The training and careers of military engineers in the Portuguese Empire were also controlled from the late seventeenth century until the early nineteenth century by several laws (dated 1699, 1732, 1738, 1763, 1792, and 1810) (Bueno 2011, 129–249).

In 1720, the creation of the Academia Real de História Portugueza by João V gave new impetus to the study of cartography by considering history as the synthesis of chronology and geography, the "two eyes of history." This concept led to the development of both historical and modern cartography in Portugal. In 1734–36 the Academia published the first two volumes of the *Geografia historica de todos os estados soberanos de Europa* by the friar Luís Caetano de Lima, who participated in diplomatic missions to Rome, The Hague, Paris, and London and followed the negotiations of the Treaty of Utrecht (1713).

The Academia Real de História Portugueza fulfilled its geographical mission by organizing a major survey of existing regional maps and encouraging the preparation of new topographic maps and chorographical descriptions. In his role as *engenheiro-mor do reino*, Academia member Manoel de Azevedo Fortes, proposed a *carta geral do reino* and regional maps be made using survey methods outlined in his *Tratado do modo o mais facil, e o mais exacto de fazer as cartas geograficas* (1722). Under his command, a generation of military engineers was trained and sent throughout the empire to perform topographic and hydrographic surveys on site (Garcia 2006). Under his leadership, Brigadier José da Silva Pais and José Fernandes Pinto Alpoim were charged with the military defense of the Portuguese conquests in South America, for which they produced topographic maps and constructed fortifications in Rio de Janeiro, Minas Gerais, Santos, Santa Catarina, the Colonia do Sacramento, and Rio Grande de San Pedro.

After the Treaty of Madrid (1750) and during the second half of the eighteenth century, expeditions were organized to establish the boundaries between Spanish and Portuguese territories in southern, far western, and northern Brazil. This development allowed manuscript cartography to play a significant role in the diplomatic efforts to define Portuguese sovereignty overseas. During the second half of the century, many of the experienced professionals who taught in the military academies had also participated in those expeditions. José I encouraged colonial governors to establish cartographic offices in their towns. The Colégio Real dos Nobres, founded in 1761 to train the future ruling class, embodied this state policy in its curriculum, which included astronomy, mathematics, practical geometry, trigonometry, military and civil architecture, design, geography, hydrography, and navigation. The University of Coimbra, reformed by Sebastião José de Carvalho e Melo, marquês de Pombal in 1772, also played an important role in the renewal of cartographic studies in Portugal.

In 1779, the founding of the Academia Real das Sciências de Lisboa, Portugal's first royal scientific academy, contributed to the development of regional mapping by sponsoring scientific expeditions (so-called philosophical voyages) to explore natural resources and to acquire information about the mores of local populations. The numerous geographical and chorographic descriptions that were presented to the Academia were later used to prepare topographical maps of the kingdom. In 1788,

FIG. 9. WORLD MAP, CA. 1801. This map comes from the untitled atlas (known as *Atlas terrestre*) of fifty-two maps printed by the Arco do Cego editorial house, Lisbon, with support from the Sociedade Real Marítima e Militar. Copper engraved. This proof copy, with empty title cartouche, has legends explaining how the map might be colored thematically according to religion, skin color, and facial shapes of world population. Size of the original: ca. 25.5 × 40.0 cm. Acervo da Fundação Biblioteca Nacional–Brasil, Rio de Janeiro.

Francisco António Ciera, a professor at the Academia Real da Marinha, also founded in 1779, was asked to coordinate the geodetic triangulation for the topographic map of the kingdom. Although not completed, these surveys opened up a new era of scientific cartography in Portugal.

In 1798, Rodrigo de Sousa Coutinho, secretary of the Ministério da Marinha e Ultramar, founded the Sociedade Real Marítima, Militar e Geográfica para o Desenho, Gravura e Impressão das Cartas Hidrográficas, Geográficas e Militares; one of its purposes was to correct errors on foreign maps, mainly Dutch, French, and English, and to examine and approve for sale all foreign printed maps circulating in Portugal. The Sociedade Real Marítima also received the first permission to print and sell maps within Portuguese dominions since, until that moment, there were many restrictions on printing in Portugal (Kantor 2010, 451–52) (fig. 9).

The transfer of the Portuguese court to Rio de Janeiro during the Napoleonic invasion (1807) led to the transfer of the naval archives and the refounding of the military academies in Rio de Janeiro between 1808–10 (Guedes 1972). The Academia Real dos Guardas-Marinhas and the Real Academia Militar undertook the training of officers in geography and topography, preparing them for the construction of roads, canals, bridges, fountains, and sidewalks—expertise crucial for the expansion of urban networks (Albuquerque 1979).

During the eighteenth century in Portugal and its colonies, military academies rather than academies of science were the main centers for new approaches to the execution and reproduction of cartography. A substantial network of professionals established in different locations allowed for the transmission of the knowledge required to control strategic areas, their wealth, and their population. The circulation of these agents, who traveled between the field, the office, and the classroom, created unique practical knowledge for Portuguese cartography during the Enlightenment.

ÍRIS KANTOR

SEE ALSO: Geodetic Surveying: Portugal; Geographical Mapping: Portugal; History and Cartography; Science and Cartography

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Akademiya nauk (Academy of Sciences; Russia). The first exclusively scientific establishment in Russia, the Akademiya nauk was founded by decree of Peter I in 1724 in St. Petersburg. Originally called the Akademiya nauk i khudozhest', it included two institutions of higher learning: the Akademicheskiy universitet and the Akademicheskaya gimnaziya, both of which trained students in the sciences throughout the eighteenth century. Up until the 1750s, the Akademiya nauk organized its research and teaching into three main classes: mathematics (chairs in mathematics, astronomy, geography, and navigation; two chairs of mechanics), physics (chairs in theoretical and experimental physics, anatomy, and botany), and humanities (chairs in eloquence and antiquities, ancient and modern history, politics, law, and ethics).

The president of the Akademiya nauk was appointed by the emperor or empress. Full members of the Akademiya included university professors, adjuncts, and extraordinary (though unaffiliated) academicians. Many early members were outstanding European scholars whom Peter I invited to St. Petersburg from places like Switzerland (mathematicians Nicolaus Bernoulli, Daniel Bernoulli, and Leonhard Euler), the German states (mathematician Christian Goldbach, physicist Georg Bernhard Bilfinger, naturalist Johann Georg Gmelin, and historian Gerhard Friedrich Müller), and France (astronomer and geographer Joseph-Nicolas Delisle).

Although the Akademiya carried on research in many fields, the exploration and mapping of Russia became one its main goals. Peter I dreamed of showing the world his emerging empire on maps made with the sophisticated techniques—cartographic projection, unified scale, and geographical coordinates—esteemed in Europe. As early as 1726, the Akademiya expressed its readiness to begin correcting existing maps and compile a general map and an atlas of Russia on the basis of new cartographic material coming to the senate (Fel' 1960). Louis Delisle de La Croyère led the first academy expedition to explore Russia's European north in from 1727 to 1730 (Gnucheva 1946).

Almost from the beginning, obstacles impeded rapid progress in mapping Russia. The sheer size of the Russian Empire itself worked against quick completion. Joseph-Nicolas Delisle, who headed the academy's astronomical and cartographic work, insisted on gathering precise astronomical observations for new maps, an extremely slow and expensive process. In a pragmatic compromise, the Akademiya prepared preliminary reports containing the latitude and longitude of key points throughout the empire, but even this proved expensive and required more skilled labor than was available. Some expeditions only yielded meager results. For example, after three years, Delisle de La Croyère returned with latitudes for just thirteen points (Narskikh 1976, 136).

The Akademiya nauk's work was hampered by the absence of sufficient funds from the senate, even though the senate's chief secretary, Ivan Kirilovich Kirilov, was entrusted with supervising the survey work necessary for the mapping of the Russian Empire. Kirilov was not a member of the academy, but as a state officer he oversaw the work of all the surveyors, including the small group working under Joseph-Nicolas Delisle. All materials of the field surveys were kept by the senate, while compilation of the general atlas of the empire was entrusted to the academy, first under Delisle's supervision and then under Euler's. This odd arrangement, compounded by the far from amiable personal relations between Kirilov and Delisle, meant that Delisle was not permitted to use the academy's print shop (the only one at the time that could perform such a difficult job) to publish an official edition of the atlas.

Instead, Kirilov assembled the data from survey work of the 1720s to produce his own atlas, the *Atlas vserossiyskoy imperii*, and a general map of the Russian Empire (*General'naya karta Rossiyskoy imperii;* see fig. 737) at his own expense in three sets (1731, 1732, and 1734). Although he planned three volumes, he only published thirty-seven maps, including his general map, in small print runs. As the first printed (though incomplete) atlas of Russia, produced for the benefit of the senate, Kirilov's work encouraged the academy toward the production of a full atlas and more complete general map.

To that end, in 1735, the senate decreed that five additional surveyors produce 173 maps for the Akademiya nauk in order to compile "a general map" that would fulfill the academy's goal of a complete map of the empire. To better coordinate with the state, the academy began storing copies (and, in some cases, the originals) of maps from other agencies involved in surveying and mapmaking activities (the Imperatorskiy kabinet, Kollegiya inostrannykh del, Voennaya kollegiya, Admiralteystv kollegiya, Kantselyariya dvortsovogo pravleniya, Kantselyariya ot stroyeniy, and Kantselyariya glavnoy artilerii i fortifikatsii). The production of general maps was to become a collective endeavor, not the work of one person or agency alone.

This tighter relationship with the state reflected the academy's increased responsibility to education. The generation that came of age under Peter I's Westernizing reforms now sought to train their children to be outward looking. The *Atlas, sochinennyy k pol'ze i upotrebleniyu yunoshestva*, a world atlas especially for the young and compiled by the academy in 1735–37, demonstrated the Russian public's increased interest in foreign lands and would benefit students at the academy's gymnasium and at the naval academy, Morskaya akademiya.

The Akademiya nauk's work on the general map forged ahead when, in 1739, the senate established a geography department in the academy with Euler as director; Euler almost immediately proposed his plan for a general map of Russia. Large-scale district (local) maps would be used to create particular or regional medium-scale maps. These regional maps, in turn, would be used to produce an all-Russian general small-scale map. Euler envisioned a collection of regional maps and a general map of the Russian Empire instead of only a single all-Russian map; in effect, a geographical atlas. This method of compilation would allow the production and publication of particular maps as the basic data for them arrived, without waiting for all maps of the country to be completed. An ingenious way of publishing an atlas quickly, the plan proved prescient. Not until the nineteenth and twentieth centuries did this method become commonplace.

After Kirilov died in 1737, younger scholars from the academy joined the mapping effort. In 1741 the academy assigned members Gottfried Heinsius and Christian Nicolas Winsheim to compile a general map and an atlas of Russia. Winsheim whetted appetites by publishing a brief outline and summary of the atlas's projected contents in a pamphlet titled *Atlas Rossiyskoy, sostoyashchiy iz dvadtsati i bolee spetsialnykh kart* in 1742. Heinsius assuaged critics in an essay outlining the project's methods of astronomic and geodetic control, ranging from unscaled bird's-eye views to rigorous triangulations (Goldenberg 1976, 50).

Finally, in 1745, nineteen years after the labor began, the *Atlas Rossiyskoy* was published in St. Petersburg with maps both in Russian and in Latin (title cartouches) with transliterated Russian (place-names). The title page and the list and description of the maps were printed in Russian, Latin and French, and German editions. This second atlas of Russia, based on observation and measurement, covered the entire territory of Russia and contained a general map of Russia (1:9,534,000; see fig. 316), thirteen maps of European Russia (1:1,470,000), and six maps of Asiatic Russia (1:3,780,000).

The academy's *Atlas Rossiyskoy* was not without flaws. It did not make full use of the Second Kamchatka Expedition maps generated by the Morskaya akademiya and the charts, plans, and descriptions made of Orenburg and the Urals by Kirilov and Vasiliy Nikitich Tatishchev. Mikhail Vasil'yevich Lomonosov, the Russian polymath who chaired the Geograficheskiy departament at the Akademiya nauk in the 1750s, later said regretfully that "looking at the then geographic archives and this atlas it is easy to see how much more accurate and fuller it could have been" (Gnucheva 1946, 185). Nevertheless, the *Atlas Rossiyskoy* represented an unprecedented achievement for a single state to map such large distances with some precision.

The process of improving the *Atlas Rossiyskoy* began almost at once. In 1746, the president of the academy, Kirill Grigor'yevich Razumovskiy, asked the Geograficheskiy departament to begin compiling a new Russian atlas immediately, benefiting from the rich but unused material already in hand at the academy. In 1748 Winsheim and Joseph-Nicolas Delisle listed maps and drawings available in the Geograficheskiy departament and included descriptions of 564 manuscript maps (Goldenberg 1976, 53).

Under the leadership of Müller and Avgustin Nafanail Grishov, the academy issued a number of important works in the 1750s: *Plan stolichnago goroda Sanktpeterburga* (1753), an atlas of the ancient habitable world (1753); *Nouvelle carte des decouvertes faites par des vaisseaux Russes* (1754) (fig. 10); maps of Kamchatka and Siberia (1755), maps of continents, and a map of hemispheres (1754–57), titles that were also bound in atlas form. But despite these efforts, by the end of the period 1746–57 mapmaking activities of the Geograficheskiy departament had decreased due to lack of new materials.

When Lomonosov became head of the Geograficheskiy departament in 1758, a more aggressive era began. Eager to improve the 1745 *Atlas Rossiyskoy*, Lomonosov used economic data collected from settlements to include demographic information on existing maps. After Lomonosov's seven-year tenure, the academy's guidance of nationwide cartographic projects began to decline. The academic and astronomical expeditions of 1768–74 and 1781–85 determined latitudes and longitudes of many points and produced valuable geographic and cartographic data used for the second general map of Russia (1:7,227,000), published in 1776 to commemorate the academy's fiftieth anniversary. But increasingly the academy's efforts were devoted to smaller, more modest projects such as new maps of Lake Baikal (1772), European Russia (1773), and the Caspian Sea (1776) and the *Atlas Kaluzhskago namestnichestva* (1782), though the

FIG. 10. GERHARD FRIEDRICH MÜLLER, *NOUVELLE CARTE DES DECOUVERTES FAITES PAR DES VAISSEAUX RUSSES AUX CÔTES INCONNUES DE L'AMERIQUE SEPTENTRIONALE AVEC LES PAIS ADJACENTS* (ST. PETERSBURG: L'ACADEMIE IMPERIALE DES SCIENCES, 1754).

Size of the original: 46.0 × 63.9 cm. Image courtesy of the John Carter Brown Library at Brown University, Providence (Cabinet Cl 754 1).

latter was compiled by Mezhevaya kantselyariya, and only printed at the academy.

In 1800, the Geograficheskiy departament at the Akademiya nauk was abolished. It had lost its importance as a cartographic research center for general mapping. Nonetheless, from 1726 to 1805 the Akademiya nauk had created and published a total of 324 cartographic works, including several atlases and general maps of the entire country, and accumulated and archived a unique collection of 790 manuscript maps and plans, providing valuable resources for the development of Russian cartography (Gnucheva 1946).

ALEXEY V. POSTNIKOV AND
NIKOLAY N. KOMEDCHIKOV

SEE ALSO: Delisle Family; Euler, Leonhard; Geographical Mapping: Russia; Science and Cartography

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Academies of Science in Spain. The history of Spanish academies with an interest in geography and mapping cannot be separated from the colossal effort undertaken by the Spanish Crown since the sixteenth century to reconnoiter its territorial dominions overseas. The cosmographer Juan López de Velasco's project to involve individuals throughout the empire in describing their local communities and regions—captured in the colorful maps of the *relaciones geográficas*—cast a long shadow over Spain's subsequent attempts to capture its imperial holdings on paper. But it was individual initiative rather than organized efforts that really gave Spanish geography its push in the eighteenth century, despite the emergence of various Spanish academies in the early part of the century, including the Academia de Guardiamarinas de Cádiz (1717), the Real Academia Militar de Matemáticas de Barcelona (1720), and the Real Seminario de Nobles de Madrid (1725).

Following an early and ultimately aborted effort in the late 1730s to consolidate cartographic knowledge through the production of a map of Spain at the Real Academia de la Historia, Jorge Juan and Antonio de Ulloa worked for the Crown to elevate a broad array of sciences to an academic standing. Juan and Ulloa had joined a group of French academicians in South America carrying out measurements to determine the shape of the earth. Upon their return to Spain in 1746, they promoted projects that enhanced geographical knowledge of the nation and its empire both formally and informally. While Ulloa worked largely in the field of natural history, helping to inaugurate the Real Gabinete de Historia Natural as well as directing the Real Casa de Geografía, Juan was intimately involved with the military academies in Barcelona and Cádiz, purchasing books and mathematical instruments for these institutions and others at the midpoint of the century. In 1755, he also created an informal academy of sciences in Cádiz, the Asamblea Amistosa Literaria, which met in his house and discussed themes related to mathematics, physics, geography, and history.

The Real Academia Militar de Matemáticas de Barcelona also served as a center for geographic instruction and was principally responsible for the professionalization of military engineers and artillery specialists. In 1739 the new director, Pedro de Lucuce, established a series of ordinances and instructions setting out the criteria for each course taught at the academy, including arithmetic, geometry, trigonometry, topography, and celestial mechanics. Lucuce was later called to Madrid in 1756 to direct the Real Sociedad Militar de Matemáticas, which benefited from the instrument collection of the Real Casa de Geografía and permission from the inquisitor general to read prohibited books. Following the broader institutional reforms of Zenón de Somodevilla y Bengoechea, marqués de la Ensenada, after 1748, other mathematical institutions emerged in cities such as Santiago de Compostela and Salamanca, where a translation of Didier Robert de Vaugondy's theoretical work was published (*Uso de los globos, y la sphera*, 1758). Beginning in 1766, Pedro Rodríguez Campomanes began work on the *Diccionario geográfico-histórico de España* at the Real Academia de la Historia, a work that would eventually be published early in the nineteenth century (1802).

Another important development in Spain was the institutionalization of property mapping as a profession. Land surveyors measured, leveled, and divided lands; delimited property boundaries and municipal borders; and resolved conflicting land claims. One center of this activity was Valencia, where increased population pressed for more irrigated lands with the inevitable and concomitant lawsuits. During the first half of the century, certificates for surveying work were granted by local municipalities, in contrast to France and Italy where the state already recognized the importance of this work. But in 1753, Valencia established the Academia de Santa Bárbara, responding to the need of practitioners to perfect drawing skills in a variety of scientific fields. Heir to the city's long tradition of baroque academies and rich cultural life in and around its universities, this academy eventually gave way to an even more important institution, the Real Academia de Bellas Artes de San Carlos (1768), which trained rural students, city dwellers, and military graduates in the science and arts of measurement required for the practice of land surveying and provided them with certificates for entry into the growing profession of *agrimensores* (Faus Prieto 2001). The Real Academia de Bellas Artes de San Fernando in Madrid, preparatory board established in 1744, founded in 1752, and reorganized in 1757, was also fundamental for the instruction of military engineers and the organization of civil projects, as well as the training of one of Spain's most important cartographers, Tomás López. López had studied at the Academia de San Fernando when it was still known as the Junta Preparatoria before he moved to France, where he became a disciple of Jean-Baptiste Bourguignon d'Anville and heir to the academic tradition of the *géographes de cabinet*. His entrance to the Real Academia de la Historia in 1776 and the publication of his *Principios geográficos, aplicados al uso de los mapas* (1775–83) represent the apogee of academic science in Spain as it related to geography and cartography.

In the 1780s, the Spanish navy undertook a series of coastal mapping projects under the leadership of Vicente Tofiño de San Miguel, director of the Academia de Guardiamarinas de Cádiz, as well as coastal maps of North America and interior maps of South America as part of the Luso-Hispanic boundary expeditions, under the direction of the military engineer Francisco Requena. Those same expeditions to the Americas were also responsible for the career of naval officer Felipe Bauzá, who accompanied Alejandro Malaspina around the world and later became head of the Depósito Hidrográfico in the first decades of the nineteenth century.

NEIL SAFIER

SEE ALSO: Administrative Cartography: Spanish America; Geographical Mapping: Spain; Property Mapping: Spain; Science and Cartography; Ulloa, Antonio de, and Jorge Juan

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Adair, John. Significant principally for his coastal surveying, much of which remained in manuscript, and for his county maps, printed and manuscript, John Adair was born in South Leith in September 1660 and died in Canongate, Edinburgh, in May 1718. We have no knowledge of his early education or training. He variously bore the titles the king's geographer, hydrographer royal, her majesty's geographer, the queen's geographer, and geographer for Scotland. While these honorifics, his fellowship of the Royal Society of London, and connections with leading virtuosi indicate his status, much of Adair's work was hampered by limited funding and by personal disputes.

Adair began mapmaking in May 1681 after being granted a license by the Privy Council to survey Scotland in order to know its bounds and as a stimulus to economic growth. Adair signaled his intentions in a circulated "Advertisement anent surveying all of the Shires of Scotland and making new Mapps of it" (Withers 2000, 2). By 1682, Adair had produced several county maps and been commissioned by the geographer royal, Sir Robert Sibbald, to undertake maps for the latter's intended two-volume description of Scotland. In later years, the two were in dispute over contractual matters, and Adair's work before 1686 was more than once hampered by lack of funds (Withers 2000, 2, 5).

By an Act of Parliament of 14 June 1686, Adair's mapping projects were funded from an annual tonnage levy on all native and foreign ships. This levy was the idea and responsibility of the Scottish Parliament. This was an important but nonetheless insufficient source of funding. Adair visited the Netherlands in 1687 to purchase surveying instruments, returning in February 1688 with the engraver James Moxon. By August 1692, Adair had completed ten sea maps, for which he received £120 Scots from the tonnage levy, and ten county maps, for which he received less than £50. Overall, Adair certainly incurred considerable debts on behalf of his country's mapping.

Adair's connections with the Royal Society led to his involvement from 1697 in plans to describe St. Kilda and other Hebridean islands. Adair's *The Description of the Sea-Coast and Islands of Scotland*, which concentrates on Scotland's east coast, was published in 1703. An intended second part was never published: records from 1704 show further maps in an advanced state of readiness. In 1706, he was surveying the Shetland Islands. In 1707, he wrote but did not publish a short work on Scotland's fishing industry. From 1708–12, Adair was involved in surveying the ports of southwest Scotland.

For John N. Moore, Adair's manuscript charts of Scotland's coasts reveal him "as a painstaking surveyor attempting to produce a realistic depiction of the Scottish seaboard." They are "vastly superior to any others of the area prior to the surveys of Murdoch Mackenzie in the 1770s" (2000, 57, 59). We may see Adair as an agent of the state, the Enlightenment surveyor as civil servant (fig. 11). Yet failure to complete his mapmaking and his country's failure to fund him have meant he has been unjustly overlooked.

CHARLES W. J. WITHERS

SEE ALSO: Marine Charting: Great Britain; Sibbald, Robert

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FIG. 11. DETAIL FROM JOHN COWLEY, "DISPLAY OF THE COASTING LINES OF SIX SEVERAL MAPS OF NORTH BRITAIN," 1734. This image, which includes Adair's survey work, captures the uncertainty about Scotland's mapped outline. The map was printed but never published. Cowley was a factor (estate manager) to the Duke of Argyll on the latter's Ardnamorchan (Ardnamurchan) estates in the west highlands: as the rhomboidal shape extending eastward from Ardnamorchan Point and the "Explanation" text make clear, Cowley used this as his base referent against which to position the several map outlines of Scotland.
Size of the entire original: 60.8 × 48.8 cm; size of detail: 20 × 39 cm. Image courtesy of the National Library of Scotland, Edinburgh (EMS.b.6.5[1]).

Administrative Cartography.

ENLIGHTENMENT
DENMARK AND NORWAY
FRANCE
NEW FRANCE
FRENCH WEST INDIES
GREAT BRITAIN
BRITISH AMERICA
ITALIAN STATES
NETHERLANDS
OTTOMAN EMPIRE
POLAND
PORTUGAL
PORTUGUESE AMERICA
RUSSIA
SPAIN
SPANISH AMERICA
SWEDEN-FINLAND
SWITZERLAND

Administrative Cartography in the Enlightenment. Administrative cartography produced between 1650 and 1800 probably accounts for one of the most prolific areas of European cartographic production. Most of the maps produced for administrative purposes were accompanied by other documents, which may be found by the thousands in archives; yet many remain undiscovered or unexplored, creating a situation that impedes our complete knowledge of this vast field.

For a contemporary definition of "administrative map" one turns first to the word "administration," defined in the *Encyclopédie* of Denis Diderot and Jean Le Rond d'Alembert as "the management of business of any individual or community, or the management of property" (Toussaint 1751). Similarly, Samuel Johnson's *A Dictionary of the English Language* defined administration as "1. The . . . conducting the publick affairs; dispensing the laws" and "2. The active or executive part of government" (1755, [1:83]). Given this vague and general sense, the term "administrative cartography" may evoke the representation of territory attached to an administration or a graphic document ordered or used by an administrative authority and its representatives for the management of part of their territory. Cartographic functions were thus connected to different categories of administrations: civil, judicial, financial, ecclesiastical, or even seignorial.

All levels of the administrative hierarchy expressed an interest in cartographic tools. An order for maps could come directly from the central or governmental power, such as the monarch or ministerial services, but it could also be issued from local or provincial administrations, for example, a municipality implementing an urban development program. There was a difference between the administrative processes relevant to royal or local authorities and to those of a seignorial administration. In much of Europe, many landholders, often aristocrats, successfully used their own administrative organization for the management of their lands, which distinguished them from the royal government and its agents. Nevertheless, the definitions of "administration" in the *Encyclopédie* and the *Dictionary* refer to government—demonstrating that the word was primarily associated with some form of centralized state or public entities in the eighteenth century; therefore, this concept takes precedence in our consideration here.

Throughout the long eighteenth century, monarchs and their ministers could play a decisive role in administrative cartography, whether through distinct mapping initiatives, the establishment of scientific and educational institutions, or the deliberate collection of cartographic material for administrative uses. This is most obvious in the case of France, beginning with Louis XIV and his minister Jean-Baptiste Colbert, but the pattern was repeated with Peter I in Russia, João V and José I in Portugal (especially during the ministry of Sebastião José de Carvalho e Melo, marquês de Pombal), Felipe V, Fernando VI, and Carlos III in Spain (the ministry of Zenón de Somodevilla y Bengoechea, marquês de la Ensenada), Joseph II in Austria, and Victor Amadeus II in Savoy, to name but a few. Where the monarch did not leave a centralized imprint on the offices requiring maps, local administrations and private corporations often filled the gap with their own demands and financed mapping projects, as in the case of Great Britain, whose Parliament, reluctant to spend money on national mapping endeavors, devolved such responsibilities to local authorities and private companies.

Map collecting was another critical function of an administrative unit, as its patrons developed archives and exerted more control over the cartographic record. Monarchs established and added to imperial and royal libraries, through purchase, gift, or fiat (King João V of Portugal ordered his diplomats to collect maps for the libraries of the palaces and University of Coimbra). Military units, concerned with both land and sea, founded archives and depots in which to deposit maps and plans; in France, the Ministère des Affaires étrangères created the Bureau des limites to house documents related to borders and frontiers. Scientific institutions, operating as royal foundations or with royal imprimaturs, collected maps and plans for their libraries. The private collections of the landed gentry and nobility as well as those of private citizens, such as the enormous collection of Jean-Baptiste Bourguignon d'Anville, were often acquired by the state to supplement existing holdings.

An administrative map was a valuable tool for governments. As an accurate representation of territory, it allowed effective management and decision making for the depicted region. The map also spared decision makers from laborious travel, thereby accelerating the decision-making process, while at the same time modifying the relationship the administrators had with the land. Administrators increasingly delegated to cartographers and other technicians the job of studying the territory on the spot and proposing improvements. The map became an indispensable artifact for governments whose decisions depended on the accuracy of the information presented. Finally, maps offered a range of support in the exercise of power, to the point of constituting a true working tool for government or by serving as propaganda for the state (Buisseret 1992) and for implementing proposals typical of governments during the Enlightenment.

An administrative map addressed a wide variety of domains and purposes, the earliest of which was the question of national and local borders. From a very early period, administrations felt the need to mark out territory, not only for national borders, but also for financial, judicial, military, or even ecclesiastical administrative districts. The mapping of national borders was usually reserved for military engineers, as this domain was thought too critical to be entrusted to other agents. In France, the territorial reconstructions and border adjustments resulting from numerous wars led to the production and examination of many maps. In 1712, a dedicated cartographic service was established within the ministry of foreign affairs (Nordman 1998, 300). In Poland, King Stanisław August Poniatowski created a similar organization to assist in the prodigious development of cartographic production. During his reign he created "appropriate conditions for the development of cartography, organized an office of cartography at the Royal Castle in Warsaw, and assembled there a sizeable collection of maps, globes, and astronomical instruments" (Mikoś 1989, 80). Such efforts were typical of many other rulers throughout Europe.

The mapping of communication routes was another prolific area because an administration's efficiency could be measured by its infrastructure and its network of roads, rivers, and canals. All maps of communication routes were not necessarily ordered by the state, but administrative maps represented a large part of the production. The extensive investigation launched in France in the 1730s illustrates this direct connection between maps and the state's power. The *contrôleur général des*

FIG. 12. "PARTIE DU CANADA OU NOUVELLE FRANCE ET DE LA NOUVELLE ANGLETERRE, DE L'ACADIE," 1713. Made in 1713 after the signing of the Treaty of Utrecht, marking the end of the War of the Spanish Succession, this manuscript map was conceived by Jesuit Nicolas Aubry and designed by army assistant engineer La Guer de Marville. It shows the new international boundaries between New France, New England, and Acadia in northeast North America.
Size of the original: 51 × 102 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge SH 18 pf 124 div 1 P 5).

Finances, Philibert Orry, initiated the production of an enormous map collection, the "Atlas de Trudaine," in the 1730s, a decade before César-François Cassini (III) de Thury began his work for the *Carte de France*. Using a detailed inventory of royal highways, Orry sought to control highway development, a vital cog in the gears for transmitting orders and affirming an absolute monarchy (Blond 2008, 1:100–154).

Administrative maps gradually expanded into so many areas that it becomes difficult to create a complete typology, as they incorporate almost every mode of cartography: maps of national, provincial, and district regions and borders; maps for revenue and fiscal policy (land registration, customs, population, taxation); maps for communication and infrastructure (road maps, post routes, rivers and canals, bridges, fortifications); maps of natural resources (forests, mines, mineral deposits); maps for urban planning and development, for disaster relief, and for judicial evidence; maps for royal and aristocratic privilege (hunting rights, property control); and maps of ecclesiastical districts ordered by church administration and religious orders for their own regulation. Finally, perhaps most symbolic for the power of cartography and the centralized state were national maps and surveys for the creation of a national atlas. All of these map types involved the administration of a country and its dependent territories (figs. 12 and 13). A period of colonization was usually followed by cartographic operations that supported the organization and establishment of administrative authorities as well as evaluating the resource potential of these newly possessed lands.

In many cases, the distinction between administrative maps and military maps is difficult to establish because the two cartographic genres were closely related. Military cartographers generally served under the jurisdiction of a central administrative authority while administrative mapping not directly related to military affairs was often concerned with raising revenue to support military operations. In addition, military engineers frequently had the technical skills and know-how to create maps that met administrative needs beyond the bounds of single military events. Numerous military maps were used for operations of an administrative nature, particularly for the representation of strategic areas, such as the plans of fortified areas, boundaries and frontiers, and military road maps.

In spite of the creation of various (mostly military) institutions, which trained engineers with cartographic skills, administrative mapping was diverse and widespread enough that it could not be undertaken solely

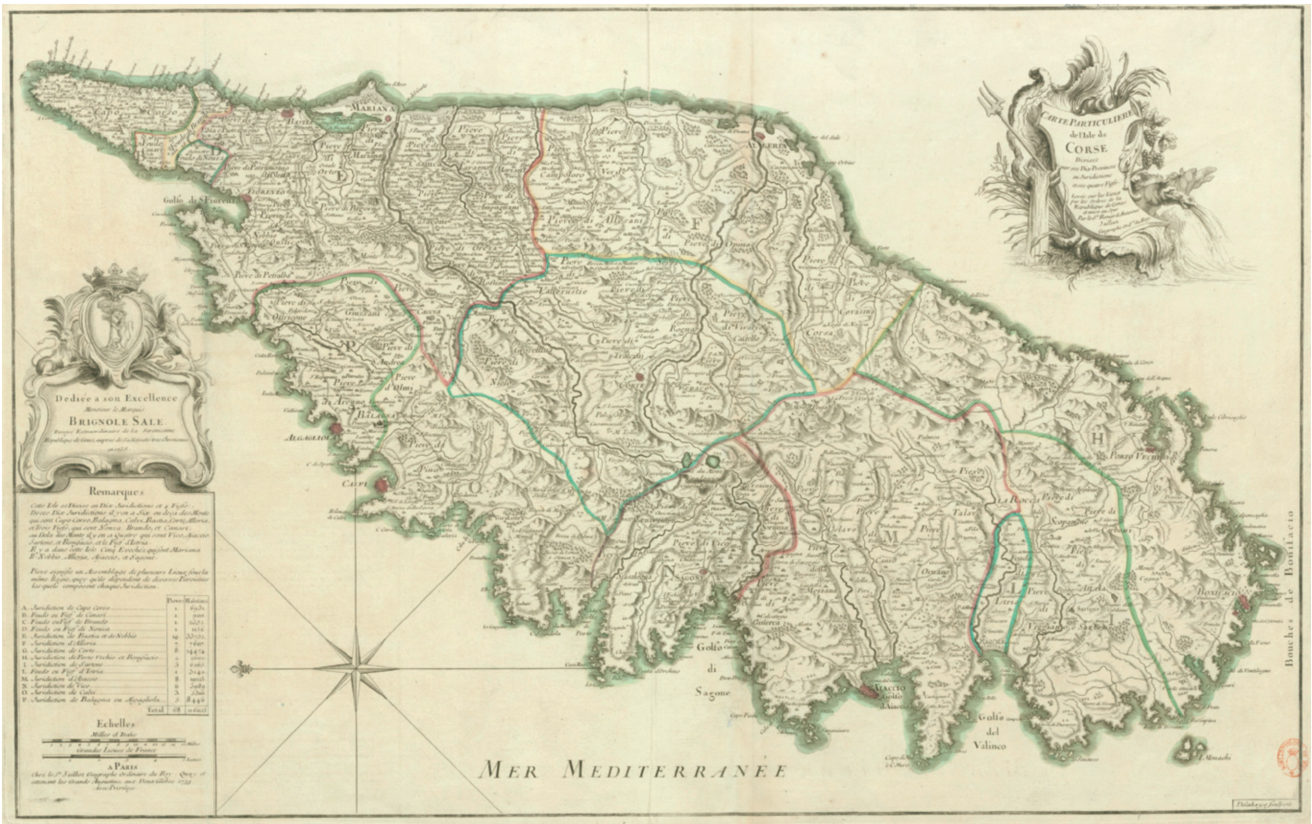

FIG. 13. BERNARD-ANTOINE JAILLOT, *CARTE PARTICULIÈRE DE L'ISLE DE CORSE DIVISÉE PAR SES DIX PROVINCES OU JURIDICTIONS ET SES QUATRE FIEFS*, 1738. Compiled by the Paris-based cartographer Jaillot, this map was ordered by the Republic of Genoa, proprietor of the island at the time, and represents the administrative districts of the island, emphasizing the control of territory even from a distant metropole.
Size of the original: 50 × 80 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge BB 565 [A 12, 100]).

by military engineers. The skills of local land surveyors, many of whom were certified by local authorities, were called upon to survey and make maps, as were the members of certain religious orders, such as the Jesuits, who had the necessary mathematical and instrumental skills. Amateur mathematicians and academics also participated in administrative mapping efforts, as did the community of commercial geographers and the *géographes de cabinet*, who compiled results from the field into printed versions of maps, often at a smaller scale, suitable for wider distribution. It was not unusual for skilled personnel to move across national boundaries when called upon or hired for particular projects. Marcel Watelet points out that the use of both military and civil surveyors for public works in Wallonia provided two-way communication between people working on-site and those in administrative offices: "Engineers frequently brought cartographic material that was indispensable to the control of the operations being carried out, and when the civil engineering structures were defective, the engineer indicated the nature of the defects on the map" (Watelet 1995, 45) (fig. 14).

In addition to institutions that trained skilled cartographers and those that licensed them, some governments also institutionalized the position of the cartographer, who thereby became a servant of the state. In 1675, John Ogilby was awarded the title "His Majesty's Cosmographer and Geographic Printer," which signified royal support of the publication of his road atlas, *Britannia*, in 1675. In 1718, the French geographer Guillaume Delisle, while he taught geography to young Louis XV, was the first to receive the title of *premier géographe du roi*; he also functioned as a court geographer in terms of supplying maps to the royal administration when needed (Dawson 2000, 47–99). This title continued to be passed on to eminent geographers who worked in the map trade as well as in the royal household and administration in France. The title of *géographe du roi* and *premier géographe du roi* brought annual stipends, but in Great Britain the title alone had to suffice as an

FIG. 14. DETAIL FROM THE ANONYMOUS "PLANT [*SIC*] DE LA CHAUSSÉE DE BRUXELLES À MONS," 1704. This detail illustrates the two links between administration and cartography. The old route is displayed alongside the new route, shown with two straight parallel lines, proposed by an engineer on site. Such graphic display allowed administrators to weigh the benefits of such improvements. The prominent arms of the Royal House of Spain, which controlled the Southern Netherlands at the time of this map's creation, emphasizes the authority of the state in the development of infrastructure. The arms of the city of Mons also appeared on the map.
Size of the entire original: 47 × 443 cm; size of detail: ca. 47 × 25 cm. Image courtesy of the Archives de l'État, Mons (Fonds des cartes et plans nº 99).

imprimatur of royal pleasure, as it came without financial support.

With the foundation and patronage of scientific institutions, such as the academies, learned societies, and engineering schools, central administrations supported the training of mapmakers who worked for the state. These institutions contributed to the development of a cartography based on technical methods, which relied on a deeper understanding of mathematics and the use of more precise measuring instruments. State-supported organizations demonstrated the desire of administrative authorities to control this sector of activity at various levels by their contributions to the advancement of astronomy, topography, field surveying instruction, and cartographic expeditions, whether national or international in scope, while simultaneously supporting reform programs, which were gaining ground in the latter half of the century. In Bavaria, for example, Elector Maximilian III Joseph established a program of reform of the absolutist regime that relied on the cartographic information provided by the new Churfürstlich baierische Akademie der Wissenschaften, founded in 1759 (Schlögl 1997).

In Spain under the Bourbons the Cuerpo de Géometras (founded 1728) was responsible for training specialists to apply techniques of geodesy in many areas. In Russia, the founding of many scientific institutions over the course of the first half of the eighteenth century contributed to the launch of ambitious cartographic operations, such as the works of Semën Ul'yanovich Remezov in Siberia or the atlas of the Russian Empire supported by the geography department, which was founded in 1739 as part of the Akademiya nauk in St. Petersburg (1725). This national atlas, the *Atlas Rossiyskoy* (1745), produced under the supervision of Joseph-Nicolas Delisle, provided a picture of the vast empire in one volume. One of academy's members, Mikhail Vasil'yevich Lomonosov, supervised the production of the first series of provincial maps of Estonia (Varep 1979, 88–89).

Depending on the administration sponsors or the projects involved, the nature, presentation, and scale of maps varied tremendously from national, provincial, or district maps to local or urban plans. This cartographic field included various types of media, including manuscript maps in ink and watercolor, printed maps, pencil drafts and sketches, and atlases. Manuscript documents were more prevalent because in most instances the administrative maps involved a single response to a unique project. Furthermore, these documents contained sensitive information, which required keeping them confidential and not reproducing them. It is understandable that the map of a road near a border or those of military districts required limited distribution because they touched the security of the state. In a few cases, printing was used in a limited way to supply maps to a small

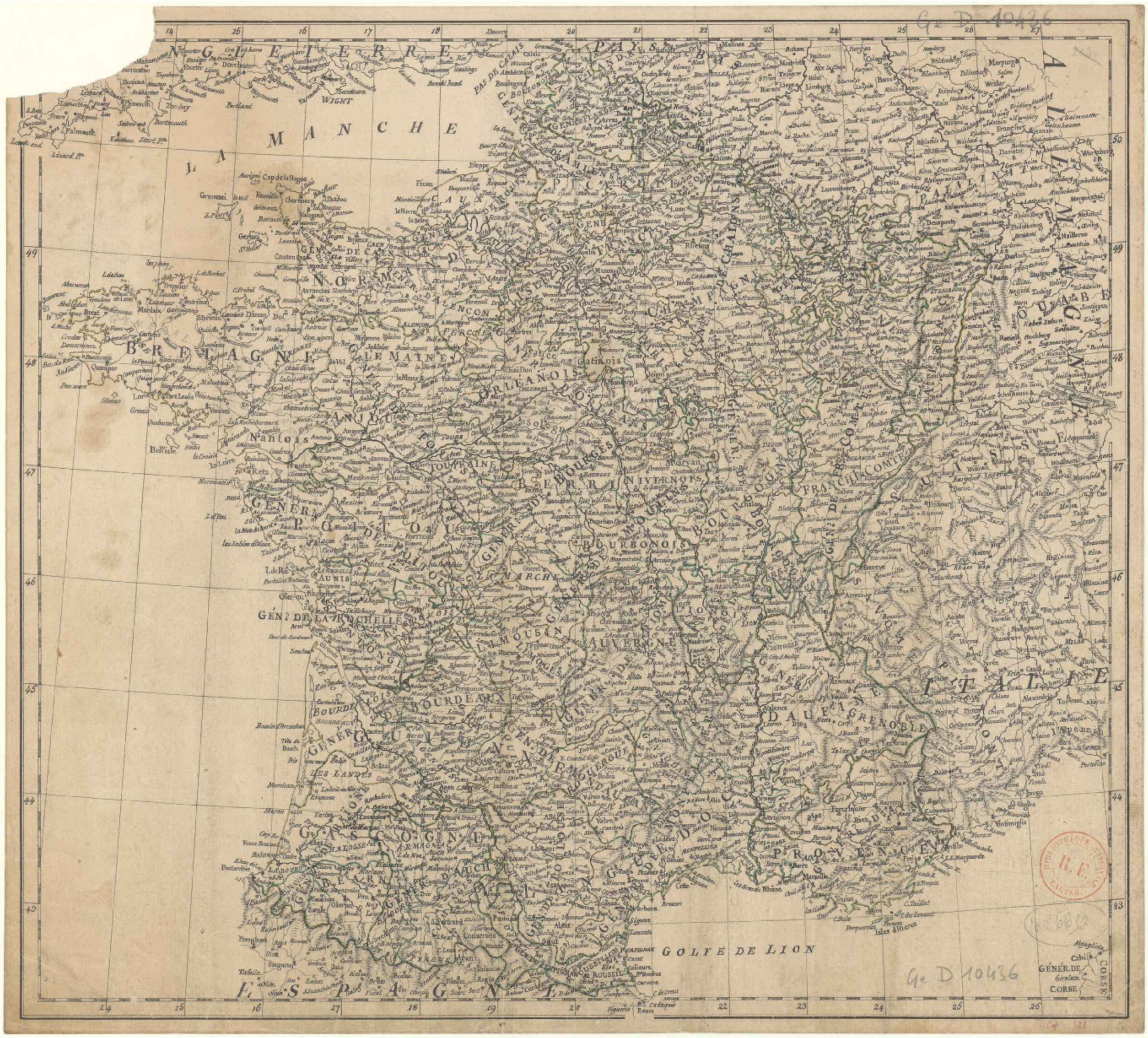

FIG. 15. JEAN-BAPTISTE BOURGUIGNON D'ANVILLE, [LA FRANCE DIVISÉE EN PROVINCES ET EN GÉNÉRALITÉS DONT LE PLAN EST CELUI DE L'ANCIENNE GAULE, 1713]. Forming part of the vast collection of historical maps created at the beginning of his career, this manuscript map represents the boundaries of the *généralités* or *intendances*, the most important administrative districts of the Ancien Régime. The reference to the outline of ancient Gaul served to legitimize administrative power across the centuries. Size of original: 41 × 45 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge D 10436).

group. Nonetheless, as a literate public grew, and with it a desire for graphic information, printed maps played an increasingly larger role in the public sphere where discussion of and reaction to administrative initiatives took place.

In other less problematic situations, the documents produced enjoyed a greater distribution. Sometimes they relied on earlier maps, especially those distributed commercially. The map of old France (France ancienne) (ca. 1713) by d'Anville, later *premier géographe du roi*, served as a basis for multiple editions that were regularly published throughout the eighteenth century as *France divisée en provinces et en généralités* (fig. 15). In some instances, the manuscript maps ordered by the government could lead to a commercial venture, for example, certain routes of the "Atlas de Trudaine" were reprinted by Guillaume Coutans in his *Description historique et topographique de la grande route de Paris à*

Reims (1775). Similarly, government-supported marine initiatives were available on the market, for example, in France (*Le Neptune françois* and *Hydrographie françoise*), in Great Britain (*Great Britain's Coasting-Pilot* by Greenvile Collins, *Orcades* by Murdoch Mackenzie the Elder, *The Atlantic Neptune* of J. F. W. Des Barres), and in Spain (*Atlas Marítimo de España* by Vicente Tofiño de San Miguel y Vandewalle). Other examples of administrative maps that reached the public are cited in the regional entries that follow.

During the same period, the appearance of technical treatises increased, contributing to a standardization of cartographic methods, signs, and colors that greatly benefited administrative operations. Several works on military engineering and surveying gained a foothold throughout Europe, building on earlier works that had focused on the design and planning of fortifications: *Les regles du dessein, et du lavis* (1721) by Nicolas Buchotte, *O engenheiro portuguez* (1728–29) of Manoel de Azevedo Fortes, and *La science de l'arpenteur* (1766) of Louis Charles Dupain de Montesson. These texts became standard reference works in Europe for implementing a cartographic language that was applicable to many domains, forming a partial list of fundamental titles used to teach engineers who would later meet the cartographic needs of the state. While a standard part of military training, within the civil sphere the French École des Ponts et Chaussées also provides an example in which mastering the map constituted the first step and the sine qua non condition to meeting administrative demands. This learning process emphasized methods that were useful to the administration, such as the construction of fundamental infrastructures for the development of land (roads, bridges, locks, canals, etc.). This process replicated in many ways the same command of maps and mapping skills required of military engineers from the late seventeenth century.

In sum, administrative cartography experienced a growing success between 1650 and 1800 that was never reversed. At the end of that period, no state was able to govern without cartographic tools. Nonetheless, for some regions much research remains to be done as more maps and plans emerge from archives and are linked with the documents to which they were originally attached, revealing the intricate relationship between administrative bodies and the visualization of space.

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SEE ALSO: Academies of Science; Boundary Surveying; Cities and Cartography; Customs Administration Map; Modes of Cartographic Practice; Taxation and Cartography; Transportation and Cartography: Post-Route Map; Urban Planning and Cartography

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Administrative Cartography in Denmark and Norway. The different administrative structures of Denmark, Norway, and the duchies of Slesvig (Schleswig) and Holstein meant that there were no coherent projects by officials to map the entire state for administrative purposes. The kings of course commissioned a number of geographical maps, as well as the topographical survey of Denmark begun in 1761 by the Kongelige Danske Videnskabernes Selskab, to allow them and their ministers to comprehend the entire country. In terms of detailed mapping for specific administrative purposes, the primary effort lay in the mapping of properties as the basis for taxation in Denmark. However, a lack of funds and trained surveyors precluded a mapping component to the 1688 *matrikel* (land register) and brought the attempted statewide cadastral survey after 1768 to a rapid halt in 1772. The southern duchies were so complex a

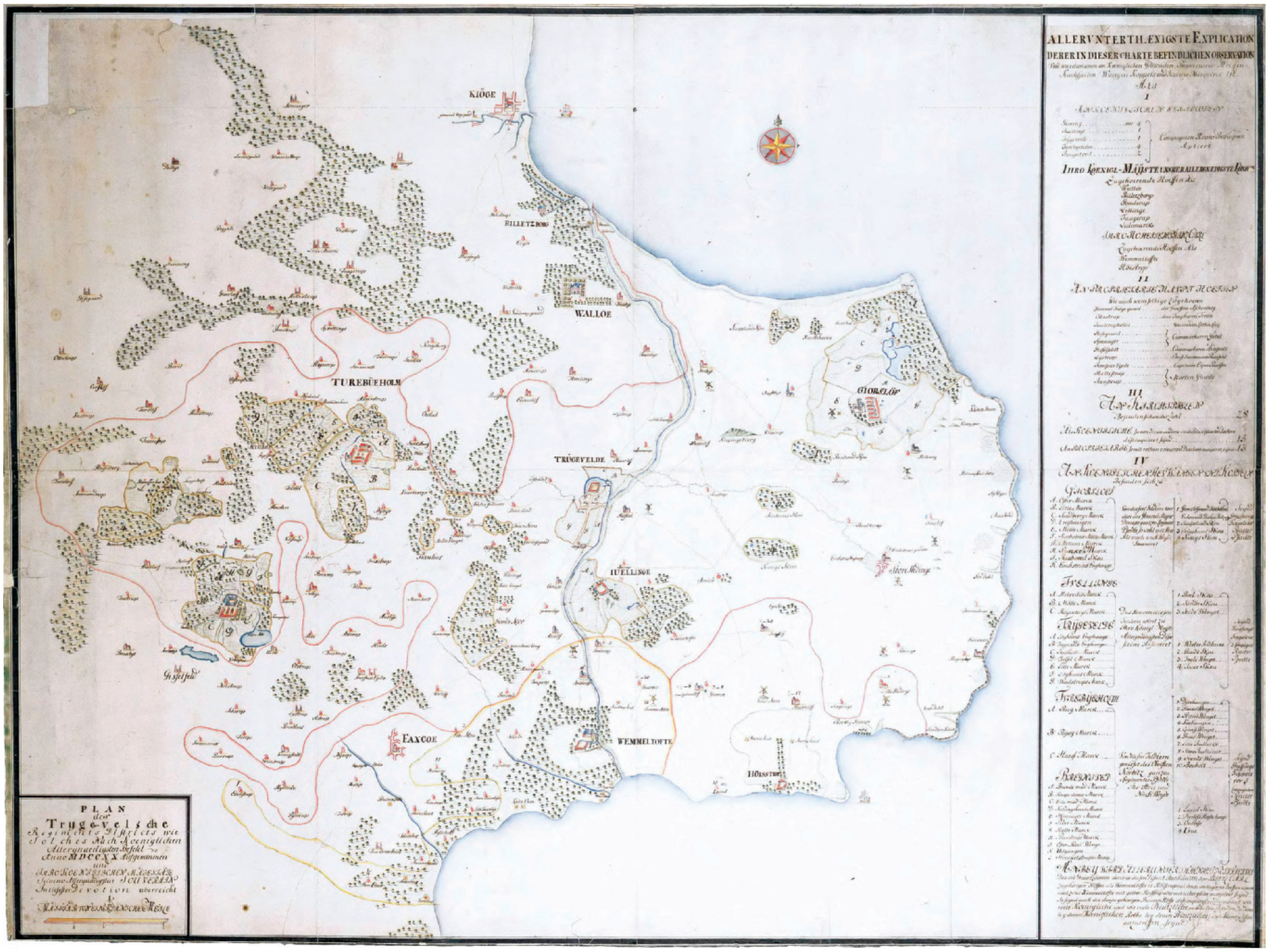

FIG. 16. ABRAHAM CHRISTIAN WILLARS, "PLAN DES TRYGEVELSCHE REGIMENTS DISTRICTS WIE SOLCHES NACH KOENIGLICHEN ALLERGNAEDIGSTEN BEFEHL," 1720. This district was centered on the royal estate of Tryggevælde, just south of present-day Hårlev in southeastern Sjælland (Zealand). Manuscript. Size of the original: 89 × 120 cm. Image courtesy of Det Kgl. Bibliotek; The Royal Danish Library, Kortsamlingen, Copenhagen (KBK 1111,252,41-0-1720).

patchwork of jurisdictions—royal, ducal, manorial, clerical, judicial—that cadastral surveys were hindered by the difficulty of isolating who had what precise rights in each property.

The core of the Danish government's funds came from the king's own properties, which were grouped into seven *rytterdistrikter* (cavalry districts). In order to enhance both income and the provision of supplies for the cavalry, Frederik IV commissioned a series of surveys of the districts in 1720–23 by Captain Abraham Christian Willars. The maps themselves varied in scale from 1:33,000 to 1:70,000 and were too general to show precise details of property ownership, but they nonetheless included much information about each district. For example, Willars's map of Tryggevælde Rytterdistrikt (fig. 16) indicates five royal estates, each distinguished by the depiction of their dependent territories, while the explanation on the right side lists each estate's military contribution in men and horses, totaling twelve companies of cavalry for the whole district (Kain and Baigent 1992, 79, 357n136; Dahl 1993, 16–17, 56–57). The *rytterdistrikter* were the first areas to be surveyed in the abortive cadastre of 1768 (see fig. 659).

Frederik V initiated a program to build new roads on the model pioneered in France by Daniel-Charles Trudaine. To that end, the French engineer Jean-Rodolphe-François Marmillod was recruited in 1764 to work for the new authority in charge of new roads, the Direktion for de nye Vejanlæg. Marmillod and his assistants began by straightening and rebuilding the road northward from Copenhagen to Fredensborg; their second road, to Roskilde, was begun in 1770. In the process Marmillod mapped the line of the existing roads, along with the proposed line of the new. As the process of new road building continued, more *vejkort* (road maps) were produced, constituting a distinct category of administrative mapping (Nørlund 1952–53, 236–37; Dahl 1993, 26–27, 66–68; Korsgaard 2006, 98–99, 123–24). The reconstruction of main roads through urban areas intersected after 1790 with the new form of *grundtakstkort*—detailed maps undertaken by individual towns for fiscal and planning reasons (Korsgaard 2006, 94–95).

Seeking to develop revenues from the under exploited Norwegian timber industry, Christian VI in 1737 established a Forstkommisjon (after 1739 the Generalforstamt) headed by the German foresters Johann Georg von Langen and Franz Philipp von Langen. The brothers mapped and described extensive areas in order to assist in forest management. The surveys were terminated when the commission was abolished in 1746, after the king's death, and the maps were never printed (Kain and Baigent 1992, 101–3). After 1762, the Danish Crown also began mapping forest resources in northern Jylland (Jutland), mostly between 1:4,000 and 1:10,000 (Korsgaard 2006, 104–5).

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SEE ALSO: Denmark and Norway

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Administrative Cartography in France. France was one of the most prolific European states in its embrace of administrative cartography, as evidenced by the large number of plans and maps lying unexplored in the archives of central and local governments. From the fifteenth century, the public institutions of France used maps regularly as tools to shape their decisions, thereby introducing a new relationship between governance and space, a tendency that incorporated all areas of administration over the course of the following centuries. By the eighteenth century, the actions and map use of administrators became inseparable and "the map, both as an aid to recall locales and as an object of reflection, became a much sought-after tool that was critical to the study of projects, whether civilian or military" (Pelletier 1994, 7).

Administrative cartography experienced a remarkable development during the reigns of Louis XIV, Louis XV, and Louis XVI. It often involved mapping administrative, judicial, and fiscal boundaries, or even describing the resources of new territories, particularly the colonies. At times, maps also became the basis for reform, offering a means to evaluate the ramifications of change. The administrative impulse was always accompanied by the will to know, to master, and to control territory and its particular regions. Consider the example of Martinique, a territory returned to France after the Treaty of Paris (1763). Its reintegration into the kingdom engendered a new phase of colonization and development that produced a proliferation of cartographic projects in the 1770s (Bousquet-Bressolier and Pelletier 1998, 56–59). Corsica's integration with France in 1769 prompted the creation of a large-scale property map of the island to inventory its geographic, economic, and human riches.

The administrative value of plans and maps lies in their multiple uses and their efficacy in constructing arguments. Maps can illustrate a theory as well as demonstrate and support a process or make important points. Their objectives are multifunctional and provide layers of meaning to political projects. They are evidence of an administration that investigates, surveys, and plans, always with the intent to increase the efficiency of its actions. In Europe, France was a unique exception because the central government actively launched and administered ambitious cartographic operations that served as examples for provincial authorities. The state had specific needs and was responsible for a special discourse on the map: "the initiative in the discourse or the geographical image is in large part that of the state" (Nordman 1989, 47). This impetus was reinforced by the centralized and hierarchical nature of the French system, with each level playing a distinct role within the system (*intendants*, subdelegates, local authorities). In most cases, information was collected in Paris in order to be checked and approved or denied.

Royal patronage supported cartographic operations considerably during the seventeenth century, owing to a desire for a uniquely French school of cartographic production that would be competitive with the English and Dutch. To this end, sovereigns supported and rewarded those cartographers who helped to improve the management of certain areas of the administration. Nicolas Sanson, one of the most productive French cartographers of the mid-seventeenth century, credited with approximately three hundred maps, was appointed *géographe ordinaire du roi* by Louis XIII and became a tutor of the Dauphin, the future Louis XIV, and contributed to a major shift in the history of French cartography. His cartographic work served as the basis for his son's manuscript "Atlas des gabelles," a collection of twenty-one maps dated 1665 of different salt tax districts, the whole prepared "for the conservation of the rights of the general form of salt tax in France" (Bibliothèque nationale de France, Paris [BnF], GE CC 1379). The date places it at the time of the efforts of Jean-Baptiste Colbert, minister to Louis XIV, to centralize tax farming.

Over the course of the Louis XIV's reign, royal institutions played a critical role for the development of cartography: "At the time of Louis XIV's accession, then, French governing circles possessed a well-developed sense of the usefulness of maps, and there were cartographers capable of responding to their needs" (Buisseret 1992, 100). The founding in Paris of the Académie des sciences (1666) and the Observatory (1667) contributed to the development of cartography based on scientific methods of recorded astronomical observations and terrestrial measurements. These institutions in turn funded research that reinforced cartography as an instrument of power. Based on carefully measured triangulation, maps sponsored by the Académie and the Observatory attained a level of accuracy previously unmatched. The triangulation network served as a basis for numerous administrative maps. In his depiction of Louis XIV at the Académie des sciences in the company of Colbert, the painter Henri Testelin illustrated the king's aspiration to establish a new basis for representing French territory. On the right side of the canvas, a large map shows the Canal des Deux Mers or the Canal du Midi, a privately funded project that served the interests of both the province of Languedoc and the central government. Scientists, various tools, globes, and maps surround the king, demonstrating his use of science to manage his kingdom.

From the late seventeenth century on, the preference for perspective sketches and bird's-eye views of territory gave way to "mathematized" orthogonal plans on which the represented distances were scaled to the actual land size, always with the aim of improving the management of the territories. Maps were surveyed and laid out geometrically, using instruments that were constantly being improved. At the same time, decorations were limited or increasingly focused in their iconography, and cartographic language grew more and more standardized, enabling its application to a series of maps and also allowing map use to become an easily learned skill. As administrators became accustomed to using maps, they drew closer to the land, at the same time reducing their need to work on site. This approach was evident at all levels of French administration, from the king's council down to local participants.

After the founding of the Académie des sciences, the state, led by Colbert, subsidized extensive and costly cartographic works. A royal pension system in France attracted renowned foreign scientists whose work improved knowledge of the realm and ensured the monarch's role as a patron of the arts and sciences. Several projects sought to define accurately the boundaries of France, starting with the astronomical research to verify accurate longitude performed by Jean-Dominique Cassini (I) and Christiaan Huygens. With the establishment of the Paris meridian, the capital became the central geographical reference point. The astronomical observations of Philippe de La Hire helped create the revised map of the outline of the kingdom published in 1693 (see fig. 625), while the astronomical observations of Joseph-Nicolas Delisle were used by his older brother Guillaume for creating numerous engraved maps, beginning with the *Carte de France dressée pour l'usage du roy* (1721), followed by maps of the provinces. This map served as the base map for the representation of boundary changes from 1648 to 1713 (fig. 17). In parallel, the publication of scientific treatises increased, serving as references for geographers supplying military and civilian administrations. The Imprimerie Royale also published the results of academic research through periodic reports and works such as *Mesure de la Terre* (1671) by the abbé Jean Picard.

Colbert regularly ordered maps to assist his decision making. For example, on 20 July 1679, he sent instructions to *intendants* calling for fiscal jurisdiction maps based on accurate measurements to improve the distribution of parishes with respect to their specific revenues and to accelerate the collection of taxes, resulting in submissions such as the manuscript "Atlas de la generalité de Rouen" of 1683 by François de La Motte, alderman of Honfleur (BnF, Ge DD 2030 [Res]). In the same year, his correspondence with the *intendant* of Grenoble referred to the use of maps that had been created for Armand Jean du Plessis, Cardinal Richelieu, to organize improvements to the rivers Isère and Drac.

This cartographic approach continued during the reign of Louis XV, a period characterized by administrators almost obsessed by maps, driven by the monarch himself, whose passion for cartography gave new impetus to this science. His geographical education was overseen by the erudite abbé Louis Dufour de Longuerue and geographers Guillaume Delisle and Jean-Baptiste Bourguignon d'Anville. In 1718, Delisle was appointed *premier géographe du roi* (with pension), and he provided maps, sometimes on short notice, to the sovereign and his royal council for work both on internal administration as well as foreign affairs. Relations were close between the Delisle family and the royal administration. For example, during the regency of Philippe II, duc d'Orléans, while negotiating with London to widen European alliances, the foreign affairs minister Guillaume Dubois relied on the researches of Delisle for the particular distribution of Italian territories (Dawson 2000, 84–88). The appointments of *géographes ordinaires du roi* and the *premier géographe du roi* were another means of Crown support

FIG. 17. *CARTE DE FRANCE,* [17??], [GUILLAUME DELISLE?]. Initially prepared in 1721, the map was reused by Delisle, perhaps as part of the geographical education of the young Louis XV. This is indicated by the paper overlying the cartouche, which describes a color scheme representing the various limits of the French kingdom under successive international treaties, from the Treaty of Munster (1648) (clear blue) to the Treaty of Utrecht in 1713 (red).
Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge D 14815).

and influence on cartographic production. In 1730 in his capacity as royal patron, Louis XV approved Philippe Buache for the position of *adjoint géographe* of the Académie royale des sciences, in recognition of his numerous works on the cartography of the kingdom. Later, Louis XV charged Buache with the geographical education of the royal princes, sons of the Dauphin Louis Ferdinand, continuing a long tradition in royal education.

A lover and collector of maps, Louis XV surrounded himself with numerous geographers from whom he commissioned maps for both personal and official purposes, such as the plan of the forest of Compiègne, painted in 1738–39 by Pierre-Denis Martin and still on display in the Château, one of the king's favorite hunting lodges. On the official level, the king's deep interest in the topography of France led to the employment in 1733 of César-François Cassini (III) de Thury and Giovanni Domenico Maraldi to embark on the cartographic inventory of the kingdom. The instructions emphasized administrative ambitions: "Without this knowledge, it would be difficult to take steps necessary for so many of the useful projects for the state and commerce, such as the construction of new roads, bridges, and roadways, new canals and river navigations, which could all facilitate the transport of goods and merchandise from one province to another and create abundance in the kingdom" (Cassini II 1735, 389). The *garde des Sceaux* Jean-Baptiste Machault d'Arnouville and the *intendant* of finances Daniel-Charles Trudaine oversaw the work, convinced of the benefits of accurate maps for the kingdom's administration, for local administrative projects, and for land management by ecclesiastical authorities and local landowners. As proof of these interlocking needs, the engineers of the corps des Ponts et Chaussées were enlisted to carry out operations on the ground, but their work did not materialize. Nonetheless, in 1733 Trudaine oversaw a cartographic operation to reform the land tax, the primary direct tax, with an extensive cadastral map. Using these cadastral plans, fiscal declarations made by taxpayers could be verified, approved, even revised in the event of dispute, but ultimately the measure was not implemented.

Two large-scale mapping initiatives marked the remainder of Louis XV's reign. The first occurred in the late 1730s when the controller-general of finances Philibert Orry undertook a reform of road policy that was formerly based on an extensive cartographic inventory of royal roads. Over the course of three decades, this survey, better known as the "Atlas de Trudaine," resulted in three thousand maps and plans that mobilized all levels of the administrative system and contributed to the founding of the École des Ponts et Chaussées in 1747. From then on, engineers trained at this institution addressed the needs of different departments: road maps, canal projects, bridge constructions, urban development, and specialized operations (fig. 18). Several years later, the king ordered the *Carte de France* from Cassini III. Based on the completion of the map of the triangulation of the kingdom (fig. 19), the *Carte de France* facilitated extensive knowledge of the kingdom from the administrative point of view, especially because the Cassini maps could be developed in various

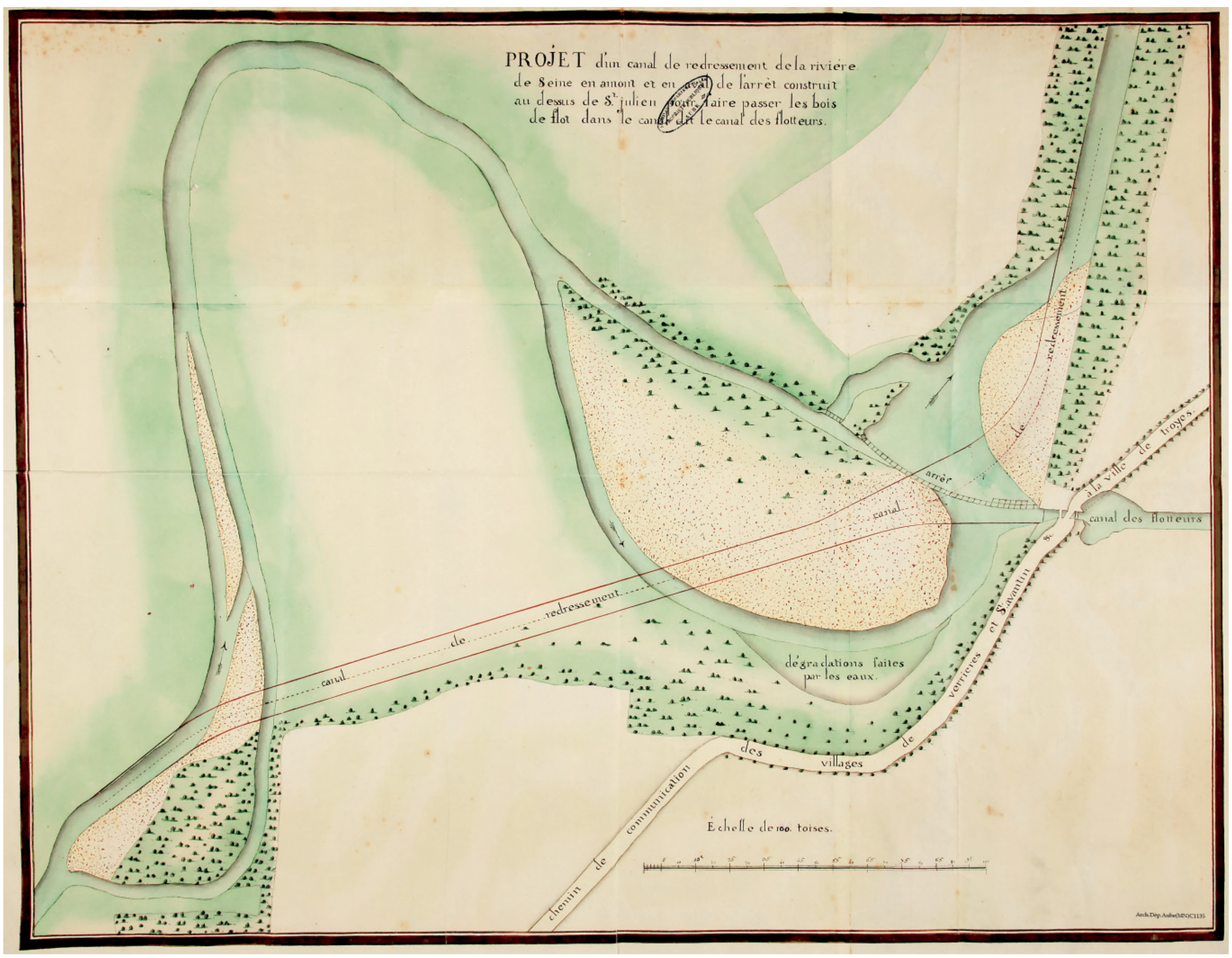

FIG. 18. "PROJET D'UN CANAL DE REDRESSEMENT DE LA RIVIÈRE DE SEINE," EIGHTEENTH CENTURY. This manuscript map by engineers of the corps de Ponts et Chaussées of the *generalité* of Châlons functioned as a tool to help straighten the course of the River Seine in order to facilitate river traffic and to improve the junction with the log-driving canal, depicted on the right.

Size of the original: ca. 50.0 × 65.5 cm. Image courtesy of the Archives départementales de l'Aube, Troyes (C 1135).

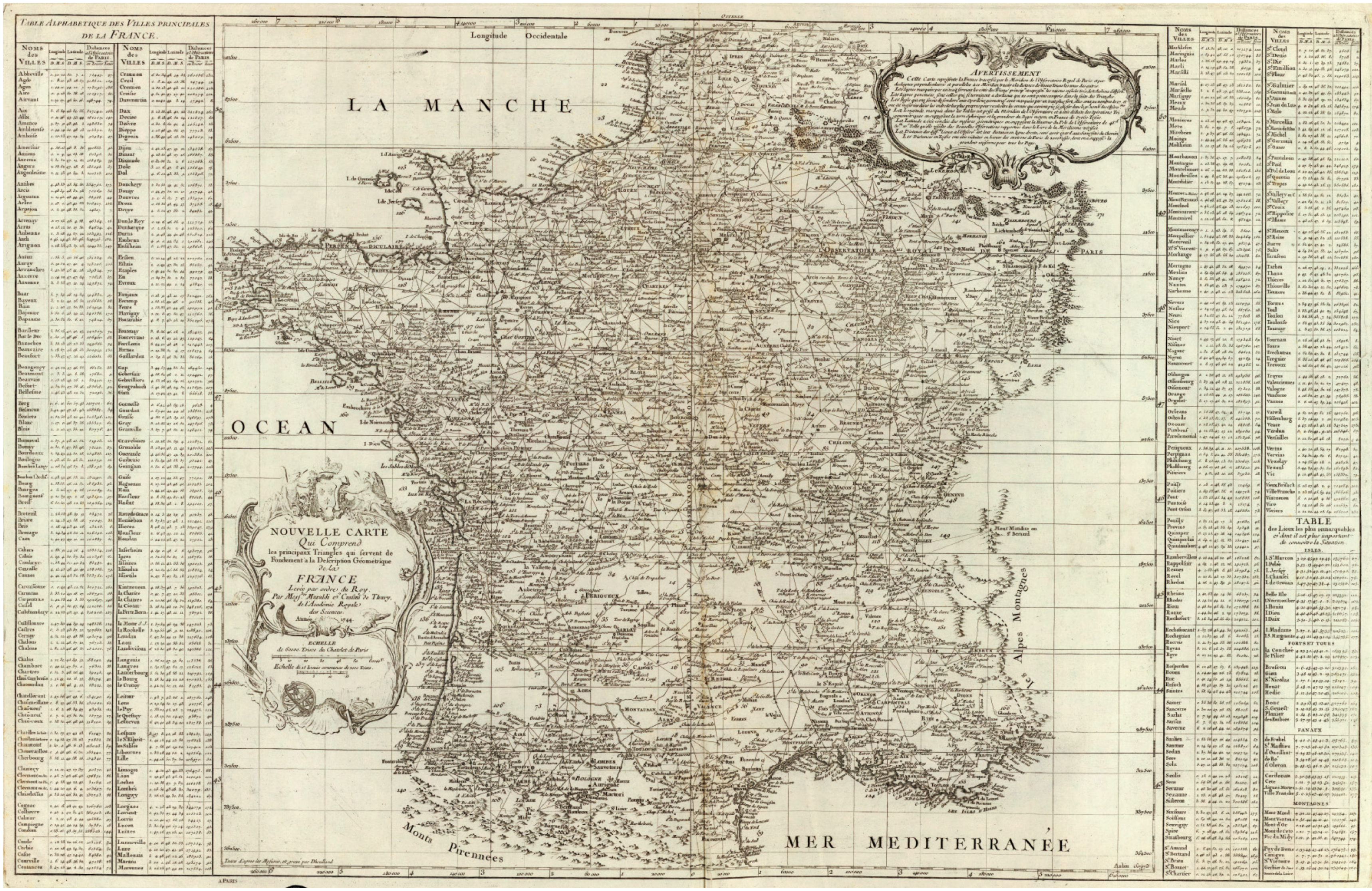

FIG. 19. *NOUVELLE CARTE QUI COMPREND LES PRINCIPAUX TRIANGLES QUI SERVENT DE FONDEMENT À LA DESCRIPTION GÉOMÉTRIQUE DE LA FRANCE* [AFTER 1755]. This map represents the boundaries of the French Kingdom and the chains of triangles created by members of the Académie des sciences, providing a geodetic framework for the accurate position of locations and the development of new maps, especially for provincial administrations. Lists on the left and right sides of the map give the results of the triangulation: for each town, its latitude, longitude, and distance from Paris. The map was drafted in 1744 and probably first appeared in print in 1745. This is a later state that shows the entire secondary triangulation, completed in 1755, and the sheet lines and coordinates of the proposed general map. The first sheet (Paris) of the *Carte générale et particulière de la France* appeared in 1756 (see fig. 140).

Size of the original: ca. 58 × 91 cm. Image courtesy of the David Rumsey Map Collection, David Rumsey Map Center, Stanford Libraries.

provincial versions. From 1756 on, the Cassinis' cartographic operations continued without the state's financial support, but administrators continued to refer to them regularly.

Louis XVI and his administrators also relied on maps to govern and to manage projects. One of the largest of his reign was the cadastre of Paris, realized under the authority of *intendant* Louis Bénigne François de Bertier de Sauvigny from 1776 to 1791. This careful survey allowed for an efficient and equitable collection of taxes from each part of the capital, an initiative that even the French Revolution did not halt (Touzery 1995). The upheavals of the Revolution did not challenge the cartographic momentum or the elaboration of various projects by administrators. Marie-Vic Ozouf-Marignier has shown especially that the creation of the limits of new departments was based on abundant previous cartographic production (Ozouf-Marignier 1992). In the course of the century, the map had become an indispensable tool for administrators, regardless of political structure.

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SEE ALSO: Colbert, Jean-Baptiste; France

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Administrative Cartography in New France. It should not be surprising that in New France cartography was closely linked to the state and to power. The king appointed and paid the majority of cartographers (whether geographers, hydrographers, or military engineers) on the basis of recommendations from colonial authorities. The governor or the *intendant* of New France approved and often financed the most ambitious cartographic projects. Moreover, the majority of maps were destined for the king or the *ministre de la Marine*. While a number of these showed the progression of geographic discoveries on the continent, some were more specifically aimed at the goals of colonial administration. The role of cartographers was crucial in preparing for colonization. Their work consisted less in ensuring respect for established boundaries, as in Europe, than in structuring the territory by marking roads and establishing the limits of concessions, *rangs*, *seigneuries*, and districts, as well as other administrative borders.

Jean Bourdon, who arrived in Quebec in 1634, initiated the first surveying efforts in Canada and prepared its first cadastral map. More than sixty surveyors continued his work under the French regime, demarcating territories that the king conceded to *seigneurs* (*seigneuries*) and those the *seigneurs* granted to "inhabitants" (*censives*) (Boudreau 1994, 54–56). Even though *seigneurs* needed to have measurements and surveys of the lands that they granted, cadastral maps remained unelaborate and rather rare.

In 1678, on orders from the *intendant* Jacques Duchesneau, Jean Baptiste Louis (then known as Jean Louis) Franquelin prepared a small-scale map locating the lands of *seigneurs* in Canada (Franquelin 1678). Destined for the minister Jean-Baptiste Colbert, this map was designed to facilitate reading the *papier terrier*, an official land register that compiled detailed descriptions of *seigneuries*, *censives*, and dues owed to *seigneurs*. Other more precise large-scale maps indicated the limits of *seigneuries* and facilitated their administration. In 1702, for example, the priests of Saint-Sulpice, at that time *seigneurs* of the island of Montreal, prepared a *plan terrier* of their *seigneurie*, with a map still held in their Parisian archives (Vaugeois 2007, 130–31). Of undeniable fiscal utility, the document includes in the margin the names of all the *censitaires* and the dimensions of the *censives*, thus facilitating both the reading of the *terrier* and the collection of *cens* and rents. Similarly, Jean-Baptiste de Couagne and Gédéon de Catalogne depicted a large part of the colony based on its smallest territorial unit: the concession to the *inhabitant* (fig. 20). These maps, on which the names of heads of families appear, required much time and money to

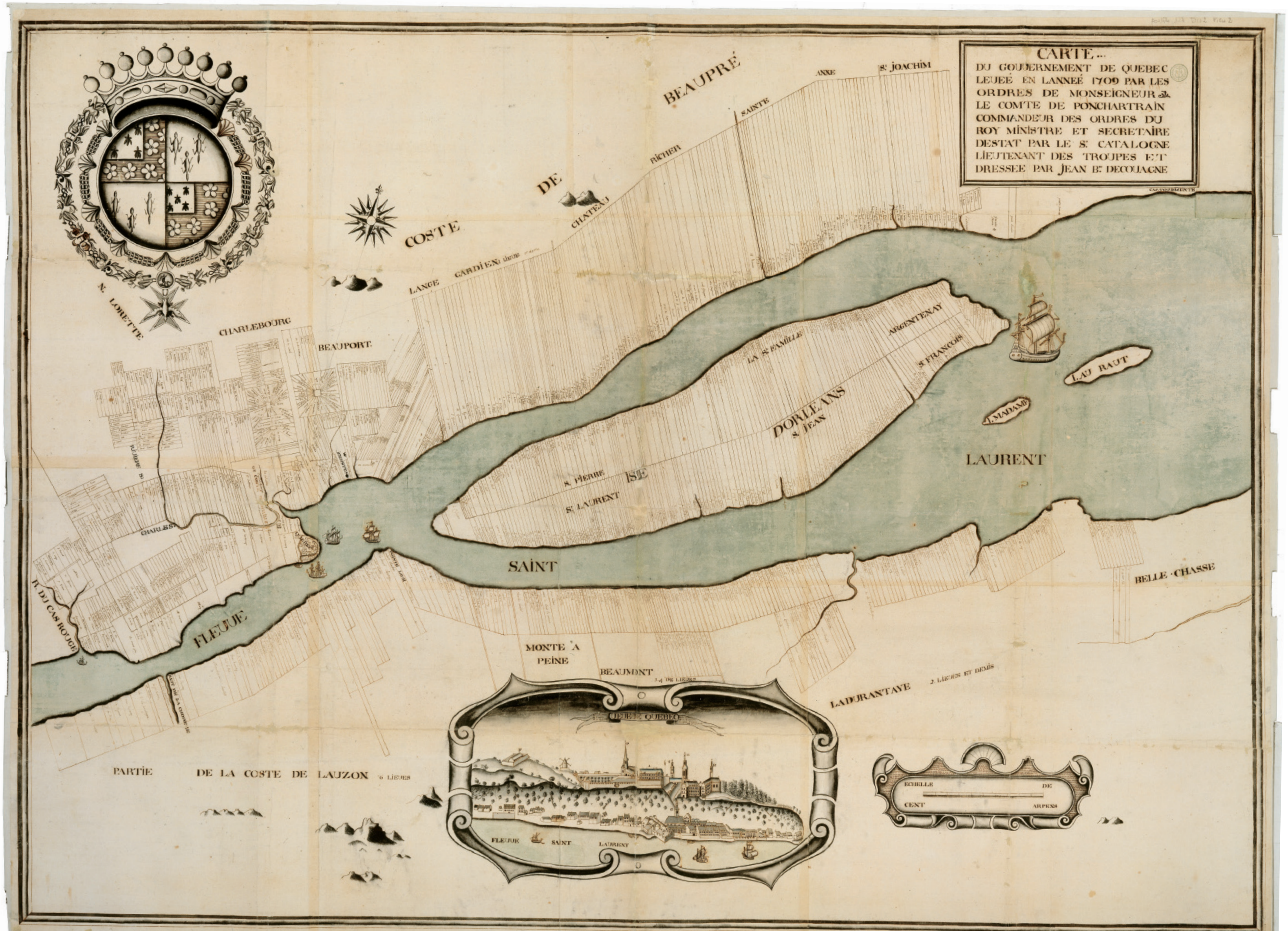

FIG. 20. GÉDÉON DE CATALOGNE AND JEAN-BAPTISTE DE COUAGNE, "CARTE DU GOUUERNEMENT DE QUEBEC," 1709. Pen and ink on paper. This map, like four others, was produced in 1709 by Jean-Baptiste de Couagne from surveys made by the military officer Gédéon de Catalogne, and it shows how the territory was cut up into *seigneuries* and smaller concessions of *habitants*.
Size of the original: 125 × 171 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge SH 18 pf 127 div 2 P 2).

produce; nevertheless, the royal administration encouraged their production for their great utility: by locating the population, the maps helped to control it and to plan the colony's development.

Quite often cartography also helped settle litigation involving *seigneurs* or *censitaires*. Among inventoried cases is that of the merchant Pierre Constantin, who claimed to have been swindled in the concession of a part of his territory in Labrador to two seal fishermen (Constantin 1738). In his request for justice from the minister Jean-Frédéric Phélypeaux, comte de Maurepas, he presented maps made by the naval officers Richard Testu de la Richardière and Gabriel Pellegrin as supporting evidence. In spite of the opposition of the *intendant*, Constantin won his case before the minister, demonstrating well how maps might be diverted from their primary function (in this case navigation) and used for civil and judicial administration.

Besides the *seigneuries*, the domain of the king, situated to the north of the Saint Lawrence River, was also the object of sharp territorial disputes. Economically important, the territory was administered by a tax farmer who enjoyed a trade monopoly in exchange for annual rent. Unsurprisingly, the administrators of this territory wanted to establish its precise boundaries. In 1732 Joseph-Laurent Normandin was sent to explore the domain in order to prepare an exact map of it, with a double objective: to facilitate the settlement of lawsuits and to restrict illegal trade in furs (Bouchard 2002).

In Louisiana the primary role of cartography was to plan the development of the colony, especially through the creation of cities (Mobile, Biloxi, and New Orleans). Bearing witness to this are the numerous plans of engineers and draftsmen recruited by the Compagnie des Indes, including those of Louis Pierre Le Blond de la Tour, Adrien de Pauger, Ignace-François Broutin, Valentin Devin, and Bernard Devergès.

These examples amply demonstrate that maps used for administrative purposes were certainly present in New France, even if not very numerous in relation to the needs of the colony. They permitted improvement in the management of territory and its inhabitants, and they facilitated, in particular, better planning for the colonization of land.

JEAN-FRANÇOIS PALOMINO

SEE ALSO: Franquelin, Jean Baptiste Louis; New France

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Administrative Cartography in the French West Indies. Beginning in 1624 the French began settling in the West Indies, specifically Saint-Christophe (Saint Kitts), Guadeloupe, Martinique, Grenade (Grenada), Saint-Barthélemy, Saint-Martin, Sainte Croix, Île de la Tortue (Tortuga), and Saint-Domingue (the western part of Hispaniola). Their goals were to counterbalance Spanish power militarily and politically and to rival the English and Dutch economically. Small-scale geographic maps and marine charts encouraged this colonization, as exemplified by the *L'Isle de Cayenne* by Étienne Vouillemont (1667), which praises the attractions and resources of Cayenne and other islands through illustrations such as the view of sugar mills inset around the map. Maps at a larger scale were required to show the division between the respective possessions, as on Saint-Christophe between English and French—for example, *Carte de lisle de Sainct Christophle* by Abraham Peyrounin (ca. 1650) showing the positions of the French at both extremities and of the British in the center or *La representation de l'isle St. Christophle, capitale des Antilles*, included in the Vouillemont map—or on Saint-Domingue between French and Spanish. Finally, maps also served to witness or even proclaim the power, wealth, and prestige bestowed on the mother country by the possession of these islands. Nonetheless, these were not maps designed for administrative purposes but were created by Paris-based geographers using a variety of sources and aimed at a consumer market. Among their resources was the work of fortification and topographical engineers who contributed to the on-site mapping of these islands in the first half of the eighteenth century (fig. 21).

After the Seven Years' War, the West Indian colonies left to France by the terms of the Treaty of Paris (10 February 1763) were the object of an important cartographic mission designed to serve the political, administrative, and military reorganization of the islands. The economic value of the colonies made it imperative for France to develop these West Indian possessions and to better ensure their fidelity to France. Loyalty to the metropole had been dulled due to hostility toward the exclusive trade regime, which rigorously restricted colonial trade to the exclusive benefit of France. Moreover,

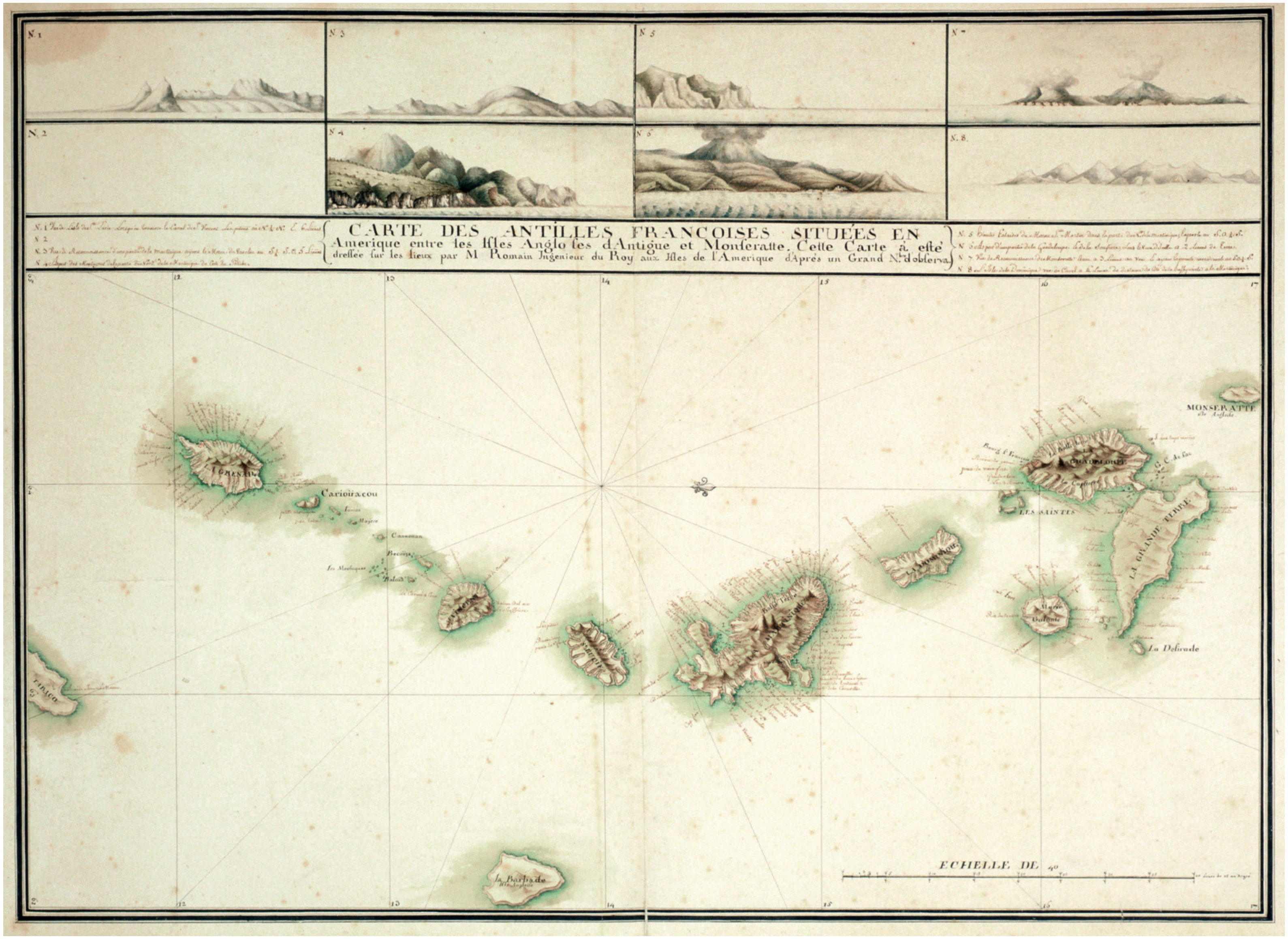

FIG. 21. JEAN-BAPTISTE-PIERRE LE ROMAIN, "CARTE DES ANTILLES FRANCOISES SITUÉES EN AMERIQUE ENTRE LES ISLES ANGLO[I]SES DANTIGUE ET MONSERATTE," FIRST QUARTER OF THE EIGHTEENTH CENTURY. Drawn with a quill pen, wash, and water color painting. This manuscript was prepared by Romain, a fortification engineer in the French West Indies who worked particularly in Grenade and Martinique. His map represents a compilation mapping from on-site observations that could provide colonial administration with an overview of the French colonies in the Caribbean.

Size of the original: 57 × 77 cm. Image courtesy of the Musée d'Aquitaine: Direction des Établissements culturels de Bordeaux, copyright © Mairie de Bordeaux, photo JM Arnaud (Bordeaux, Musée d'Aquitaine, Collection Marcel Châtillon, Inv. n°2003.4.67).

the islands were militarily strategic as they provided a launch base for attacking British holdings in the region.

Thus the urgent need to reorganize the administration and the defense of the islands (Guadeloupe, Martinique, and Saint-Domingue) pressed for the creation of a topographic and geometric map for each colony. Previous small-scale geographic maps or maritime charts by Paris geographers Philippe Buache, Guillaume Delisle, Jean-Baptiste Bourguignon d'Anville, and Jacques-Nicolas Bellin did not precisely describe the terrain. However, more detailed maps by colonial engineers, such as Amédée-François Frézier, or by local surveyors were not based on the more refined tools of triangulation and observations and measurements on the ground, such as were used in midcentury French topographical maps (among them the map of the Alps drawn by General Pierre-Joseph de Bourcet in 1748–60), the Cassini *Carte de France*, or the works produced by students of the new civilian and military engineering schools such as the École du Génie de Mézières and the École des Ponts et Chaussées. In the West Indies, the legislation of 24 March 1763 reorganized the defense and the administration of the colonies and instructed the governor of each colony to have drawn "an exact map of all the parts of the colony . . . with a detailed *mémoire* on the nature of the coasts and of the interior of the country" (quoted in Glénisson 2004, 17).

While surveys were successfully concluded in Martinique and partially completed in Guadeloupe, the map of Saint-Domingue remained unfinished, even when the large-scale map of the Franco-Spanish border was prepared in 1776. Closely linked to strategic objectives, these maps remained state secrets under the control of the *directeur des fortifications*, with copies to be kept under lock and key (Bousquet-Bressolier and Pelletier 1998, 53, 54). In the end, because of haphazard French politics in the West Indies, the maps were little used or totally forgotten.

On several occasions from 1770 to 1792 successive ministers, preoccupied by the confusion that seemed to reign in the Dépôt de la Guerre and the Dépôt des Colonies, asked colonial governors for copies of the maps drawn by the *ingénieurs géographes* in the West Indies. Although the engineers encountered many difficulties in their mapping work, these repeated requests showed the French desire to assemble precise cartographic documentation to be used in the administration and the defense of the colonies (Glénisson 2004, 22–23).

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SEE ALSO: French West Indies

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Administrative Cartography in Great Britain. The mid to late eighteenth century was an era of transformation. The unprecedented economic growth and technological advancements brought by the Industrial Revolution shifted the largely agrarian economic base to manufacturing and trade. In 1700, approximately 60–70 percent of the English workforce was employed in primary industries (mostly farming); however, by 1801 this had fallen to only around 36 percent. This shift was closely related to the trend toward urbanization, as between 1700 and 1801 the percentage of England's population that lived in towns with over 2,500 inhabitants increased from 18.7 percent to 30.6 percent (Brown 1991, 67, 401). Private landowners and investors drove the intense development of new infrastructure and the reform of the countryside that together characterized Britain's so-called age of improvement (Darby 1973). Change brought with it a heightened demand for specialized maps that could be used by decision makers to guide infrastructure development, land management, and urban planning. By contrast, Britain's civic administration became involved only when property rights were affected.

In Britain, Parliament was disinclined to assume responsibility for large infrastructure expenditures, including surveying programs. Instead, legislative acts devolved administrative and financial responsibility for specific programs to corporations that were often privately and locally run. Only as needs evolved did Crown officials gain a more sophisticated appreciation of cartography and a willingness to invest in it.

An example of the Crown's devolution of responsibility occurred in 1631 when the Company of Adventurers led by Francis Russell, fourth earl of Bedford, was charged with the "great designe" of draining the southern fens of East Anglia (Darby 2011, 82). In 1639, their chief engineer, Cornelis Vermuyden, presented Charles I with a special sketch plan of the area. In the 1650s, Jonas Moore surveyed the southern fens at a scale of half a mile to an inch; the map was eventually published as the monumental *A Mapp of ye Great Levell of ye Fenns* (ca. 1658) (Willmoth 1993, 88–120). It became the base map by which the Fen Office as-

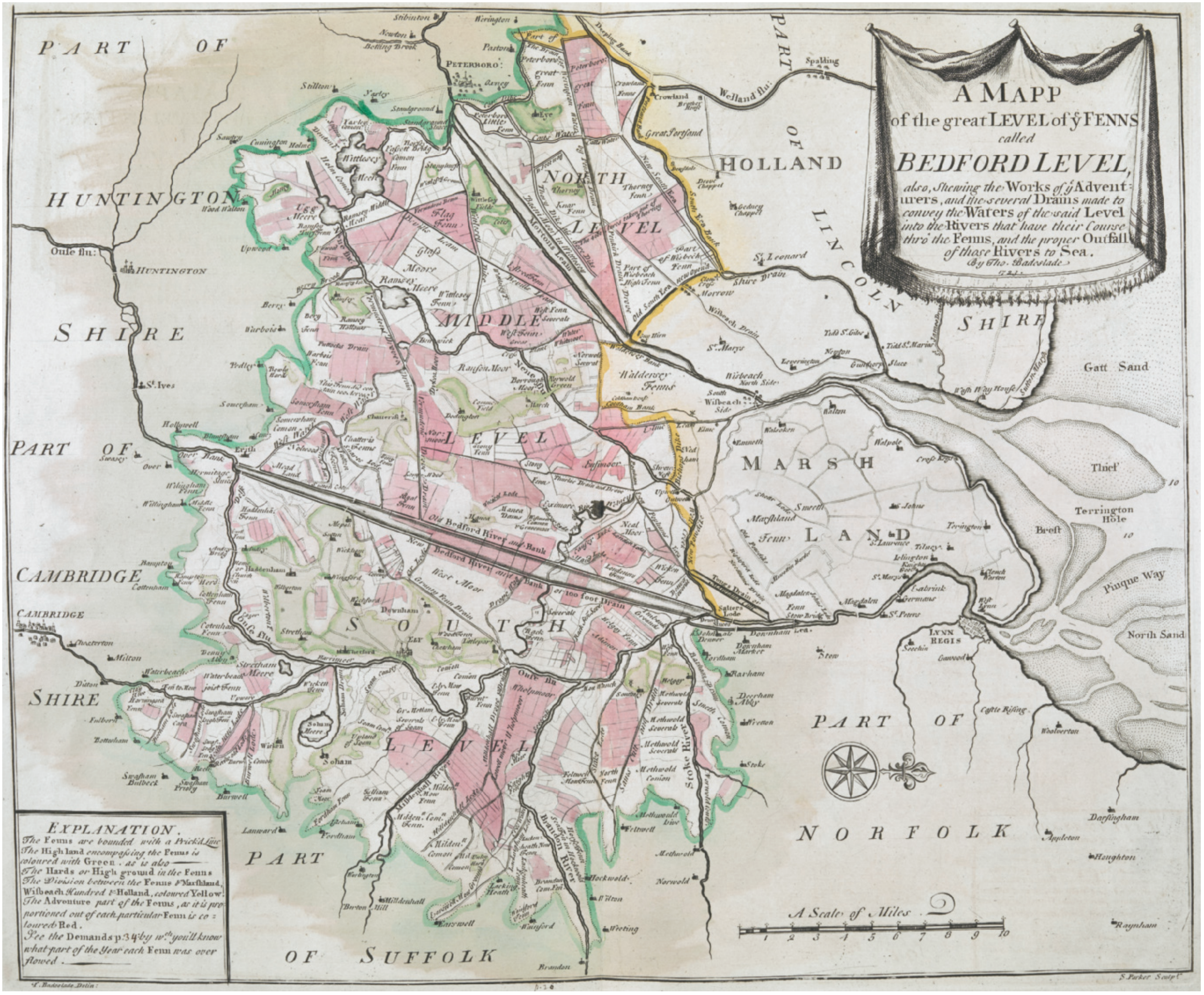

FIG. 22. *A MAPP OF THE GREAT LEVEL OF YE FENNS CALLED BEDFORD LEVEL,* BY THOMAS BADESLADE, 1723. Copper engraving printed in Badeslade's *The History of the Port of King's-Lyn* (London: Author, 1725). It depicts reclaimed southern regions of the fenlands employing the same orientation as Jonas Moore's map (1658) but is updated substantially; it shows canals and enclosed properties with the names of major proprietors.
Size of the original: 32 × 39 cm. © The British Library Board, London (Cartographic Items 578.l.8).

sessed taxation. Important small-scale maps of the area were published by William Dugdale (1662) and Thomas Badeslade (1725) (fig. 22); another large-scale general map would not be published until Charles Nalson Cole's map of 1789.

The management of forests became a growing governmental concern, as clearing for farmland and the rise of the Royal Navy's demand for ship timber resulted in dramatic deforestation. While in 1608, James I made plans for a so-called Great Survey of the royal forests and Oliver Cromwell followed suit in the 1650s, little was achieved due to lack of financing. Consequently, in 1662, Samuel Pepys was forced to rely on the vague outlines of the Forest of Dean on John Speed's map of Gloucestershire.

The period following the American Revolution, in the 1780s, marked the most acute shortage in the domestic supply of ship timber. A 1783 survey of oaks in the major royal woods had shown that supply was only around a quarter of its 1608 level. In response, the Crown Land Revenues Act of 1786 mandated that a systematic survey of the royal woods be conducted in an effort both to institute scientific methods of sylviculture and to find ways by which the forests could be most effectively exploited. This resulted in seventeen land revenue reports (1787–93) focusing on specific forests (Albion 1926,

FIG. 23. "THIS GEOMETRIEAL [*SIC*] SURVEY OF ALICE HOLT FOREST IN THE COUNTY OF HANTS," BY JAMES WYBURD, 1787. Colored manuscript on parchment. This map depicts the perambulated limits of the woods with notes on tree species (e.g., types of oak). The parcels of land created by parliamentary enclosure are visible on the periphery.
Size of the original: 80 × 76 cm. Image courtesy of The National Archives of the U.K. (TNA), Kew (F 17/334).

135–36, 439). They were accompanied by finely drafted maps based on careful perambulations, exemplified by the map of Alice Holt Forest (1787) (fig. 23).

In contrast to many of their European counterparts, British authorities did not commission any maps relating to the assessment of taxation, though a land tax was introduced in 1692. This lack of maps was intentional, as the landed class, who dominated Parliament, did not wish to enable any mechanism that might increase taxes.

Christopher Saxton had received official patronage to publish his small-scale county maps (1574–83); the immense cost of surveying and the later lack of government sponsorship ensured that virtually no new general surveys were made after his, during the seventeenth century. A breakthrough was the publication of Joel Gascoyne's *Map of the County of Cornwall Newly Surveyed* (1699) at the trend-setting large scale of one inch to one mile (1:63,360). Gascoyne received detailed information from the county's lord-lieutenant, who clearly recognized the map's potential as a device of governance. Few other large-scale maps were published until 1759 when the Society of Arts decided to award premiums for the finest county surveys. Over the next fifty years, thirteen maps were so honored, including Benjamin Donn's *Devon* (1765), Peter Perez Burdett's *Derbyshire* (1767), and William Yates's *Lancashire* (1786). By 1800 only Cambridgeshire and Rutland had not been surveyed (Harley 1965).

Land redistribution, which created what we consider today to be the typical English field, was one area where the use of maps became important. The causes and effects of the enclosure process were highly complicated and remain a topic of great academic controversy; however, it is clear that contemporary agricultural scientists maintained that enclosure would promote efficiency and produce higher crop yields. A more important motivation stemmed from the realization that enclosed estates often yielded landlords anywhere between 15 and 20 percent more net profit through higher rent than comparable common fields (Brown 1991, 65). This process took two paths: informal enclosure predicated on local, private agreements as in earlier centuries, and, from 1750, formal or parliamentary enclosure, which was authorized by private acts of Parliament. Given the landed class's domination of Westminster, it was of little surprise that the latter recourse met with easy passage, even though thousands of long-term tenants would be dispossessed by the higher rents. Parliamentary enclosure continued well into the nineteenth century, and by the end of the process approximately eight million acres in England and Wales had been enclosed. The first phase of parliamentary enclosure occurred between 1755 and 1780 and, focusing on the East Midlands, accounted for 38 percent of all parliamentary enclosures, while the second wave, occurring during the Napoleonic Wars, accounted for 43 percent (Kain and Baigent 1992, 237). Each parliamentary enclosure was documented by a written register and from 1775 tended to be accompanied by a cadastral map specially drafted by an estate surveyor. Indicative of the normative role these maps played in legalizing enclosure (unlike many estate maps), they tended to be quite plain and utilitarian in design, depicting the parcels of each new landholder, and did not always describe land use (Kain, Chapman, and Oliver 2004).

The passage of the Post Office Act in 1660, which created scheduled runs on designated mail routes, made improving the road system imperative. In 1663 a novel experiment was devised on the Great North Road, making part of its length a toll road, or turnpike. After 1695, numerous roads were converted into turnpikes and trusts were authorized to build new ones. As internal trade expanded from 1750 to 1770, the turnpike system grew exponentially (Guldi 2012).

This system of local and private management sanctioned by Parliament ensured dramatic improvements in road quality, and journey times from London to many towns nearly halved from the 1750s to the 1770s. The pace of turnpike development slackened following the credit crisis of 1772 and the American Revolution, but a new boom ensued in the 1790s, continuing into the next century. Turnpike trusts commissioned a vast quantity of carefully drafted maps, both to be used to manage existing roads and to act as official submissions to Parliament for proposed projects. Perhaps the finest example of this genre is Joseph Salway's lithographed plan of turnpikes in west London (1811).

The Industrial Revolution necessitated the transport of vast quantities of raw materials, most notably coal from the mines to the burgeoning industrial cities. While the turnpikes were more commodious for fast light passenger travel, horse-drawn barges operating on canals were far more economical for industrial transport. A steady pace of improvement after 1660 almost doubled the length of navigable rivers by the 1720s, so that most places in England lay within twenty-four kilometers of a waterway (Darby 1973, 75; Brown 1991, 130, 147). By the 1750s, private corporations petitioned Parliament for mandates to build and administer canals, and the proposals for these petitions were invariably accompanied by maps, generating a vast corpus of carefully finished engineer's plans and system maps, some of which were later printed for public consumption.

Most of the canal building activity occurred in the industrial belts that traversed the North, the Midlands, and Scotland's Central Valley. Following on the activity in the first half of the eighteenth century, there were two intense periods of canal building. The first lasted from 1759 until the mid-1770s and set the foundation for James Brindley's "Grand Cross," which linked England's four main rivers by 1790. The even more frenetic canal mania of 1791–96 initiated projects that saw England's canal system expand to over 6,400 kilometers (Brown 1991, 150–52), as illustrated by Thomas Conder's map, *Lines of All the Navigable Canals* (1795).

Officials employed maps of urban areas for two main purposes: first, to serve as plans for future development and second, to act as a device to assist in the administration of the city as it already existed (Delano-Smith and Kain 1999, 200–213). One of the greatest tragedies to ever befall London also presented the greatest opportunity for its redevelopment. The Great Fire of London, 2–5 September 1666, leveled 60 percent of the city; the destruction was officially surveyed and depicted on a map printed by Wenceslaus Hollar. Charles II specified that any plans to rebuild the city had to be presented

FIG. 24. *A PLAN OF THE CITY OF BATH, IN THE COUNTY OF SOMERSET,* BY JOHN WOOD THE ELDER, 1735 [1736]. Copper engraving. Wood's plan was further advanced pursuant to the publication of his *An Essay towards a Description of Bath* (1742–43).
Size of the original: 33.5 × 43.0 cm. © Bath in Time Bath Preservation Trust Collection.

cartographically, the most famous map being Christopher Wren's *Londinum Redivivum* (1666). Wren advocated replacing the ancient labyrinth of medieval streets with broad avenues radiating from piazzas, creating an ideal baroque city. This map and several other competitors were considered by the Privy Council; however, it was inevitably decided that London would be largely rebuilt on its old pattern, and with its established property boundaries as affirmed by John Oliver's *Certificate Survey* (1667).

The revived London enjoyed tremendous growth, and from 1700 to 1801 its population increased from 575,000 to 900,000 inhabitants, easily making it the largest city in Europe (Brown 1991, 419–20). Numerous maps depicted the city's westward expansion, forming the new neighborhoods of Soho, St. James's, and Mayfair, which were rationally planned with straight streets and green squares. Later on, officials commissioned maps that presented options for alleviating London's severe congestion problems, the most notable projects being the construction of Westminster and Blackfriars bridges in 1750 and 1769 and the dramatic expansion of the West End.

Elaborate urban planning was not confined to London. John Wood the Elder's plan of Bath (1736) presents the ideal Georgian city, with straight wide streets surrounding the new Queen's Square, in sharp contrast to the adjacent medieval city (fig. 24). While often more utilitarian than idealistic, many plans were drafted anticipating the growth of industrial centers such as Birmingham, Manchester, and Liverpool, whose populations all increased more than tenfold from 1700 to 1801.

The appearance of privately produced large-scale plans showing the elevations of city buildings greatly abetted civil administration. The first of these to be published was John Ogilby and William Morgan's plan of London (1676), based on William Leybourn's surveys, at a scale of one hundred feet to an inch (1:1,200), groundbreaking in its depiction of every plot in city and the finest impression of the newly rebuilt capital. The most important map of Georgian London was John Rocque's *Plan of the Cities of London and Westminster and Borough of Southwark* (1747), in which a new theodolite was employed to ensure accuracy at a scale of two hundred feet to an inch (1:2,400). This map had numerous official uses, such as setting taxation rates and hackney fares, demarcating parish boundaries, and policing, a purpose for which it was employed during the Gordon Riots of 1780. Rocque's work was superceded by Richard Horwood's map (*Plan of the Cities of London and Westminster, the Borough of Southwark*, 1792–99, often simply called "Horwood's map" or "Horwood's plan"), which at an even larger scale demarcated every individual property.

The rather limited role of British government officials in mapping for civil administration and infrastructure extended well into the nineteenth century. Although the Board of Ordnance in 1791 began what would become a concerted effort to map England and Wales at one inch to the mile (1:63,360), it was initially primarily for military purposes. Only in the 1820s did the Board begin larger-scale surveys at 1:10,560 to assist in the administration of taxes in Ireland and in the 1850s very large-scale (1:1,056) city plans.

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SEE ALSO: Great Britain; Urban Mapping: Great Britain

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Administrative Cartography in British America. The patronage and use of cartography by administrators both in Britain and its American colonies underwent a process of evolution. In the latter half of the seventeenth century, officials in London actively used maps in their deliberations, but did not normally directly commission them. Rather, they relied on the small-scale general maps, as well as town plans done at behest of colonial proprietors. It was not until the mid-eighteenth century that authorities at the colonial level began to commission general surveys, and only after the Seven Years' War (1756–63) did the Board of Trade directly sponsor and oversee such endeavors (Edney 2008; Johnson 2017).

The basic elements of administrative mapping in the seventeenth century were cadastral maps, called land plats in contemporary American vernacular, that generally reflected one of the two basic systems of land settlement in the thirteen colonies. The "New England method," which prevailed in the northern colonies, saw that land grants were given to town corporations, with the surveying of plats done before the settlement was to occur. The "Virginia method," which prevailed in the southern colonies, saw individual settlers claim land, which would then subsequently be surveyed. Irrespective of the system, cadastral plans were usually required to be registered with authorities (Kain and Baigent 1992, 265–76, 285–89). To give officials a broader view of their jurisdiction, land plats were often reduced in scale and aggregated to form composite general maps of broader areas, an excellent example being John Reid's *A Mapp of Rariton River* (1686), commissioned for the proprietors of East Jersey (Kain and Baigent 1992, 304–5).

The Great Fire of London in 1666 convinced many administrators that towns needed to be based on geometrical plans. Devised at the behest of Pennsylvania proprietor William Penn, Thomas Holme's design of the colony's new capital, *Portraiture of the City of Philadelphia* (1683) (see fig. 905), depicts a grid of wide, straight thoroughfares and several open squares. It was thought that this rational plan would make the city easier to traverse, facilitate tax assessment, and help prevent the spread of fire and infectious disease. A similar ethic is visible on Christian Lilly's 1702 plan of the recently founded commercial center in Kingston, Jamaica, done by order of the island's legislature. It is also conspicuous on all maps of Savannah, then capital of Georgia, founded in 1733. The inception of the iconic grid pattern of streets that now covers most of Manhattan is discernable on Bernard Ratzer's *Plan of the City of New York* (1770), where it depicts the city's expansion northeastward into the area around Delancey Square.

How administrators collected available maps provides insights into the administrative imperatives of officials in London, as well as showcasing the promotional and developmental schemes of the various colonial proprietors. William Blathwayt, the secretary of the Lords of Trade, the British agency that administered colonial affairs from 1675 to 1696, for example, collected forty-eight maps into what is known as the "Blathwayt Atlas" (ca. 1683). It included two maps printed by John Seller—*A Mapp of New Jersey, in America* [1677] and *A Map of Some of the South and Eastbounds of Pennsylvania in America* (1681)—that Penn had commissioned to depict both of his colonies in a utopian light for prospective settlers (Black 1975, 88–98, 102–8). Also in Blathwayt's collection were later manuscript variants of Augustine Herrman's published map of Virginia and Maryland (1673), created at the behest of Maryland proprietor Cecil Calvert, second baron Baltimore, and Joel Gascoyne's "Second Lord Proprietors map," *A New Map of the Country of Carolina* (1682) (Black 1975, 109–18, 145–48; Cumming 1998, 164–65, 174–75). Perhaps the most sophisticated of these maps was Richard Forde's of Barbados (ca. 1676), considered the earliest economic map of any English American colony, which employed pictorial symbols to denote the windmills and the various crops found on each plantation (fig. 25) (Black 1975, 180–85). Thomas Holme's *A Mapp of yᵉ Improved Part of Pensilvania* (ca. 1687), also commissioned by Penn as a settlement plan, depicted the orderly system of townships using the Delaware River as a baseline (Pritchard and Taliaferro 2002, 365–67).

In the following decades, neither the Board of Trade nor the colonial legislatures was willing to sponsor surveying programs. Consequently, very few general maps were produced. As a rare exception, the Barbados legislature provided official support for the surveys that resulted in William Mayo's *A New & Exact Map of the Island of Barbadoes in America* (1722), which depicted 986 plantations. While Barbados was geographically small, its highly profitable sugar industry ensured that by the 1680s its overall exports were greater than that of all the other British American colonies combined. The Barbados legislature's pioneering sponsorship of general surveys was likely motivated by the extreme value of the land and the need to accurately demarcate proprietary rights and to facilitate agrarian management (Pritchard and Taliaferro 2002, 126–29).

The impetus for state-sponsored surveys developed from the need to commission boundary surveys. The seventeenth-century royal charters that had defined provincial and proprietary patent boundaries were often predicated on an inaccurate comprehension of geography, ensuring ill-defined and overlapping claims to jurisdiction. In the 1720s, the growth of settlement along provincial frontiers and administrative changes, such as the establishment of new colonial governments under royal authority, ensured that the surveying of boundaries became an imperative. The first of these endeavors was the demarcation of the line between North Carolina and Virginia in 1728 (Cumming 1998, 223–24). This was followed by surveys of the New Hampshire–Massachusetts Bay boundaries (1733–41) (Edney 2007) and *A Survey of the Northern Neck of Virginia* (1737), depicting the limits of Lord Fairfax's tract (Pritchard and Taliaferro 2002, 146–51). The success of these surveys and the emergence of a cadre of seasoned professionals encouraged some colonial legislatures to sponsor medium-scale surveys of their provinces. The various commissioned surveys of North Carolina made by Edward Moseley led to a general map of the province published in 1733 (Cumming 1998, 235–37), which is thought to have played a role in the deliberations over the disputed North Carolina–South Carolina boundary line. Mapping colonial boundaries continued to engage authorities until the Revolution. Of greatest symbolic importance was the demarcation by Charles Mason and Jeremiah Dixon (1763–67) of the boundary between Pennsylvania and Maryland (see fig. 112).

In the 1750s, the prominence of several highly skilled professionals and military engineers, as well as heightened defense concerns (Edney 2008) and the increased affluence of the colonies, encouraged direct official patronage at the provincial level. The first of the resulting surveys was Joshua Fry and Peter Jefferson's of Virginia in 1751, later published in London in 1753 (Taliaferro 2013). While serving as surveyor general of both Georgia and South Carolina, from 1754 and 1755 respectively, William Gerard De Brahm surveyed coastal regions, resulting in *A Map of South Carolina and a Part of Georgia* (1757) (Cumming 1998, 280–81). In 1757, North Carolina governor William Tryon charged William Churton to survey that province, an endeavor finally brought to print in 1770 by John Abraham Collet, and presented to Wills Hill, Lord Hillsborough, the colonial secretary (Cumming 1998, 308–9; Pritchard and Taliaferro 2002, 204–7). Nicholas Scull surveyed eastern Pennsylvania at the behest of the Penn family; his map was first published in 1759 (Pritchard and Taliaferro 2002, 188–89).

FIG. 25. RICHARD FORDE, *A NEW MAP OF THE ISLAND OF BARBADOES* (LONDON: PHILLIP LEA [1685]). Copper engraving; this is the second of three states, the first printed ca. 1676. This is the earliest economic map of any English American colony, depicting hundreds of plantations with proprietors' names, and featuring pictorial symbols representing windmills, churches, and a wide variety of crops, but omitting fortifications. As a Quaker, Forde was thought to be a pacifist and was opposed to the hegemony of the Church of England. Size of the original: 48 × 56 cm. © The British Library Board, London (Cartographic Items Maps 185.m.1[17]).

Following Britain's conquest of all of North America east of the Mississippi River at the conclusion of the Seven Years' War, the Board of Trade devised a mapping program that took advantage of the skills of military surveyors trained in techniques of large-scale topographical mapping. A prelude to this effort was the Board's decision to finance Thomas Craskell and James Simpson's survey of Jamaica, published in 1763.

Also in 1763, Samuel Holland proposed that the Board of Trade sponsor a General Survey of North America, which aimed to systematically create an accurate general map of all of British North America, as captured by a series of medium-scale regional maps. The Board expressly mandated that the surveyors accompany their maps with detailed reports identifying the most promising locations for future development, analyzing their potential with regards to trade, navigation, and natural resources. These factors helped the Board to devise proposals for land settlement. Holland led endeavors in the northern colonies, focusing on both the Gulf of St. Lawrence and New England, and coordinating his efforts with J. F. W. Des Barres, who compiled the coastal surveys for the charts of *The Atlantic Neptune*. De Brahm was in charge of the southern regions, beginning with the survey of the peninsula of Florida (Hornsby 2011; Johnson 2017).

FIG. 26. SAMUEL HOLLAND, "A MAP OF THE ISLAND S^{T}. JOHN IN THE GULPH OF S^{T}. LAURENCE IN NORTH AMERICA," 1767, MANUSCRIPT. During his 1765 survey, Holland divided the island—now Prince Edward Island—into sixty-seven townships of approximately twenty thousand acres each; this plan bears a list of the names of the 103 proprietors granted lands by ballot on 23 July 1767.
Size of the original: 62 × 94 cm. (Cartographic Items Maps K.Top.119.96.2 TAB).

A huge number of manuscript maps were dispatched to London by Holland and De Brahm. Many influenced the decisions of the Board of Trade. Holland's map of St. John (renamed Prince Edward Island in 1798) divided the island into sixty-seven townships. The Board of Trade declared it to be the authoritative settlement blueprint, overruling a bid for possession of the entire island by the politically powerful consortium of speculators led by John Perceval, second earl of Egmont. In 1767 the Board of Trade distributed the lots to individual proprietors by ballot (fig. 26). Likewise, De Brahm's detailed map and report of Mosquito Inlet was responsible the foundation of New Smyrna in 1768, which quickly became the second-largest settlement in East Florida (Johnson 2017, 106–9, 159–60).

The General Survey was not completed as intended because De Brahm was recalled to London in 1770, and Holland had to cease operations due to the commencement of hostilities in 1775 between Britain and its colonists. Nonetheless, thousands of miles of coastline and territory had been accurately charted, more than was accomplished by any other mapping program. In the northern colonies, the area mapped extended from the northern reaches of the Gulf of St. Lawrence southward to Rhode Island, and in the southern colonies, the entire Floridian peninsula was charted (Hornsby 2011).

The 1760s saw increased mapping efforts, which focused on specific purposes such as defining Indian boundaries, infrastructure development, and forestry management. In 1763, the British government decreed the Proclamation Line, which divided the thirteen colonies from the interior lands reserved for the Indians. The Board of Trade sponsored a systematic survey of this boundary. Largely conducted in the south between 1768 and 1779, the venture was led by John Stuart, who employed skilled surveyors such as Bernard Romans, David Taitt, and Samuel Savery. Stuart and his draftsman Joseph Purcell eventually created "A Map of the Southern Indian District of North America" (1775), which not only demarcated the boundary, but was an up-to-date accurate general map of the southern colonies (Cumming 1998, 302–3, 323–24; Edelson 2017, 141–73).

Colonial administration and commerce relied on an efficient communication infrastructure, and from 1693 a formal postal system operating on a designated series of routes was progressively devised. Herman Moll's *A Map of New England, New York, New Jersey and Pensilvania* (1730) was the first map to depict and describe the post roads in the critical corridor between Portsmouth, New Hampshire, and Philadelphia. In 1764 the British government requested the governor of Connecticut to commission a survey that specifically delineated the post roads, which resulted in Moses Park's *Plan of the Colony of Connecticut in North-America* (ca. 1766) (see fig. 304), the only general map of the province printed during the colonial era. Several important road maps were drafted in America, including "A Map of the Road from Trenton to Amboy" (1762), for New Jersey, by Gerard Bancker based on John Dalley's 1745 surveys. In the same province, in 1766, Azariah Dunham mapped the road along the Middlesex-Somerset line (both maps held by Princeton University). Massachusetts governor Sir Francis Bernard commissioned Francis Miller to draft "A Plan of the Road between Boston and Penobscot Bay" (1765) as well as a set of plans depicting the road from Boston to Albany, representing the most extensive road surveys of the period (sold by Bonhams, London, June 2011). Hugh Finley, the surveyor general of post roads, drafted a "Plan of a Road from New Hampshire to Canada" (1774), mapping the proposed route between the Connecticut and St. Lawrence valleys. In 1778, Purcell drafted "A Map of the Road from Pensacola in W. Florida to St. Augustine in East Florida," based on Stuart's detailed surveys of this newly completed artery (The National Archives of the U.K. [TNA], Kew, MPG 1/1012–13 and CO 700/Florida 54).

The white pine stands of northern New England were long recognized as the ideal source of mast timber for the Royal Navy and therefore had significant economic value. Legislation, passed from 1691 to 1729, gradually developed the Broad Arrow policy whereby any white pines above a certain size growing on unenclosed land were the exclusive property of the Crown. It is estimated that between 1695 and 1775, approximately 4,500 masts were shipped to the Royal Navy (Johnson 2017, 143). Thomas Scammell's "A Map of a Portion of the Province of Maine showing Pine Forests" (1772) is an example of economic mapping, based on the work of inspectors dispatched in the early 1770s to survey important timber stands (TNA, CO 700/Maine 20). In 1772, Miller surveyed the upper Connecticut valley, drafting two forestry maps, accompanied by an ingenious plan for the construction of a canal to aid the transport of logs down the river (fig. 27). The General Survey's maps of Maine produced by Holland's associates also depicted the locations of related infrastructure such as grist and saw mills (see fig. 839).

Economic mapping was also used to aid the highly lucrative fur trade. In 1770, authorities in London dispatched Elias Durnford to map the river passage between the Mississippi River and Lake Maurepas, West Florida (in modern-day Louisiana), to discern the viability of the proposed Iberville Canal, which would allow the British to bypass Spanish-held New Orleans and to better access the fur trade in the interior.

At the conclusion of the American Revolution (1775–83), Britain lost possession of the thirteen colonies but continued civil mapping programs in Canada and the West Indies. Some of the preexisting administrative maps of the lost colonies were adapted to support Loyalist restitution claims, most exquisitely exemplified by "Eighteen Plans of American Loyalists' estates" (1782), a cadastral atlas in manuscript form of areas of Georgia, based, in part, on De Brahm's surveys (TNA, MPI 1/61). In Canada in the 1780s and 1790s, Holland oversaw an impressive series of mapping programs done to facilitate the resettlement of the Loyalists. This was a prelude to a new era when official British agencies would sponsor mapping programs extending all the way to the Pacific and Arctic frontiers.

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See also: British America; De Brahm, William Gerard; Holland, Samuel (Johannes)

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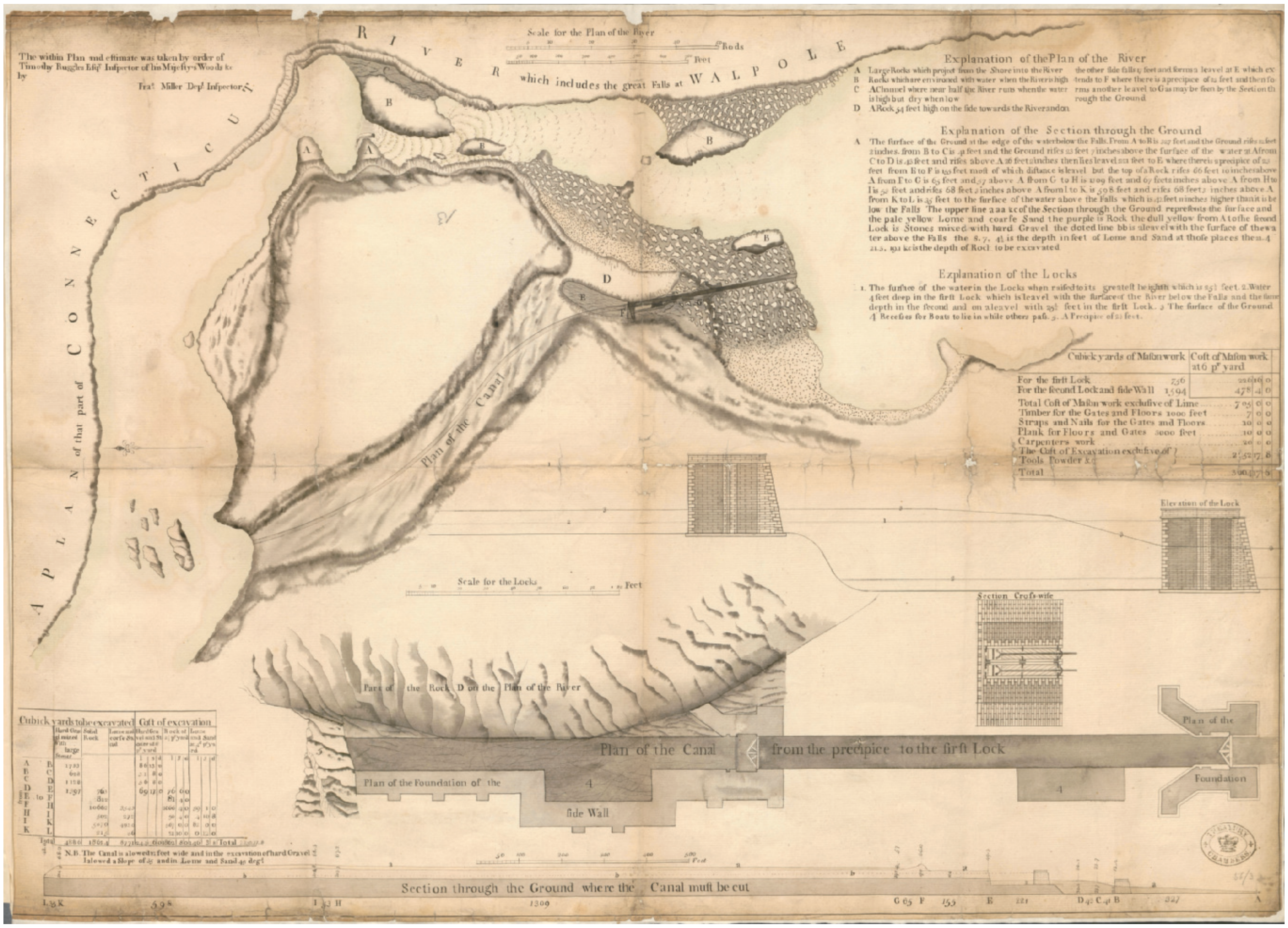

FIG. 27. CAPT. FRANCIS MILLER, DEPUTY INSPECTOR OF HIS MAJESTY'S WOODS, "A PLAN OF THAT PART OF THE CONNECTICUT RIVER WHICH INCLUDES THE GREAT FALLS AT WALPOLE," [1772]. This manuscript plan of a proposed canal bypassing Walpole [Bellows] Falls on the Connecticut River in order to transport timber downriver was commissioned by Timothy Ruggles, inspector of His Majesty's Woods in North America, and was drawn using formal civil engineering conventions, complete with quantitative specifications and an orthographic perspective. The canal was never built because of its high estimated cost (£2,252 17s 8d) and the advent of the American Revolution.
Size of the original: 53.3 × 74.7 cm. Image courtesy of The National Archives of the U.K. (TNA), Kew (MPD 1/56/3).

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Administrative Cartography in the Italian States. Administrative cartography in the Italian states during the Enlightenment relied heavily on the work of military engineers, primarily in Savoy, whose work was inspired by considerations of war and government. To exercise control over an administrative network of provinces, towns, and cities, military surveys functioned as instruments "for the management of resources and infrastructures. Maps of roads, of mines, and of woodlands were thus drawn up along with maps of frontier boundaries, fortifications, and theaters of war. [These works] form one of the two main genres of cartography produced within the Duchy of Savoy (the other being that produced by land surveyors)" (Sereno 2002a, 179). This observation about Savoy could apply to all the Italian states.

Administrative maps delineating civil and religious settlements were particularly important within the Grand Duchy of Tuscany. From 1750, the ruling House of Lorraine implemented various reforms in the territorial network of the state, generating substantial cartographic work by Ferdinando Morozzi (Rombai 2005, 67–70), who produced collections of watercolored manuscripts comprising forty to forty-five maps of the region's vicariates from 1771 to 1773 (Prague, Národní Archiv, Rodinný Archiv Toskánsckých Habsburk [NA, RAT

Map]; Siena, Archivio di Stato [AS], Comune di Colle di Val d'Elsa, Carte topografiche Morozzi; see Guarducci 2008, 21–24) (fig. 28). Combining on-site surveying with compilation at the drawing board, these maps—homogeneous in scale and content—were joined together in 1784 to form the large manuscript "Carta geografica del Granducato di Toscana" (ca. 1:78,550) (Prague, NA, RAT Map, 146 cc. and 155; Rombai 1993, 149–55).

Morozzi's contemporaries included Luigi Giachi and his brothers Antonio and Francesco, three draftsmen and land surveyors to the grand duke who, from the 1750s to the 1790s, produced dozens of manuscript atlases covering the vicariates and dioceses of Tuscany, usually basing their work on Morozzi's depictions of individual provinces. Luigi Giachi alone produced the 1769 atlas, "Il Granducato di Toscana" (Florence, Biblioteca Nazionale Centrale [BNC], Carte mss. A.I.13), the collections of large-format maps of vicariates and dioceses (1793 and 1799) (Prague, NA, RAT Map, 133–143 and 196–211), the large "Pianta del Granducato di Toscana divisa nelle Diocesi" (1795) (Prague, NA, RAT Map, 147), and the "Pianta della Provincia Inferiore dello Stato Senese

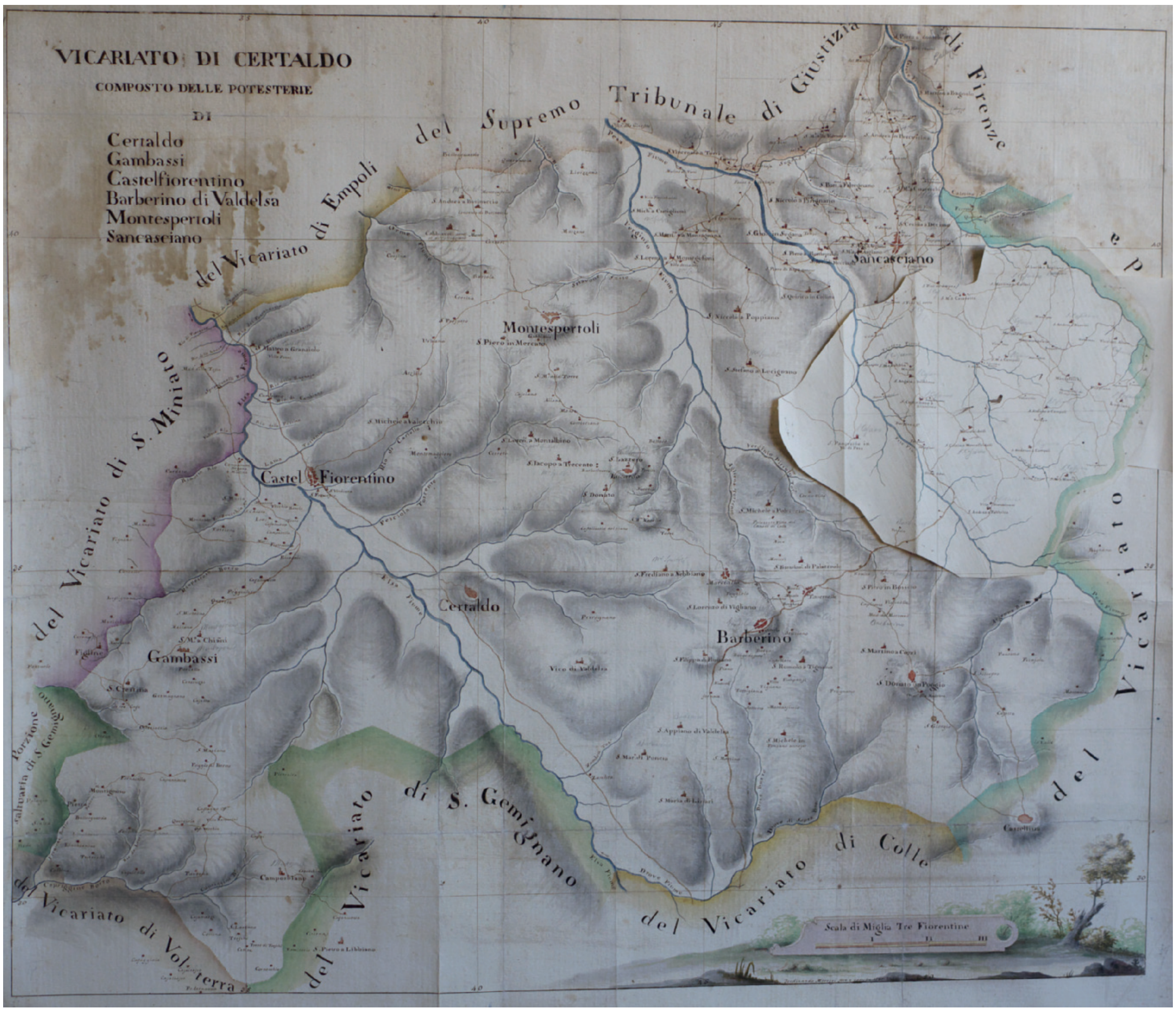

FIG. 28. "VICARIATO DI CERTALDO," BY FERDINANDO MOROZZI, 1780. The map forms part of a collection of administrative cartography prepared in the 1770s and 1780s for the reform of the provincial and communal districts in the Grand Duchy of Tuscany. Manuscript in ink and watercolor on paper, hand colored. Scale ca. 1:33,000. Size of the original: 114 × 104 cm. Image courtesy of the Archivio di Stato, Siena (Colle di Val d'Elsa archivi, Carte topografiche Morozzi, 4).

divisa in cancellerie" (1797) (Prague, NA, RAT Map, 209) (Rombai 1993, 115–18, 123).

Like other states, the Grand Duchy of Tuscany also generated numerous maps of individual fiefs and domains, such as the collection commissioned by the sovereign in 1771–72 (Florence, AS, Miscellanea di Piante, 80, 246, 249/b, 260, 551, 660, etc.). The best example is the large "Pianta del marchesato di Castiglioni della Pescaia" (Florence, AS, Piante dello Scrittoio delle R. Possessioni, n. 109) in Maremma, comprising portraits of the towns of Castiglioni and Tirli, prepared in 1780 by the engineer Alessandro Nini, who collaborated with the mathematician Leonardo Ximenes. Similarly, in the Kingdom of Naples, several examples depict fiefs and domains. The "Pianta geometrica delli feudi di Carovigno, Serranova e del Colombo" (1726) (Naples, AS, Allodiali, I serie, fs. 158, pianta n. 1) exhibits on-site measurements in its geometrical structure; Nicola Schioppa's "Mappa dello Stato di Ajello in Calabria Citra" (1771) (Naples, AS, Archivio di Tocco di Montemiletto, b. 131, inc. 24) shows a more advanced approach; the "Topografia de Feudi" (1787) (Naples, AS, Biblioteca-Manoscritti, vol. 127), helped to resolve a dispute regarding the fief of Monte di Mezzo (Martullo Arpago et al. 1987, 90, 58–59, 29 respectively). Six large watercolored ground plans of the fiefs of the Moncada family in eastern Sicily were prepared by local land surveyors at the turn of the eighteenth to nineteenth century, including Pietro La Piana's "Pianta topografica generale della contea di Aderno Centorbi e Biancavilla" (Palermo, AS, Fondo Moncada, Carte dei feudi; La Piana, n. 9), noteworthy for its accurate relief and detailed rendering of topography (Laudani 2002, 52–55, fig. 26).

The use of maps to exert local control may be seen in the atlas of nine topographical maps (now in a private collection in Florence) produced by the engineer Tommaso Rajola in 1771–73, who performed on-site surveying with a plane table. Commissioned by the Roccella prince Vincenzo Maria Carafa, the maps served to control and administer the fiefdom of Roccella Jonica in Calabria. A fine copy of these working maps was prepared in Naples between 1774 and 1789 (Fuda 1995, 32–37).

Throughout the peninsula, innumerable manuscript or printed maps on a large topographical scale were created to manage rivers or reclaim marshy areas. Produced by technical experts and scientists working for various states, the maps helped analyze the layout and composition of terrain and determine the best interventions. The Venetian Magistratura alle Acque dedicated great attention to such questions. Depictions of the plains of the Veneto and Friuli predominate throughout the Enlightenment period, with hundreds of maps dedicated to the hydrography of the lagoon and lowland areas. As examples, a map of ca. 1670 covers the region's hydro-

FIG. 29. REPRESENTATION OF THE FLUVIAL NETWORK IN THE VENETO BETWEEN ADIGE AND CANALBIANCO, EIGHTEENTH CENTURY. The map represents the topography of the river network along the coast of the territory of the Veneto, combining the hydrographic and road networks, soil use, settlements, and the boundaries between the communities. Manuscript in ink and watercolor on paper, hand colored.

Size of the original: 134.5 × 272.0 cm. Image courtesy of the Museo Correr, Venice (Cartografia, Mappe Giustinian, 15).

FIG. 30. "TOPOGRAFIA DEL CORSO DELLE ACQUE DEL BASSO TREVIGIANO CON PORZIONE DELLA LAGUNA," BY DOMENICO MARCHETTI (ENGINEER), 1788. This map, concerned with the flow and problems of water and including the remains of archaeological sites, was compiled by the Magistrate of Adige to focus in great detail on the complex realities of Venetian-Friulian hydrography. Manuscript in ink and watercolor on paper, hand colored. Scale ca. 1:14,500.
Size of the original: 95 × 154 cm. Image courtesy of the Museo Correr, Venice (Biblioteca, Ms. Provenienze diverse C, 840/4).

graphical basin and the Venetian lagoon (Venice, Civico Museo Correr [CMC], Biblioteca, Archivio Lazara Pisani Zusto, Cartografia, 17/60); an eighteenth-century map depicts the river network between the Adige and Canalbianco, providing a detailed topographical account of coastal terrain where marshlands still predominated (fig. 29); Domenico Marchetti's "Topografia del corso delle acque del Basso Trevigiano" (1788) (fig. 30) focuses more sharply on the complex situation of the Venetian and Veneto-Friuli lagoons (Cavazzana Romanelli 2004, 78; Cantile 2004, 96).

Innovative analytic cartography was also produced in Piedmont. Examples include Giovanni Giacomo Cantù's "Corso del Fiume Sesia" (1755), which identifies places and buildings damaged by the river flood of 1755 and shows recent restoration work, and Gioseffo Depauli's "Typo regolare del corso del Fiume Pò" (1758), which helped to plan the canalization of the river (Turin, AS, Corte, Carte topografiche, series III, Sesia; Finanze, Tipi della sez. II, 92) (Comba and Sereno 2002, 2:138–40, pls. 88, 89).

Within Tuscany in the second half of the eighteenth century, the grand duke's mathematicians, Ximenes and Pietro Ferroni and their collaborators, produced topographical depictions of terrain using innovative surveying methods to achieve accurate content. Ximenes prepared the "Carta topografica generale del Lago di Castiglioni" (1758–59) as part of a project for improving the plain around Grosseto (Florence, AS, Segreteria di Finanze ante 1788, f. 749). Ferroni's "Carta corografica del Valdarno di Pisa" (1774) anticipated his later work on problems posed by the reorganization of other water courses, for which he produced the "Mappa topografica che dimostra lo stato delle acque di Valdinievole" (draftsman: Stefano Diletti) and the "Pianta speciale dei Torrenti, Fossi e Canali frapposti al Lago di Bientina o di Sesto e al Fiume Arno." Both maps accompanied a report (8 June 1780) regarding land reclamation in the wetlands (Florence, AS, Piante Ponti e Strade, n. 21). Together with his pupils Salvatore Piccioli and Cosimo Zocchi, Ferroni also worked on projects in the southern Val di Chiana, most notably the "Pianta della Pianura di Valdichiana posta tra il Callone Pontificio e il Lago di Chiusi," and created maps of Lake Trasimeno and the

Val di Chiana (draftsmen: Luigi Sgrilli and Antonio Capretti) to explore a possible navigable canal linking the two areas (Prague, NA, RAT Map, 245, 247–248, and 250). Other Ferroni waterway maps include the "Pianta che dimostra l'andamento dei principali fiumi, fossi e strade di tutta la Val di Chiana" (Florence, AS, Camera delle Comunità e Luoghi Pii, f. 1548) and the "Pianta del Valdarno e dell'Usciana" (1780) concerning the Val di Nievole (Florence, AS, Segreteria di Finanze ante 1788, f. 936, ins. 1780).

In addition to hydrographical problems, Ferroni mapped more extensive areas topographically, such as the Maremma di Grosseto, the Casentino, and eastern Tuscany. By the 1780s he turned to road systems with strikingly innovative plans, for example, the "Pianta dimostrativa di una parte del Casentino, la Pianta dimostrativa dei progetti delle due linee di strada che dalla Consuma andrebbero sino al fiume Arno" and the "Pianta dimostrativa delle strade presenti che da Stia e Pratovecchio vanno alla cima dell'Appennino" (Florence, BNC, Cappugi, n. 308). Major road building operations active around the middle of the eighteenth century within the Grand Duchy generated innumerable maps. After the administrative reforms of 1773 a great number of locally focused atlases provided a census of public highways, such as Carlo Maria Mazzoni's "Campione delle Strade situate dentro il circondario di Pietrasanta" (1783) (Pietrasanta, Archivio Storico Comunale, Stradario Mazzoni) (Boncompagni and Ulivieri 2000). The administration of road and travel was central to the collection titled "Viaggi d'Italia" gathered by the Florentine land surveyor Antonio Giachi (Florence, BNC, Ms., II.XI.4). Around 1760 Giachi produced a similar though more detailed version of this manuscript travel atlas titled "Guida per viaggiar la Toscana" (Florence, Biblioteca di Geografia dell'Università degli Studi, and Biblioteca dell'Istituto Geografico Militare) (Cantile 2003).

From late medieval times central authorities in all the Italian states had paid particular attention to communication networks with cartography dedicated to this theme. In the Venetian Republic, Valentino Bartoli provided a road map in his 1650 account of the Terraglio Vecchio (Treviso, Biblioteca Comunale, Fondo cartografico, 141). More than seven meters long, this map follows the course of the road from Mestre to Treviso, with different colors identifying different road surfaces (Cantile 2004, 90–91).

In Savoy, the route from Turin via Cuneo to Nice, an important link with the Ligurian Sea, was represented on the "Carta corografica dove dimostrativamente son segnate le strade e calle" (Turin, AS, Corte, Carte topografiche per A and B, Nice n. 8). Dating from ca. 1679, it shows the territory of Piedmont and a projected overall road network that was of great strategic and—above all—military significance (Sereno 1984; Carassi 1984, 94). Francesco Antonio Bruna's "Dimostrazione delle strade tendenti da Carignano a Cuneo" (1759) (Turin, AS, Corte, Materie economiche, Ponti e Strade, m. 6, fasc. 1), constructed from on-site surveying, displays features of a twentieth-century thematic map.

From the 1660s onward the Republic of Genoa promoted "ambitious road schemes to improve communications with Lombardy and the East [i.e., Parma and Tuscany]" (Quaini 1984, 225). This effort produced maps like Stefano Scaniglia's "Descrittione della strada da ristorarsi da Sestri sino alla terra di Riccò" (1688) (Genoa, AS, busta 17, n. 1083) (Quaini 1994, fig. 24) and Giovanni Batta Costanzo's "Piano della strada nuova dalla Spetia sino a Parma" (1660) (Genoa, AS, Raccolta cartografica, busta 17, n. 1101). Later, Matteo Vinzoni's "Descrizione delle strade che vengono nel territorio di Savona" (1743) detailed the area's road network (Genoa, AS, Raccolta cartografica, busta 28 bis, Miscellanea, n. 105) (Quaini 1983, 39).

The maintenance and preservation of woodlands also encouraged administrative cartography. Again, the Venetian Republic took the lead from the beginning of the seventeenth century and especially during the eighteenth by producing thematic maps, which concentrated on state- and community-owned woodlands of tall timber, traditionally used in shipbuilding and in civil and military construction work (Casti and Zolli 1988; Casti 1994). Archival examples display a variety of cartographic approaches to handling different types of woodlands. Geometrically based maps of publicly owned woodlands of Friuli contrast with a more pictorial approach of the woods in the Sauris basin (1752). Pictorial maps show the lots of woods in the Carnic Alps at the time of harvest and the aftereffects of the harvest on Monte Pal (Bianco 2001, figs. 8, 10, 19). Further examples exist for the woods in Carnia, whether held in common or owned by the municipality, and for timber harvests (before and after) in the But Valley and the area of Lumiei (Bianco and Lazzarini 2003, 68, 69, 76, 77, 130). Forest cartography in the Veneto reached its peak at the turn of the eighteenth to nineteenth century with the work of the Republic's inspector of forests, Candido Morassi. Wide-ranging and systematic cartographic descriptions were prepared to halt the decline and erosion of the woodland stocks in the Belluno and Carnia areas. Giovanni Ongaro's drawing of the local wood of Chiarascatis di Moggio in 1794 (Bianco and Lazzarini 2003, 129) was produced to create an atlas of all the publicly owned woodland in the Carnia area (ultimately prepared by Antonio Pilizzari) (Bianco 2001, 89). In Piedmont, Cantù and other state-employed technicians produced a map of the woods of the Valle d'Exilles in the upper Susa Valley (1739–40) (Vienna, Kriegsarchiv; see Sereno 1991). From 1752 to 1764, the Ufficio Topografico Reale commissioned systematic surveys of the woods of Savoy "in relation to the exploitation of the mines in certain alpine valleys and the associated need to know the nature and extent of forestry resources" (Sereno 2002a, 179; 2002b, 100n113).

In the Grand Duchy of Tuscany the manuscript "Relazione e piante delle boscaglie di S.A.S." (1654–55) by Zorzi de Negri, head of the Arsenale at Pisa (Pisa, Biblioteca Universitaria) includes an atlas of woodland maps of Maremma in perspective view. A manuscript collection from the mid-eighteenth century (Florence, AS, Magona) shows the coppice woods existing within an eight-mile radius of the grand duke's metal foundries in the Montagna Pistoiese, Pietrasantino, and Maremma areas. Each of these woods was reserved exclusively as a source of fuel supplies for such facilities and supervised by the iron foundry authority, Magona del Ferro (Valentini 1993, 298). Other eighteenth-century manuscript maps in Florence (AS) treat forests or wooded game reserves—for example, Pigelleto dell'Amiata, Teso in the Montagna Pistoiese area (by Giovanni Caluri, 1797), the Cascine di Firenze farm (by Antonio Bicchi, 1796), and the Massa Marittima game reserve (second half of the eighteenth century).

The Republic of Genoa produced maps of public woodlands, particularly for border areas, such as Vinzoni's map of the woods of Pertigara ("Selva della Pertegara," 1711, Genoa, AS, Archivio Segreto, Confinium, 190), the large Savona woodlands (1724), and the Consevola woodlands (1757) (Moreno 1990, 41–48; Quaini 1994, fig. 22). The forestry assets of Savona were mapped anew by Gerolamo Gustavo 1759–60 as "Tipi di tutte le Masserie ed altri ripartimenti" (forty-two manuscript maps, ca. 1:4,850; Savona, Biblioteca Civica, scaffale nuovo, I/1, ms. 19), a collection intended to assess the quantity and quality of local assets. Working with the Piedmont engineer Antoine Durieu, Gustavo later surveyed the boundaries of the Consevola woods in 1770–71, 1790, and 1796. In 1782 he prepared the "Tipo geometrico del Bosco Camerale Ronco di Maglio," and in 1780, with another Piedmont engineer, Vincenzo Denisio (Denis), compiled the "Carta topografica fatta sopra il luogo . . . che comprende l'intiera Regione de' Selvatici" (Levi 1986, 211–14).

Timber was vital for the mining industry: for constructing tunnels and galleries and as fuel for smelting. Maps aided not only the administration of forests but also the location and exploitation of mineral resources. In the Duchy of Savoy in the 1750s, military engineers took part in surveys intended to give new impetus to the mining industry. Both the "Carta dimostrativa delle vicinanze d'Allagna colla posizione delle Miniere" (1754, by Alessandro Tesauro) and the "Pianta e profilo delle due cave del Rame di S[t]. Giacomo e S[t]. Gioanni esistenti nel territorio d'Alagna" (1754, by Giovanni Domenico Ravichio) (Turin, AS, Corte, Carte topografiche, serie III, Alagna) show topographical features, mineral seams, and mining shafts (Comba and Sereno 2002, 2:134–35, pl. 85). The "Carta topografica in misura della Valle d'Anzasca, parte della giurisdizione dell'Ossola superiore e parte Inferiore nell'Alto Novarese" (1758, by Giambattista Sottis, engineer) reveals lead, gold, and iron mines (fig. 31) (Comba and Sereno 2002, 2:135–36, pl. 86).

In the Grand Duchy of Tuscany, the imperial land surveyor, Francesco Antonio Eegat, prepared a series of maps reflecting exploration of the Colline Metallifere from the 1760s onward. The "Carta topografica del territorio compreso tra Montieri, Boccheggiano, Prata e Massa Marittima" and the "Pianta e veduta della miniera e dell'opificio dell'allume situato nel territorio di Monterotondo" located all mines, even those in use in ancient times (Florence, AS, Miscellanea di Piante, 29a, and 29b). The grand ducal engineer Mazzoni produced other maps in the 1760s covering the mines of the Valtiberina and the Apuan Alps: the "Pianta corografica del Capitanato di Pietrasanta" (1762–64) and "Mappa topografica di Val di Tevere" (1767) (Florence, AS, Miscellanea di Piante, 192 and 248); both display remarkable pictorial representations and content not strictly related to mining (Valentini 1993, 299, 301). In 1766, Mazzoni also prepared other thematic depictions of the mining areas in the Apuan Alps (Florence, AS, Miscellanea di Piante, 2/a and 2/b, 86/a and 86/b, 188).

In Habsburg-ruled Lombardy, a reference for patenting mining was provided by the "Carta mineralogica della Valsassina e della Valcavargna" (Milan, AS, Atti di governo, Commercio, p.a., m. 203) prepared in 1779 by the naturalist Ermenegildo Pini, who had been commissioned by the authorities to investigate the extent of mineral resources and the damage caused by mining to woodlands and forests. He used color coding to identify different categories of minerals. Minerology merged with early geology in the *Carta compendiata dello Stato di Milano* (Milan, 1790, engraved by Domenico Cagnoni), a thematic work hand colored by the Olivetan monk Mauro Fornari that identified different rock formations in the territory (Milanesi 1990, 166).

Two related categories of administrative cartography were inspired by the state's need to exercise military and commercial control over its territory: maps of fortifications and customs boundaries. In Tuscany from 1739 to 1749, Odoardo Warren, a colonel in the engineering corps joined fellow military engineers Andrea Dolcini, Giuliano Anastasi, Gaetano Benvenuti, and Niccola Lotti in compiling the "Raccolta di piante delle principali città e fortezze del Gran Ducato di Toscana" (Florence, AS, Segreteria di Gabinetto, n. 695), around sixty cartographic depictions accounting for the local setting, armaments, and function of specific towers, forts, and fortified urban centers.

FIG. 31. "CARTA TOPOGRAFICA IN MISURA DELLA VALLE D'ANZASCA, PARTE DELLA GIURISDIZIONE DELL'OSSOLA SUPERIORE E PARTE INFERIORE NELL'ALTO NOVARESE, COL DELINEAMENTO DELLE MINIERE ESISTENTI NEI TERRITORI D'ESSA VALLE," BY GIAMBATTISTA SOTTIS, ENGINEER OF THE UFFICIO DI TOPOGRAFIA REALE, 1758. The map forms part of the administrative sources concerning the use of woodlands in support of industrial mining. Its topographic detail shows the Valley Anzasca and part of the Val d'Ossola in the northeast Piedmont. Manuscript in ink and watercolor on paper, hand colored. Scale ca. 1:24,000.

Size of the original: 94.5 × 139.3 cm. Image courtesy of the Archivio di Stato, Turin (Corte, Carte topografiche per A e B, Anzasca).

Around the same time a series of maps and perspective views titled "Città e fortezze del granducato and città murate, ville granducali e fortezze di Toscana" (Florence, AS, Segreteria di Gabinetto, n. 696, and Rome, Istituto di Storia e Cultura dell'Arma del Genio, cartella XXII, nn. 1563–1656) covered similar themes, as did the hand-colored atlas "Collezione delle piante e prospetti delle fortificazioni situate lungo il littorale toscano" by the grand duke's architect Pietro Conti (1793) (Florence, Osservatorio Ximeniano). A series of maps produced in the 1780s and 90s by a group of state architects concerned customs houses and surrounding areas within the grand duchy (Florence, AS, Miscellanea di Piante, 292 bis).

The sovereign of different regions enjoyed exclusive hunting rights, often depicted on maps used for the preservation of royal game reserves. In Piedmont, these included the "Carta topografica della parte della Provincia di Torino serviente al grande distretto delle Regie Caccie," three manuscript sheets drawn in 1766 by Pietro Denisio (Turin, AS, Corte, Archivio topografico segreto, 15A VI rosso) (Massabò Ricci and Carassi 1987, 306n71). In Tuscany numerous maps of the grand duke's hunting reserves included the large "Pianta della R. Bandita del Poggio Imperiale" (1793) (Prague, NA, RAT Map, 269), rendered with almost geometrical precision and topographical detail. In the Bourbon south of Italy, Giovanni Antonio Rizzi Zannoni headed a team to produce the "Carta topografica delle Regie Cacce" (1784) (Naples, BNC, b. 29B/62, 1–2).

In Puglia and Tuscany, transhumance practices were documented in maps showing primarily the areas of winter grazing used by the livestock breeders of the Appenines. The maps are rather similar in character to cadastres, indicating *tratturi*—the grassed routes that shepherds and flocks were required to take when moving from the mountains—and the various areas of restricted grazing (that is, those that were subject to state duties). In Puglia, such maps are exemplified by the topographical map of the territory of Corato in the Bari region, produced in 1753 by the *compassatori* (surveyors) Giuseppe Cuoci, Francesco Antonio Zizzi, and Ignazio Romito (Bari, AS, Atti demaniali, b. 36) (Angelini 1987, 126; Angelini and Carlone 1981, 85); the "Atlante dei tratturi Capecelatro" (1649–52) drawn using visual perspective by Giuseppe de Falco and containing 102 maps of *tratturi* and the buildings located along their route; the "Atlante dei tratturi Crivelli" (1712) by Michele Sarracca and Giacomo di Giacomo, with 110 maps; the "Atlante Michele" (1693–97) by Antonio Michele and

Nunzio Michele, with 28 maps; and the "Atlante delle locazioni della Croce" (1735–60) by Agatangelo della Croce, a collection of 23 maps (Iazzetti 1987, 596–611; Valerio 1993, 61–62). In Tuscany, the atlas titled "Pianta delle dogane dell'Uffizio dei Paschi di Siena" (1745) (Florence, AS, Miscellenea di Piante, 748), drawn and hand colored by the engineer Innocenzio Fazzi, covers the territories subject to state duties with 25 maps indicating various different kinds of grazing (Barsanti, Bonelli Conenna, and Rombai 2001, 76).

Finally, administrations then as now responded to natural events, whether lowland river floods caused by extreme weather conditions, mountain landslides, or earthquakes. Although the cartography dedicated to floods and landslides is rather modest in character, referring to specific areas, the maps dealing with far more catastrophic tectonic events fall into the thematic mapping category. A series of on-site inspections by the Carmelite Father Eliseo della Concezione and other technicians immediately after the disastrous Calabrian earthquake of 1783 led to the production of a large atlas with sixty-seven engravings, as part of the *Istoria de' fenomeni del tremoto avvenuto nelle Calabrie e nel Valdemone nell'anno 1783* (1784) (Bonica 2006, 204).

The range of administrative cartographies throughout the Italian states reflects the increasing sophistication of the state apparatus in responding to the needs of its citizens and government at all levels.

LEONARDO ROMBAI

SEE ALSO: Italian States

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Administrative Cartography in the Netherlands. Although completely eclipsed by the better-known Dutch commercial map trade, institutional cartography in the Netherlands offered the main mechanism for visualizing the Dutch landscape from the sixteenth century (Koeman and Van Egmond 2007). Large-scale property maps produced by local land surveyors and ordered by various institutions (ecclesiastical, academic, and civic) addressed administrative needs of local authorities for taxation, landownership, urban expansion, and judicial resolutions; these mapping efforts are treated elsewhere in this volume. Within the wide-ranging scope of administrative cartography, two main endeavors stand out: polder mapping and river mapping (polders are lands reclaimed for cultivation). Their common focus on managing water means that the results are known generically as *waterstaatskaarten* (*waterstaat* maps), or maps that explain the state of the water in polders and rivers and of the land along the banks of both (Donkersloot-de Vrij 1995; Hameleers 1991).

Polder maps were produced by local and regional *waterschappen* (water management boards) charged with managing water barriers, waterways, water levels, water quality, and sewage treatment in their respective regions. In the western parts of the Seven Provinces, and especially in Holland, powerful *waterschappen*, *heemraadschappen*, and *hoogheemraadschappen* and smaller polder boards undertook surveys to map their territories in detail (fig. 32). The very early history and importance of the *waterschappen* and the creation of their mostly manuscript maps are described by Cornelis Koeman and Marco van Egmond, who also list twenty-six polder maps printed in the Netherlands before 1650 (2007, 1263–68, 1292–94; Hameleers 1991). This practice continued and improved in the second half of the seventeenth and first half of the eighteenth centuries and expanded from Holland to the other provinces in the Dutch Republic, especially to the area of the Rhine-Meuse-Scheldt delta in Zeeland, Utrecht, Gelderland, and Overijssel, where accurate maps for water management were needed the most.

With this expansion, new surveys were carried out and multisheet maps on larger scales were published. Koeman (1985, 143–48) provides a list of sixty-eight printed polder maps made between 1575 and 1850. Of the twenty-four published before 1650, four were still being printed in the eighteenth century, one as late as 1767. Of the sixteen maps published between 1651 and 1700, seven were reprinted later in the eighteenth century, and one as late as 1818. For instance, the twelve-sheet wall map (ca. 1:30,000) of the *hoogheemraadschap* of Rijnland of 1647 by Jan Jansz. Dou and Steven van Broeckhuysen was printed for the last time in 1746 (Koeman and Van Egmond 2007, 1267n102). Although a century had passed, the topography had hardly changed, but the coats of arms of the board members had to be updated (Hart 1969; Koeman 1985, 138). The unquestioned peak in this map genre is the *T Hooge Heemraed-Schap van Delflant* (1712, 1:10,000), a wall map by the brothers Nicolaas Samuelsz. Cruquius and Jacob Cruquius. Because of its large scale, metrical accuracy, and stunning visual impact, the Cruquius map surpasses all other *waterschap* maps of the period under consideration (Koeman 1985, 139–42), and only its lack of index numbers for the plots of land prevents it from being considered as a cadastral map. That a great number of seventeenth- and eighteenth-century polder maps were treated as commercial products is evident in their inclusion, for example, in the nine-volume *Atlas der Neederlanden*, an *atlas factice* kept in the Universiteitsbibliotheek Amsterdam (Werner 2013).

Waterschappen also created river maps because rivers might run through their territories or affect the state of water management within the polder. Although each province had its own water management plan and was responsible for its own flood protection, some provinces lacked the technical staff and hired surveyors from the *waterschappen*. This decentralization meant a fragmented river management program in the republic, especially problematic given that the major rivers of the Netherlands were in a deplorable condition, mainly as the result of continuous silting. During the eighteenth century, all the rivers that formed part of the dense

FIG. 32. DETAIL FROM MATTHEUS VAN NISPEN, ABEL DE VRIES, AND B. VAN DEN HEUVEL, “NIEUWE CAERTE VAN DE VERDRONCKEN WAERT VAN ZUYT-HOLLANDT,” 11 JUNE 1686. Ink and watercolor on paper; ca. 1:9,250. The parcels shown are polders. Compare the turbulent part of the Merwede, called *den ouden Wiel* (the old wheel), with the same area on the Cruquius map made almost fifty years later (fig. 33).

Size of the entire original: 104 × 130 cm; size of detail: ca. 24 × 38 cm. Licentie CC-BY, Kaartcollectie Binnenland Hingman, Nationaal Archief, The Hague (4.VTH, inv. nr. 1926).

Rhine-Meuse delta started to have trouble discharging their waters into the North Sea, with far-reaching consequences for military defense and for shipping and commercial interests.

Both intellectual and political discussions on how to deal with these issues began in the vulnerable province of Holland, the southern part of which was not only the political, economic, and cultural center of the Dutch Republic, but also mostly below sea level. In the early 1730s a provincial public works department was set up to coordinate the various efforts, and a network of observation posts was established in the field. The goal was not only to devise solutions for the short term, but also to anticipate developments that might occur in the future, such as the predicted rise in sea level. In the long term this would require all the Dutch provinces, cities, and water authorities to work together in a national approach, something that did not happen until the nineteenth century.

From 1731 onward the provincial public works department was led by the former Rijnland surveyor Cornelis Velsen, who, together with Nicolaas Samuelsz. Cruquius, was the principal advocate of this centralized approach. On the basis of an extensive theoretical study of the Dutch *waterstaat*, they designed an elaborate cartographic scheme that substantiated such an approach. They proposed both a general “water map” (topographical map with emphasis on the relationship between landscape and water) of the province of Holland, as well as a detailed series of large-scale maps of the river network to be used in modeling the dynamic interplay between humans and the physical environment and to provide the department with the means to monitor, supervise, and manage this complex interaction.

To this end and to provide examples of the proposed mapping routine, Cruquius designed two separate maps representing extreme situations in the waterway network of Holland. These spectacular and uniquely dynamic printed maps were a one-sheet “water map” of the delta island of Goeree in the southern part of Hol-

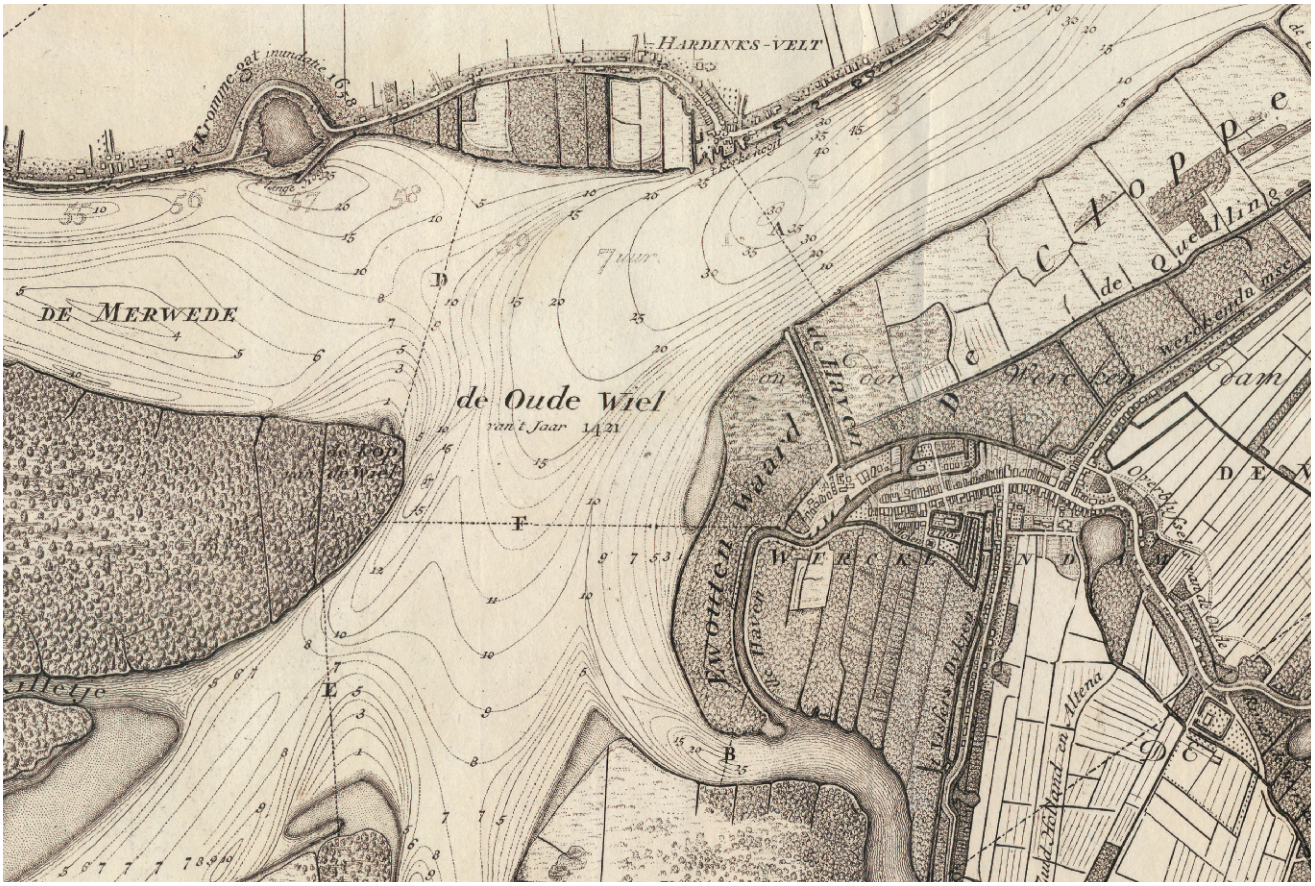

FIG. 33. DETAIL FROM NICOLAAS SAMUELSZ. CRUQUIUS, *DE RIVIER DE MERWEDE, VAN (ONTRENT) DE STEENEN-HOEK* (THE HAGUE, 1729–30). Copper engraving on two sheets; 1:10,000. Detail from sheet one showing the use of isobaths; these, and other data (see fig. 801) revealed that the Merwede had a very irregular depth and rate of flow, and that as much as two-thirds of the river's volume drained off through the kills to the south, resulting in flooding there and unreliable depths for shipping to ports downstream.
Size of the entire original: 54 × 128 cm; size of detail: ca. 18.5 × 27.5 cm. Image courtesy of the Universiteitsbibliotheek Utrecht (Moll 155-I a [Dk41-13]).

land (1733) (see fig. 190) and a map of the Merwede (a lower branch of the Meuse) in two sheets (fig. 33); Cruquius also produced an overview map of the latter (see fig. 801). The dynamic nature of the maps resulted from Cruquius's incorporation of all types of hydrographic, astronomic, and meteorological data into the maps by way of diagrams depicting, among other phenomena, the fluctuation of water levels, the variation of the tides, and the velocity of the water. This conceptualization of the waterscape, however, was expressed at its best through the system of isobaths that he used to visualize the otherwise imperceptible river beds. It was the first time that the delineation of depths was introduced on a printed map, though the method had been used occasionally on manuscript maps of Dutch rivers dating back to the early sixteenth century (Van den Brink 1998, 2000).

Although the realization of the projected "water map" of Holland proved to be too expensive, mainly due to the costs of the accompanying scientific research, the public works department did construct a manuscript map of the main rivers in the province of Holland on a uniform scale of 1:10,000 and along the guidelines set out by Cruquius and Velsen. Between 1731 and 1754, printed river maps based on this master map were produced of the Meuse (fig. 34); the Lek, a branch of the Rhine (1751–54); and the Linge, which connects the Meuse and Rhine (1753–54). All three maps were surveyed and mapped by Melchior Bolstra, who had succeeded Velsen as surveyor of the Hoogheemraadschap van Rijnland in 1731. Because of their dense topographic detail, an embargo restricted their distribution. All maps were therefore published in very small issues (40–50 copies), while the engravers involved (among them the Amsterdam-based map publisher Isaak Tirion) were enjoined to strict secrecy (Van den Brink 1998, 134; 2000, 72–75).

In 1754, the year that Cruquius died and Velsen had to withdraw from his post due to illness, another Rijnland surveyor, Dirk Klinkenberg, took charge of the public works department. He was assisted by Bolstra, who directed a group of surveyors, as well as the Leiden professor Johan Lulofs. Together with his successor Christiaan Brunings, Lulofs functioned as *inspecteur-generaal* of the rivers. As part of an ongoing discussion with authorities in Gelderland, Utrecht, and Overijssel, the public works department of Holland eventually did some river mapping and data collection in those provinces in an attempt to balance the distribution of the Rhine and Meuse Rivers. They began to prepare a large number of maps on different scales to support these laborious negotiations. Financial and legal obstacles seriously limited the time available for surveying, and the department was forced to abandon the preferred map scale of 1:10,000. In most other respects, however, the department stuck to all procedures and protocols defined by Cruquius and Velsen until the end of the eighteenth century. Besides producing a coherent series of more than

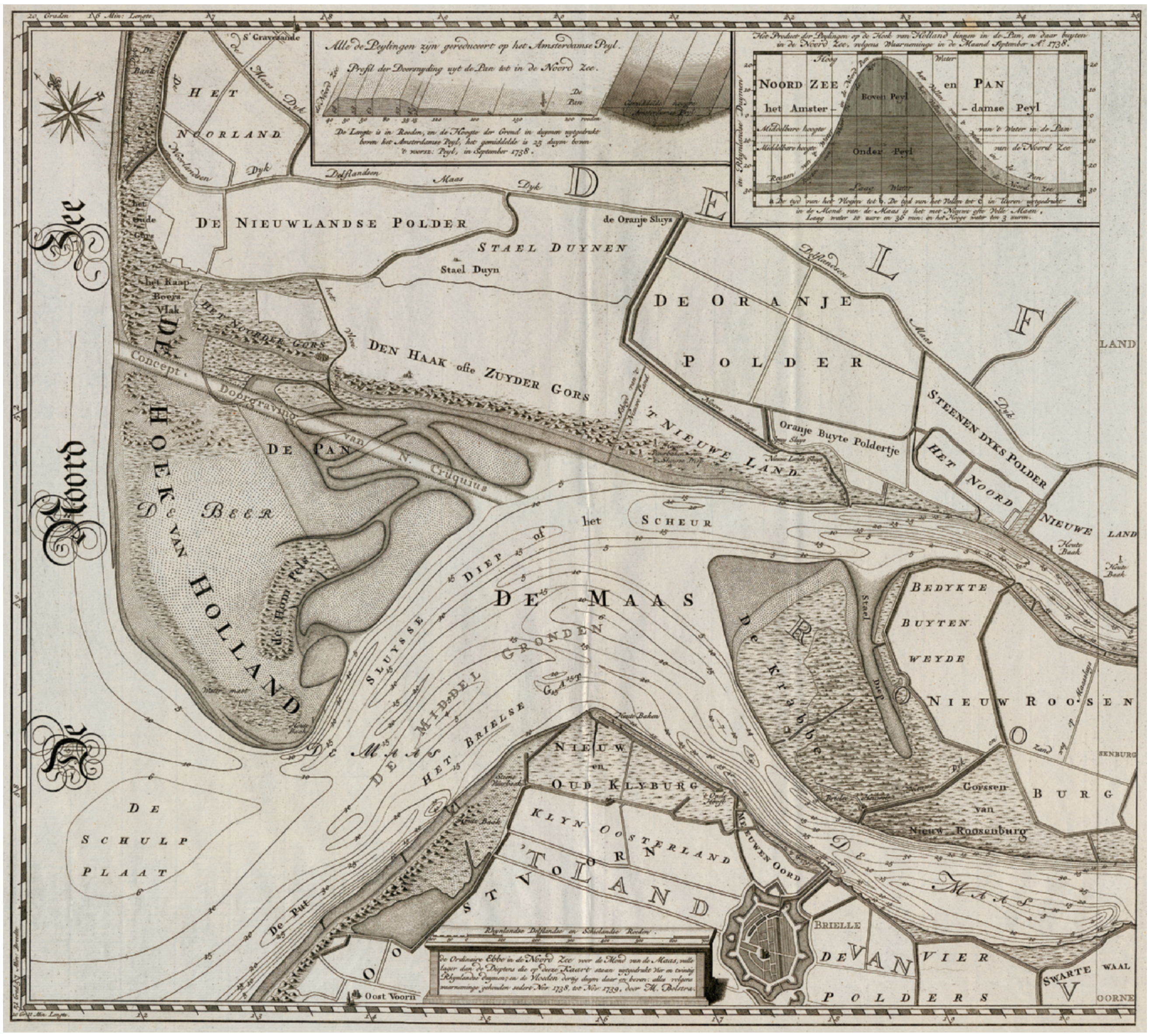

FIG. 34. MELCHIOR BOLSTRA, *KAART VAN DE BENEEDEN RIVIER DE MAAS EN DE MERWEDE, VAN DE NOORD ZEE TOT HARDINKSVELD* (THE HAGUE, CA. 1741). Copper engraving on six sheets; ca. 1:20,000. The first sheet of the map, showing the mouth of the Maas (Meuse) and Hoek van Holland. Isobaths in the river indicate depths, while at the top a profile and a graph show the high and low watermarks in September 1738.
Size of the entire original: 74 × 292 cm; size of sheet one: 56.2 × 62.4 cm. Image courtesy of the Universiteitsbibliotheek Utrecht (Moll 150-I a [Dk41-12]).

one hundred printed river maps showing the principal anomalies in the Dutch river system, the department managed to assemble a huge database with all kinds of methodical information on many physical phenomena. Thus, when the Republic of the Netherlands formed a national department of public works (Rijkswaterstaat) in 1798, they were able to draw on the work done in Holland. By the early 1830s, Cruquius's dream of a map of the Dutch rivers uniform in regard to scale and design was finally realized with the publication of the *Algemeene rivierkaart van Nederland* (1:10,000) (Koeman 1985, 177–82).

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SEE ALSO: Cruquius, Nicolaas Samuelsz.; Netherlands, Republic of the United; Transportation and Cartography: Canal Map; Wiebeking, Carl Friedrich von

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Administrative Cartography in the Ottoman Empire. In the first half of the seventeenth century, after an impressive period of expansion over the Black Sea, Mediterranean Sea, Indian Ocean, and Red Sea, the Ottomans began to lag behind their Western contemporaries in marine charting and general geographical knowledge. This deficiency in geographical matters led to the first true Ottoman acquaintance with Western science. The maps presented as gifts by European merchants functioned as persuasive tools to arrange meetings with the members of the Ottoman government. The Ottoman state remained mired in its usual administrative practice (as described in "Ottoman Empire, Geographical Mapping and the Visualization of Space in the" in this volume). Although some individual attempts were made to buy maps that covered the empire, the government never created a permanent agency for employing cartographers until the establishment of the engineering colleges in the first half of the eighteenth century with the help of European experts. Instead, state officials periodically relied on and supported the private production of maps and other geographical material to meet administrative needs. This entry considers those efforts launched or sponsored by the central government or carried out under its watchful eye. However, the use of maps in administration remains a subject for further research.

Evliyā Çelebi mentions fifteen artisans working at eight shops in Istanbul who had multilanguage skills, with particularly excellent command of Latin, and who supplied mariners with marine charts (*Seyāḥatnāme*, vol. 1, Istanbul, Topkapı Sarayı Müzesi Kütüphanesi [TSMK], B. 304, f. 163a). The principal sources for their map production were the works of Western cartographers such as Gerardus Mercator and Jodocus Hondius, whose *Atlas minor* was translated into Turkish by Muṣṭafā ibn ʿAbdullāh Kātib Çelebi, the scribe of the imperial council in 1655 (although the maps and other drawings might have been completed at a later date, based on the verbal statement of the renegade Meḥmed İḫlāṣī). Although the autograph copy of this translated work, titled "Levāmiʿü'n-nūr fī ẓulmeti aṭlas minur" (Istanbul, Nuruosmaniye Yazma Eser Kütüphanesi, 2998), included only 13 maps, other copies exist with as many as 148 maps (Istanbul, Köprülü Yazma Eser Kütüphanesi, Türkçe Yazmalar II 178). Kātib Çelebi principally based his universal geography, the authoritative "Cihānnümā," according to division of continents in the "Levāmiʿü'n-nūr." The maps in Kātib Çelebi's original copy (TSMK, R. 1624/1) were later improved and supplemented by İbrāhīm Müteferriḳa, who also printed the book (1145/1732). Müteferriḳa also published Kātib Çelebi's *Tuḥfetü'l-kibār fī esfāri'l-biḥār* (TSMK R. 1192), correcting the four manuscript maps before printing them. "Münteḫab-ı Baḥriyye" (completed in 1646) (Istanbul, Süleymaniye Yazma Eser Kütüphanesi, Āşir Efendi 227) included almost 100 geographical maps and sketches, all drawn by Kātib Çelebi himself, although he did not pay much attention to mathematical accuracy in his drafts. He drew the maps without regard to scale, by initially drawing the framework and preliminary outlines instead of the system of coordinate lines. While translating a map, he conveyed geometrical values by copying and illustration, prioritizing direction and place-names rather than scale and location (Sarıcaoğlu 2004).

The geographer Ebūbekir ibn Behrām ed-Dımaşḳī translated the *Atlas maior* of Joan Blaeu (1662) in 1086–96/1675–85 for an official project in which all the necessary materials were provided to him by the central government. The translated work, "Nuşretü'l-İslām ve's-sürūr fī taḥrīri Aṭlas mayur" (TSMK B. 325 and 333), emerged as a shorter version of the former, reducing eleven volumes to nine, which contained only 242 of the original 593 maps. This translation appeared in an even more abbreviated version of two volumes titled "İḫtiṣār-ı tercüme-i Aṭlas mayur," whose delicate copies contained 62 maps (TSMK R. 1634). It is easy to presume that more than one artist/mapmaker was employed during the reproduction process, which used traditional Ottoman illustration techniques, enhancing the translated maps in accordance with an Islamic/Ottoman heritage and even creating some new maps. Although perfection was not expected for the placement of toponyms, geographical coordinates, and positioning, a relative certainty for the mathematical values is apparent. Luigi Ferdinando Marsigli referred to an Abu Bekr Efendi as one of the sources for his Ottoman Empire map of 1687; this person might have been the same as Coğrāfyācı Ebūbekir Efendi, whom Marsigli was very likely to have met during his stay in Istanbul. To this group of maps should be added the regional maps contained in manuscripts written under direct influence of the translations of the *Atlas minor* and *Atlas maior*.

İbrāhīm Efendi, a Hungarian former slave and translator commonly known as "Müteferriḳa," founded the first state-sponsored printing house and press with Arabic characters in the Ottoman Empire, having obtained formal permission in 1727. However, it was nine years before he secured a licence to print maps. Before his printing house commenced operation, he printed a test map of the Marmara Sea (1132/1720), which he had translated and adapted from a foreign work; it survives only in the form of the woodcut block from which it was printed. In 1137/1724–25 he printed a map of the Black Sea (*Baḥriyye-i Baḥr-i Siyāh*) (fig. 35), which included

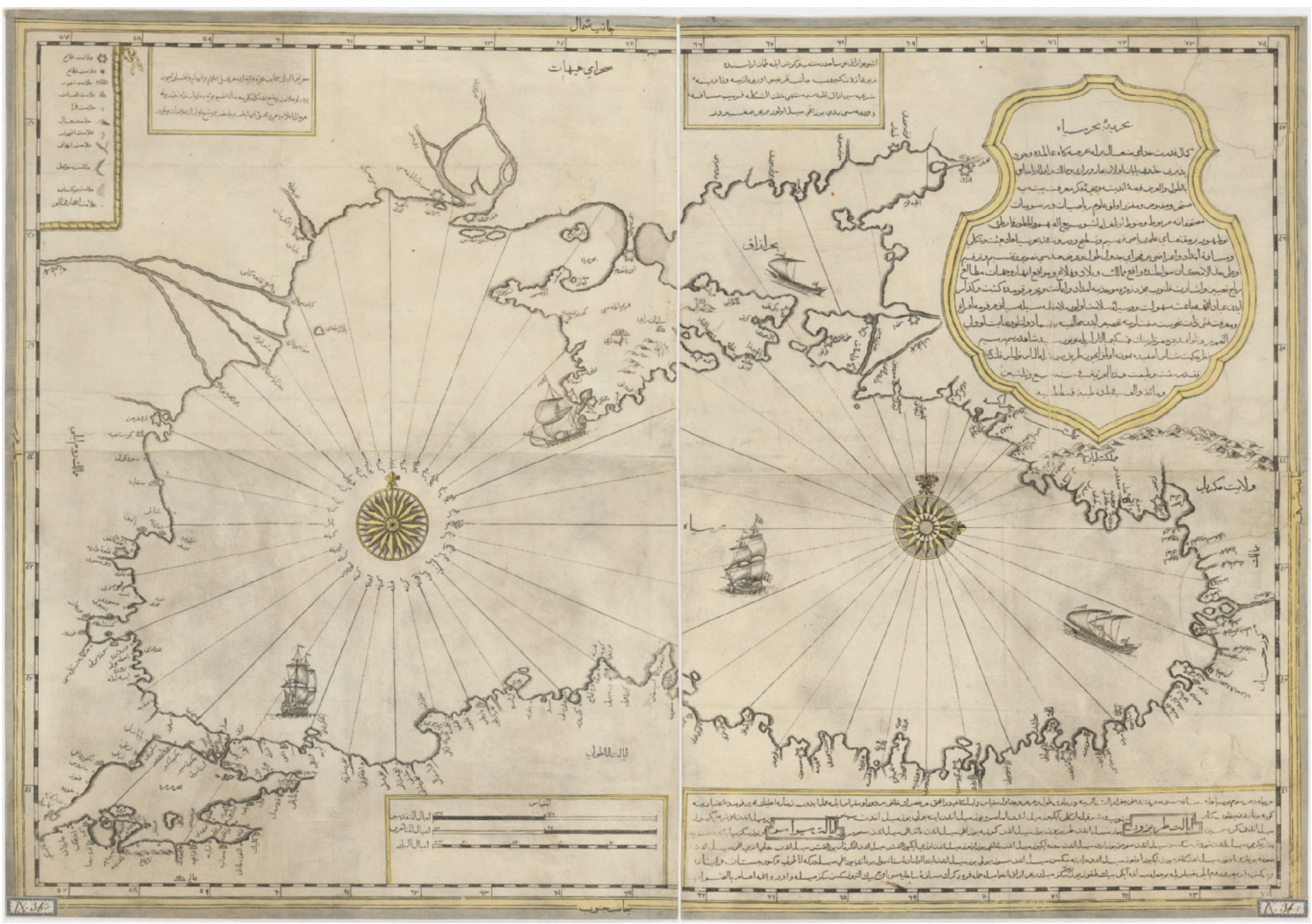

FIG. 35. *BAḤRIYYE-İ BAḤR-İ SİYĀH*, PRINTED BY MÜTEFERRİḲA PRINTING HOUSE, 1137/1724–25. The map of the Black Sea, the first printed Ottoman map. Size of the original: 69 × 99 cm. By permission of Houghton Library, Harvard University, Cambridge (51-2587).

latitude and longitude and was drafted on three different types of mile scales. He later printed two more maps: Iran (*Memālik-i İrān*) and Egypt (*İḳlīm-i Mıṣr*), both prepared as additions to books he published (Sarıcaoğlu and Yılmaz 2008, 155–77). Besides these maps, Müteferriḳa personally drafted a wall map of Ottoman lands and Asia ("Memālik-i ʿO̲smāniyye ve İḳlīm-i Asya"), which remained unprinted (TSMK H 447; see fig. 617) and exists in two more manuscript copies.

Two of the six machines of the Müteferriḳa press were designed for map printing, examples of which include a terrestrial map, a chart of the Mediterranean and the Black Sea, a map of the Ottoman islands in the Mediterranean, and a map of the gulf of Venice and the Adriatic Sea. All were contained in Kātib Çelebi's *Tuḥfetü'l-kibār fī esfāri'l-biḥār*, published in 1141/1729. Müteferriḳa also printed the *Tārīḫ-i Hind-i ġarbī* (1142/1730), which included three terrestrial and celestial maps. But none of the books from Müteferriḳa press could replace the work of Kātib Çelebi's *Cihānnümā* (1145/1732) with twenty-seven maps and thirteen plates. In addition to the large-scale regional maps of Europe, Africa, Asia, North and South America, the Poles, Japan, the Indian subcontinent, Iran, the Caucasus, the Arabian peninsula, Asia Minor, and the city of Istanbul, there are celestial maps that represent traditional astronomical bodies and celestial regions, stars, tropics, and images of a terrestrial globe and the universe. Müteferriḳa personally produced some additional maps to be printed in the *Cihānnümā* that eliminated the errors of Kātib Çelebi's drawings (fig. 36). In

FIG. 36. *ULUNOĠĀY ÇERĀKİSE ĀBĀZA ṬĀ'IFELERİNİN YERLERİ, KŪH-I ELBRUZ DAĠİSTĀN, ŞİRVĀN VE TAMĀMEN GÜRCİSTĀN MEMLEKETLERİ VE GENCE VE REVĀN VE ḲĀRṢ VE ÇILDIR VE ṬRABZŌN VE ERŻURŪM EYĀLETLERİNİN ŞEKLİDİR*, ENGRAVED BY AḤMED EL-ḲIRĪMĪ, 1145/1732. The map of the Caucasus region from Dagestan to Erzurum in Kātib Çelebi, *Cihānnümā*, printed by Müteferriḳa printing house.
Size of the original: ca. 27.0 × 35.5 cm. Image courtesy of the Süleymaniye Yazma Eser Kütüphanesi, Istanbul (Hamidiye 931, between 407–8).

preparing his maps, Müteferriḳa always provided latitude and longitude values and most have scale and compass direction. Although he referred to multiple distance units such as Islamic, Italian, and French miles in the distance table, he generally set the scale to the French mile. Among the other units of measurement used by Müteferriḳa were the league and various time and stopping-points along the main routes. Features peculiar to Müteferriḳa were his use of symbols employing pictorial representation and his application of hand color and compasses to his maps.

Müteferriḳa's rich collection of maps and atlases included those brought from Paris by Yirmisekizçelebizāde Meḥmed Saʿīd Efendi, the son of the Ottoman diplomat sent to France. These diverse sources undoubtedly included the works of Johannes Janssonius (*Nouvel/Novus atlas*), the Blaeu family (*Atlas maior*), Nicolas Sanson (*Atlas nouveau*), Andreas Cellarius (*Atlas coelestis seu Harmonia macrocosmica*), and the Homann family (*Neuer Atlas*). Two signatures appear on the maps drafted by Müteferriḳa—"İbrāhīm el-Coġrāfī" and "İbrāhīm-i Ṭopḫānevī"—but unfortunately the great majority of his works are unsigned. From inscriptions one can assume that he was assisted by two draftsmen, Aḥmed el-Ḳırīmī and Mıġırdıc Ġalaṭavī.

The arrival of Claude-Alexandre, comte de Bonneval, in Istanbul marked a significant moment in the process of Ottoman adoption of European cartographic practices. A former French army officer who submitted his service to the Ottoman Empire in 1729 and became known as Ḫumbaracı Aḥmed Paşa after converting to Islam, Bonneval played a key role in the foundation of ʿUlūfeli Ḫumbaracı ocağı (corps of bombardiers) in 1734–35, an institution that raised Ottoman awareness of contemporary European surveying techniques. There, students heard lectures on geometry, trigonometry, ballistics, and mechanical drawing. During the period of grand vizier Rāġıb Paşa, the curriculum was extended to cover practical courses aimed at training students in cartographic surveying and mechanical drawing. The importance of ʿUlūfeli Ḫumbaracı ocağı in Ottoman cartography was enhanced by the engineering lectures of Saʿīd Efendi, who published four books on surveying.

The imperial naval engineering school, Hendeseḫāne (later Mühendisḫāne), established in the imperial arsenal at Kasımpaşa in 1189/1775, lay at the heart of institutionalized cartographic training within the Ottoman Empire. At the college, French military experts such as André-Joseph Lafitte-Clavé and Joseph Gabriel Monnier de Courtois gave practical courses in the field using plane table and compass. In addition, at this time the same French engineers and their Ottoman pupils produced several maps, chiefly fortress plans (Lafitte-Clavé 2004). Seyyid ʿOsmān, one of the cartography teachers at the college, later became the first instructor of the newly established mapmaking branch of the school; and the French engineer Parale was appointed his deputy. In 1210/1795, Mühendisḫāne-i Berrī-i hümāyūn (imperial military [land] engineering school) was opened, where training focused primarily on drafting maps and plans of fortresses and fortifications. In the meantime, French officers such as François Kauffer and Achille Tondu continued to give cartography lessons, prepare military sketches, and supervise Ottoman cartographic draftsmen. Maps produced by these qualified cartographers were used by the sultans, since some administrative maps survive among the personal papers of Abdülḥamīd I, drafted in response to his request. Similarly, Selīm III rewarded those who drafted fortress maps and plans.

The following maps represent a period of transition for Ottoman cartography, by shifting the division of earth based on the climes to a view based on continents. One particular map of the northern regions up to latitude 40°, *Memālik-i ʿOs̱māniyye'nin akṭār-ı şimāliyyesi ḫarīṭası* (Süleymaniye, Esad Efendi 2049) was printed in 1790 by Yenaki İspitar Boyar, a distinguished Ottoman-Greek voivod, but most likely not in the Ottoman capital. The manuscript annotations highly resemble the calligraphy of Ottoman-Greek bureaucrats. The map indicates political borders in eight colors, and from the seal on the edge of the map, it can be assumed that it belonged to Kauffer. A regional block-printed map of Europe, Asia, and Africa, with hand coloring and manuscript annotations (Istanbul, Başbakanlık Osmanlı Arşivi, Haritalar Kataloğu 18) was drafted by the Ottoman chargé d'affaires in Vienna, Konstantin Tipaldo; its scale and color date it to 1802; it was a translation of a map he obtained in Vienna. A manuscript map of Europe and Asia (Süleymaniye, Pertev Paşa 374) was translated by Ḳule Ḳapılı Seyyid Ḥasan, an engineer in ʿUlūfeli Ḫumbaracı ocağı. Drawn in color in the early 1800s, it was probably taken from a French map printed in St. Petersburg. His personal notes make clear that Seyyid Ḥasan copied the map using the very same scales of 150 miles and 50 hours. In addition to their elegant frames and delicate ornaments, these three maps share the characteristic of outlining in color the internal boundries between the Ottoman provinces.

The Mühendisḫāne-i Berrī-i hümāyūn press was founded in 1797 under the direction of Müderris ʿAbdurraḥmān Efendi. It housed a special printing press for the publication of maps. Four regional maps, of Asia, Europe, Africa, and the Americas, copied from the *Atlas général* (ca. 1740) of Jean-Baptiste Bourguignon d'Anville, were duplicated there in 1797, after they had been translated and adapted by Maḥmūd Rāʾif Efendi. Portolan charts of the Mediterranean, the Black Sea, and the Sea of Marmara were also printed in 1801; but the printed versions of neither the first nor the third have yet been detected. When the press moved to Üsküdar, Müderris ʿAbdurraḥmān published the first atlas in Turkish, titled *Cedīd aṭlas tercümesi* (1218/1804–5). It was based on and largely copied from the *General Atlas* of William Faden, translated by Resmī Muṣṭafā Ağa, although one map was omitted. It was printed only in fifty copies and included twenty-four map plates in color that were adapted into Turkish by Aḥmed Vāṣıf Efendi and Yakovaki Efendi. The copperplates were engraved in Vienna and the maps were printed on a special Istanbul paper made from silk (fig. 37). Zimmī Masis, Mollā Abdullāh, Ḥasīb Dede, Mollā Aḥmed, Mollā Selīm, İbrāhīm, Mesʿūd, and the French draftsman Likar all worked on the preparation of these maps; Likar was officially appointed to draft maps at the Mühendisḫāne-i Berrī-i hümāyūn in 1800. As a supplement to the *Cedīd aṭlas tercümesi*, Maḥmūd Rāʾif Efendi prepared an Ottoman translation of *Atlas général* of d'Anville titled *ʿUcāletü'l-coġrāfya* that was printed without maps.

Following his death, the map collection of the *reʾīsülküttāb* (secretary of state) Ebūbekir Rātib Efendi, containing 630 items, bound and unbound, was taken to the Mühendisḫāne together with his full set of wooden plane tables (Beydilli 1995, 284–87). The engineering colleges with their presses remained the sole institutions capable of meeting the cartographic demands of the Ottoman administration as well as serving as training grounds for Ottoman cartographers until the early nineteenth century. The products of these Ottoman draftsmen, who were trained in contemporary surveying practices, is still being inventoried. Their full contribu-

FIG. 37. *DEVLET-İ ʿALİYYE'NİN ASYA ṬARAFINDA OLAN MEMĀLİKİ* (ASIAN TERRITORIES OF THE OTTOMAN STATE), ÜSKÜDAR MÜHENDISḪĀNE PRESS, 1218/1803–4. From *Cedīd aṭlas tercümesi*, copied from the *General Atlas* of William Faden, translated by Resmī Muṣṭafā Ağa, and published in Istanbul; the first atlas published in Turkish. Size of the original: ca. 54.0 × 71.5 cm. Image courtesy of the Geography and Map Division, Library of Congress, Washington, D.C.

tion to Ottoman administration remains to be analyzed. Indeed, within the sphere of bureaucratic efforts, apart from the military endeavours launched by the central government, administrative maps for provinces and cities with indications of administrative boundaries barely existed.

FİKRET SARICAOĞLU

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

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Administrative Cartography in Poland. The Polish-Lithuanian Commonwealth lacked a strong central government, although it was one of the largest and most populous countries of Europe in the seventeenth and early eighteenth centuries. Its kings were elected by the nobility and their power was always limited by the Sejm (parliament), which was dominated by the nobles. The highest-level administrative subdivisions, the voivodeships, enjoyed considerable autonomy, each with its own legislature. Consequently, many of the factors that encouraged comprehensive small- and medium-scale mapping for administrative purposes elsewhere in Europe were lacking in Poland, and such efforts were scattered and relatively ineffective. Within this rather diffuse situation, the Roman Catholic Church and its orders emerged as perhaps the most effective mapping agency within the Commonwealth.

Individual Catholic orders were involved in cartography. The Franciscan Observants (Ordo Fratrum Minorum de Observatia, known in Poland as the Bernardines) prepared two maps of their provinces (Flaga 1991, 48–65). Both titled *Alma provincia reformata SS. Antonij Padvani Maioris Poloniæ/Provincia reformata S. Mariæ Angelorvm Minoris Poloniæ*, one was prepared in Biała Podlaska and printed in 1718 in Leipzig (copy in Warsaw, Biblioteka Narodowa, BN ZZK 7194); the other contained similar geographical content but was engraved on three copperplates by Samuel Donnet in Gdańsk in 1720 (ca. 1:3,000,000). Another map of the same order was prepared in Augsburg by the engraver and publisher Tobias Conrad Lotter and published as *Polonia seraphico-observans, juxta domicilia propriae & alienæ jurisdictionis geographicè delineata* (not before 1753) (Alexandrowicz 2005, fig. 16). Other Polish orders that are known to have produced maps of their provinces are the Augustinian Friars, Friars Minor Capuchin, Carmelites, Trinitarians, and Jesuits (Rastawiecki 1846, 134–39).

The most ambitious mapping project undertaken by the Latin Church in the Polish-Lithuanian Commonwealth was initiated in 1784 by the king's brother, primate archbishop Michał Jerzy Poniatowski. The goal was no less than to collect materials usable for preparing a relatively large-scale map of the entire state. The parishes, being the smallest units of territory for Latin Church administration, made a logical starting point for gathering detailed topographic data. The core materials were manuscript descriptions of parishes written by parish priests in response to detailed questionnaires. Information was sought under nine headings: (1) names of villages and towns in the parish in alphabetic order, each described by distance and direction to the parish church; (2) distances and directions to all neighboring churches; (3) distances to neighboring market towns; (4) description of roads—their state (stony road, sandy road, etc.) and areas that they cross (forests, marshes, etc.); (5) hydrographic elements—rivers, marshes, ponds, bridges, dikes, dams, etc.; (6) mountains, ravines, etc.; (7) mills, sawmills, steelworks, glassworks, monuments, etc.; (8) public and private roads, road distances in miles between villages and other objects; and (9) Latin Church administration borders (Wernerowa 2003, 167–68; Buczek 1982, 104–5).

From 1784 to 1788 the completed questionnaires were compiled into a dozen manuscript volumes comprising some 2,500 leaves and 2,278 sketch maps (Kiev, Vernadsky National Library of Ukraine; Wernerowa 2003, 165–92). Largely thanks to the work of Father Franciszek Salezy Czajkowski, a number of manuscript maps were produced using this data, although few survive (fig. 38) (Olszewicz 1932, nos. 187, 211, 213, 222, 223, 241; Buczek 1938). On the basis of all these materials, the royal geographer Charles (Herman Karol) de Perthées prepared detailed maps of several voivodeships at ca. 1:225,000: Poznań, Kalisz, Brześć Kujawski and Inowrocław, Płock and Dobrzyń land, Masovian, Podlachian, Łęczyca, Rawa, Kraków and the Duchy of Siewierz, Sandomierz, and Lublin (Olszewicz 1932, nos. 203, 215, 217, 224, 226, 252, 258, 261–63, 266). In the period 1792–1806, six of Perthées's voivodeship maps were published in Paris or St. Petersburg.

At the local level, plans of cities were generated by Komisje Brukowe (paving commissions, from 1659) and Boni Ordinis commissions (from 1765), bodies that were responsible for improvements to urban infrastructure and city planning. Together these commissions produced a number of urban maps for administrative purposes, but following the partitions at the end of the eighteenth century, city government passed into the hands of foreign powers.

LUCYNA SZANIAWSKA

SEE ALSO: Poland

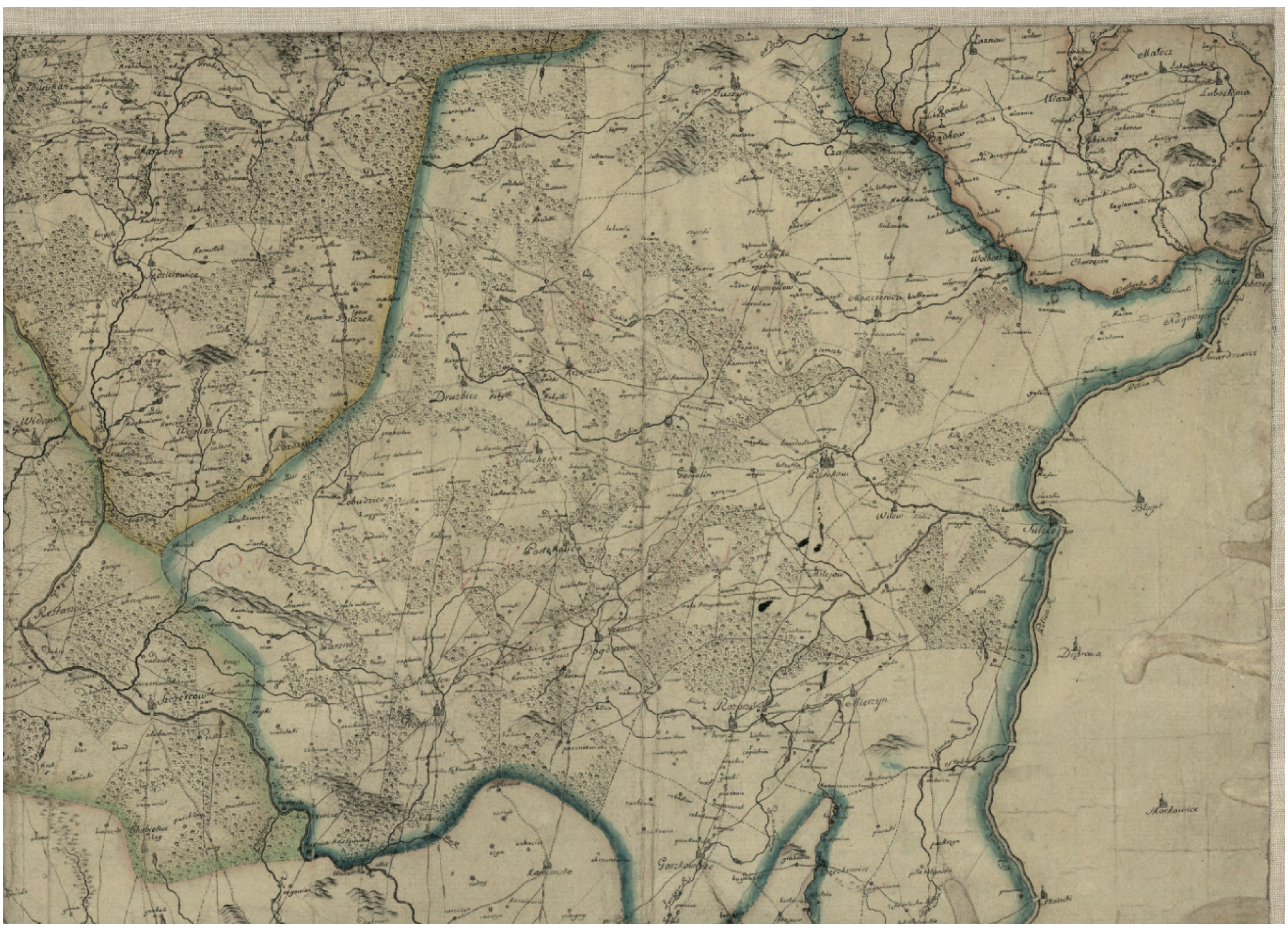

FIG. 38. DETAIL FROM A MANUSCRIPT MAP OF THE SIERADZ VOIVODESHIP, CA. 1789, BY FRANCISZEK SALEZY CZAJKOWSKI. Scale ca. 1:185,000. Colors designate the boundaries of deaneries, dotted lines show diocesan boundaries. Numerous roads are shown, relief is indicated by mole-hill symbols, and in some areas symbols indicate woods or swamps.

Size of the entire original 58.5 × 83.5 cm; size of detail: ca. 30 × 42 cm. Image courtesy of the Biblioteka Narodowa, Warsaw (BN ZZK 12 993).

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Administrative Cartography in Portugal. By the first half of the eighteenth century, cartographic knowledge in Portugal had already helped model a territorial vision for the exercise of power. Up to 1662 there existed two printed maps of the whole territory (1561, 1662) that facilitated a unified vision of Portugal (Alegria et al. 2007, 109–41, 1044–45). Beginning in the seventeenth century, many military maps favored the idea that a linear border should delimit the territory of the kingdom. In addition, there existed regional maps showing settlements, relief, vegetation, hydrographic features, drainage systems, and coastal areas (Daveau and Galego 1995, 92–98). However, no maps precisely described the administrative divisions, nor was it customary to represent geographic information on maps for administrative purposes. Finally, no institutions centralized cartographic production, nor was it possible to engrave and print maps in Portugal. For these reasons, not surprisingly, the reformist governments of the eighteenth century had to invest significantly in the cartography of the territory, demanding resources very different from those that had served the passive central administration of the Antigo Regime.

José I's famous minister, Sebastião José de Carvalho e Melo, marquês de Pombal, transformed cartography into a technical instrument in the service of the state for the first time in Portugal. Under his direction, many maps were created to demarcate agricultural regions, plan communication routes, improve river navigation, and reform economic activities (Mendes 1982). Pombal's ministry also supported the teaching of mathematics and astronomy, as well as welcoming foreign professors. These efforts explain, in part, the Enlightenment desire to produce cartographic, statistical, and demographic knowledge that characterized the subsequent governments. Moved by this desire and by the example of the Cassinis' work in France, Luís Pinto de Sousa Coutinho, minister of foreign affairs and war, ordered the execution of the general triangulation of the kingdom in 1788. He intended that this work would not only achieve scientific and military goals but also serve as a base for a "Carta geral do reino," a general map of the kingdom. To that end a geodetic committee was established, presided over by Francisco António Ciera, professor at the Academia Real da Marinha. In 1798, the first Portuguese institution oriented toward cartographic production with administrative goals was founded, the Sociedade Real Marítima, Militar e Geográfica para o Desenho, Gravura e Impressão das Cartas Hidrográficas, Geográficas e Militares, a scientific and military agency charged with publishing the "Carta geral do reino" as well as printing and publishing military and hydrographic maps and elaborating Portugal's geometric cadastre. This was the first state institution to direct geodetic work in Portugal, work precociously suspended in 1804 due to the shortage of financial and human resources and the political and military situation (wars with Spain, French invasions, and the transfer of the court to Brazil). The Sociedade was therefore limited to publishing the *Carta dos principaes triangulos das operaçoens geodezicas de Portugal* by Ciera (1803), and the completion of the "Carta geral do reino" was postponed until the following century (1856). However, the early triangulation work facilitated the appearance of very detailed terrestrial maps, such as the *Carta topográfica militar do terreno da península de Setúbal* by José Maria das Neves Costa (ca. 1813–15).

In 1790, when the geodetic survey began, the reform of the administrative division of the kingdom was also ordered, inspired by the division of territory discussed in revolutionary France the year before, based on the geometric map of Mathias Robert de Hesseln, with new demarcations following an almost Cartesian geography (*Nouvelle topographie ou Description détaillée de la France divisée par carrés uniformes*, 1780). The aim of the reform was to rationalize the whole administrative grid, previously characterized by irregularity and geographical discontinuity. To accomplish this reform, *juízes demarcantes* (demarcation judges) were nominated in 1793 to produce both exhaustive statistics and elaborate exact maps for the final demarcation of each of the kingdom's provinces. But this reform remained incomplete because the "Carta geral do reino" continued to be obstructed by political events. Without the general map, the *juízes demarcantes* could neither finalize their projects nor present scientific criteria as arguments against the vested interests of local power and ordinary Crown judges. These latter groups, acutely aware of impending reform, drew their own maps and plans to

FIG. 39. "MAPPA DA PROVINCIA D'ENTRE DOURO E MINHO," BY VILAS BOAS, AFTER 1805. The colored lines indicate boundaries of local districts and the larger *comarca* to which they belong; the table at upper right provides data by each *comarca*, from the number of cities and parishes to the number of clergy and adult men, and total populations of each. Manuscript.

Size of the original: 131 × 98 cm. Image courtesy of the Biblioteca Nacional de Portugal, Lisbon (D.94.R).

support their demarcation proposals, turning their maps into true "rhetorical devices of persuasion" (Livingstone 1992, 29).

Out of this process came one detailed and rigorous regional map, drawn by the commissioner of the province of Minho, Custódio José Gomes de Vilas Boas, a military graduate in mathematics: "Mappa da provincia d'Entre Douro e Minho levantado em 1794 e 1795, de par com as indagações economico-politicas; tudo para servir à regulação das comarcas da mesma provincia, e outros objectos de utillidade publica" (Map of the province of Entre Douro e Minho, completed in 1794 and 1795, informed by economic and political research; all to facilitate the regulation of the counties of the same province, and other objects of public use) (fig. 39). The title illustrates the relationship between administration and cartography engendered by Portuguese reformism in the late eighteenth century.

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SEE ALSO: Geodetic Surveying: Portugal; Portugal

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Administrative Cartography in Portuguese America. Administrative cartography in Portugal's American colonies was mostly performed and supervised from Portugal by the Portuguese Crown or the Conselho Ultramarino, which handled all Portuguese colonial policy. Two features characterized this activity: the impact of Portuguese colonization as it moved toward the central regions of the continent and technical changes to cartographic practice that began in the late seventeenth century.

The discovery of gold in the southeastern and central-west regions of Brazil, the Portuguese exploration of the Amazon basin, and the incessant disputes between the Spanish and the Portuguese over Colonia del Sacramento in the south all demanded better definition of both internal and external frontiers. Internal frontiers included divisions between captaincies, *comarcas* (a subdivision of captaincies originally of an ecclesiastical nature), bishoprics, and various other administrative divisions. External frontiers, by contrast, usually represented borders with Spanish American colonies. Up until this period, the border between the two Iberian monarchies had been based on the Treaty of Tordesillas, which had proposed a more or less imaginary dividing line 370 leagues to the west of an unspecified island in the Cape Verde archipelago. However, in 1720 the French geographer Guillaume Delisle read a treatise on the measurement of longitude before the Académie des sciences in which he offered a revised interpretation of the true position of the Tordesillas line, proposing new configurations of Portuguese and Spanish possessions in the Americas. Portuguese administrative authorities feared this argument would give Spain a scientific basis for its claims in America. Acting for King João V, Luís da Cunha, the Portuguese ambassador to France, even tried to stop Delisle from publishing his treatise by offering money, but to no avail (Furtado 2012, 307–8). Treaties following the War of the Spanish Succession—Utrecht (1713), Madrid (1721), and Cambrai (1720)—also had important repercussions for South America, including Colonia del Sacramento, which had until then been considered Portuguese territory.

In the context of these major European diplomatic negotiations, in 1719 the Conselho Ultramarino began to encourage the production of maps of Brazil, initiatives that included sending the Jesuits Domenico Capassi and Diogo Soares, also known as the *padres matemáticos*, to Brazil in 1729 to undertake a major cartographic survey whose maps would be collected in the "Novo atlas da América portuguesa." This period coincided with the reign of King João V, which saw a major change in the instructional methods for military engineers who surveyed the empire's holdings. A more practical orientation, emphasizing technical uniformity and implementing a more schematic and universal language, was reflected in new technical manuals such as Manoel de Azevedo Fortes's *O engenheiro portuguez* (1728–29). Jesuits were important surveyors of Brazil, like Jacobo Cocleo who drew the "Mapa da maior parte da costa, e sertão, do Brazil" (1699/1700)—the first to represent surveyed geographical information of the interior of Brazil (fig. 40). Many other surveyors were Portuguese military engineers, such as Tomás Robi de Barros Barreto, who mapped the southern and southeast coast of

FIG. 40. JACOBO COCLEO, “MAPA DA MAIOR PARTE DA COSTA, E SERTÃO, DO BRAZIL,” 1699/1700. Size of the original: 224 × 1205 cm. Photograph by Paulo Schettino. Permission courtesy of the Arquivo Histórico do Exército, Rio de Janeiro (n. 23–24.2798; CEH 1530).

Brazil. A third group contributed to the cartographic effort: intrepid expeditionaries known as *bandeirantes*, who traveled from São Paulo through the captaincies of Minas Gerais, Mato Grosso, and Goiás and produced maps recording routes and interior spaces throughout the colony. The Biblioteca Nacional in Rio de Janeiro holds an important collection of these so-called *mapas de sertanistas*. While Jesuits played an important role in this cartographic project, their objective focused on areas central to their missionary activities, such as the missions in the extreme south of Brazil and those in the Amazon basin, exemplified by *Paraquariæ provinciæ Soc. Iesu* (different versions of 1647, 1726, 1732 [see fig. 757]) and Father Samuel Fritz’s *El gran Rio Marañon, o Amazonas con la mission de la Compañia de Iesvs* (1707), respectively.

In 1746, Alexandre de Gusmão, secretary to João V, ordered the “Descripçam do continente da America Meridional,” a consolidation of geographic knowledge of Brazil created under the supervision of the governor António Gomes Freire de Andrade in Brazil. This manuscript map was one of the sources for the so-called Mapa das Cortes (“Mapa dos confins do Brazil”), a manuscript produced from textual and cartographic sources under Gusmão’s direction in Portugal (see fig. 447). In 1749, two manuscript copies were made in Lisbon, called *mapas primitivos* (primitive maps); in 1751 six more copies were made—three in Lisbon and three in Madrid—to be distributed to Luso-Hispanic boundary expeditions. The Mapa das Cortes was employed in the negotiations for the 1750 Treaty of Madrid, terms of which were based on the principle of *uti possidetis*, which posited that disputed land belonged to the power that had populated and colonized the territory and was in possession at the time of the treaty. Despite the renegotiation of these boundaries in the treaties of Pardo (1761) and Santo Ildefonso (1777), from 1750 onward Portuguese America began to acquire a form that very much resembles Brazil’s territorial configuration in the twenty-first century.

The Luso-Hispanic boundary expeditions marked with previously unmatched precision the territorial divisions between the two Crowns and produced many cartographic documents, including those of the Portuguese cartographer António Pires da Silva Pontes Leme, who became a member of the demarcation commission, Comissão de Demarcação das Divisas entre os domínios Portugueses e Espanhóis in 1780. Under orders from the overseas secretary, Rodrigo de Sousa Coutinho, Pontes Leme and Miguel António Ciera produced the “Carta geografica de projecção espherica da Nova Lusitania ou America portugueza e estado do Brazil” (1797) (Costa et al. 2004, 151; and see fig. 633).

Administrative cartography was not limited to questions involving external boundaries of Portuguese America. The colonization of Brazil also demanded the precise demarcation of administrative divisions between captaincies, *comarcas*, bishoprics, and towns, as well as the accurate representation of rivers and routes that penetrated into the interior. For example, between 1778 and 1800, the military engineer José Joaquim da Rocha produced various maps that portrayed the captaincy of Minas Gerais either in part or whole. Rivers attracted cartographic attention, since they represented routes of territorial penetration as well as natural dividing lines for internal frontiers, the most prominent being the Maranhão, Amazon, and Tocantins in the north; the São Francisco, Doce, and Tietê in the southeast; and the Plata, Grande, Uruguay, and Iguaçu in the south. Guarding the coast against intruders also required mapping Brazil's ports, islands, inlets, and fortifications. Jacinto José Paganino's vast mapping project of 1784, the *Roteiro occidental para a navegação da costa, e portos do Brasil*, fits within this context and presents an overview of Brazilian coastal features.

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SEE ALSO: Portuguese America

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Administrative Cartography in Russia. The high point in Russian administrative cartography before the reforms of Peter I in the early 1700s centered on the work of the talented scholar Semën Ul'yanovich Remezov, whose general and regional maps provided the first detailed geographical, historical, and cartographic descriptions of Siberia. Remezov compiled three collections of maps and *chertëzhi* (geographical drawings): the "Chertëzhnaya kniga sibiri" (1699–1701), the "Khorograficheskaya chertëzhnaya kniga" (1697–1711), and the "Sluzhebnaya chertëzhnaya kniga" (1702–30), the latter completed posthumously. All three atlases were compiled in manuscript. Under the Boyar Resolution of 1696, one of the earliest government directives for Russian mapmaking (I Polnyy suod zakonov [PSZ] Rossiyskoy imperii, tom 3, no. 1532; *Polnoye sobraniye* 1830, 3:217), Remezov was assigned to produce the most celebrated of the three, the "Chertëzhnaya kniga sibiri."

A systematic program of government-led geographical exploration and mapping began after Peter I proclaimed the Russian Empire in 1721. Peter I's General'nyy reglament (1720) included a chapter on land maps and national drawings, in which he asked every government department to have on hand general and particular land maps or *chertëzhi* of boundaries, rivers, cities, towns, villages, churches, forests, and so forth (PSZ, tom 6, no. 3534; *Polnoye sobraniye* 1830, 6:157). From this point forward, many maps were linked to specific national initiatives.

The rapid development of commerce and industry under Peter I put Russian cartography to new uses. Everywhere the old techniques were inadequate to accomplish the new tasks. Maps had the potential to become engineering documents with precisely defined metric properties. Traditional Russian mapmakers lacked not only survey and cartographic expertise, but knowledge of mathematics as well. The need for organized scientific training was apparent.

In line with European reforms, Peter I created new institutions for specialized training. After the short-lived Shkola tsifiri i zemlemeriya, a school of arithmetic and land measuring that burned down in 1699, the first systematic training for surveyors (geodesists) began at the school of mathematics and navigation, Moskovskaya matematiko-navigatskaya shkola, founded by Peter I in Moscow in 1701. After 1715, this training relocated to St. Petersburg's Morskaya akademiya, the naval academy founded the same year. Before it closed in 1752, the Morskaya akademiya trained most of the Russians skilled in surveying, cartography, and geodesy during the first half of the eighteenth century.

Among its varied course offerings, the Moscow school offered classes in trigonometry (linear and spherical), navigation (planar and Mercator or chart navigation, circle navigation, and great-circle arc navigation), keeping a ship's log, practical astronomy, elementary surveying, and geography (Sergeyev 1954). The chief instructors were Henry Farquharson and Stephen Gwyn, who were recruited by Peter I from Britain. Leontiy Filippovich Magnitskiy, a prominent Russian mathematician, taught geometry and trigonometry and assisted Yakov Vilimovich Bryus in astronomy and geodesy.

Not all graduates sought employment in cartography; the Moscow school was the first specialized institution of higher education in Russia producing for all economic sectors of the rapidly developing nation. The Russian navy, whose officers performed many topographical tasks, was one of the main employers of surveyors. Maps were required for countless other administrative purposes: building dams and canals, locating mineral deposits and timber forests, and expanding fortifications and lines of communication. In these diverse undertakings, the majority of skilled labor had received the same training under the same instructors at the same two schools—the Moskovskaya matematiko-navigatskaya shkola and the Morskaya akademiya. Consequently, early modern Russian mapmakers often held similar opinions concerning the purpose of cartographic activities and how to conduct them.

At the beginning of Peter I's reign, administrative surveys often synthesized older reconnaissance methods with scientific methods then current in Western Europe. One early set of official instructions in manuscript, "Punkty kakim obrazom sochinyat' landkarty," called for surveyors to plot one instrument course per district. An iron "measuring chain 10 or 30 sazhens long" (one sazhen = 2.134 m) was to be used to measure lines, while astrolabes with diopter sights measured the compass points of course lines. The instructions also called on surveyors to determine the distances between villages by making inquiries "according to descriptions by the inhabitants," along the instrument course (Moscow, Rossiyskiy gosudarstvennyy arkhiv drevnikh aktov, f. 248, stol. 14, stlb. 1201, stolpik 53; O geodezistakh). Distances determined in this way, when compared with those measured by the chains, yielded a corrective factor to the distances measured off of by description alone. The instructions called for the extensive use of intersections to determine positions. Latitudes on the intersections of roads with district boundaries served as an additional control. In practice, however, latitude measurements were usually taken only in provincial capitals.

By the 1730s and 1740s Russian surveyors were operating under more scientific guidelines. They were determining their latitude from observations of meridian solar elevation and their longitude from calculations of the distances and differences in the latitudes of individual points. These control procedures made it possible to combine maps of different territories (special maps) to generate maps of the major regions of the country (particular maps) and the empire as a whole (general maps). The emergence of this scientific and technical orientation, already prized in Europe, allowed Russian cartographic works to enter the atlases and compilations of major European scholars of the period.

By the 1750s, all aspects of Russian field cartography (organizational, technical, and personnel) had become integrated into state service. From Peter I's reign onward, the senate was largely responsible for the organizational and technical supervision of mapmaking; prominent Russian officials Ivan Kirilovich Kirilov and Vasiliy Nikitich Tatishchev played a major role in drafting the instructions and programs for surveys. At the Akademiya nauk in St. Petersburg, Joseph-Nicolas Delisle, Leonhard Euler, and Andrey Dmitriyevich Krasil'nikov developed mathematical frameworks for determining geographical coordinates and devising cartographic projections.

Surviving handwritten maps from the first half of the eighteenth century show us how much of Russia was surveyed during the period. In 1727, Russia consisted of 285 *uyezd*s (administrative districts); by the 1740s the number had increased to 298. Geodesists mapped at least 241 *uyezd*s, or about 81 percent of the total. Such surveys, maps, and geographical descriptions provided abundant material for making atlases and general maps of Russia in the 1730s and 1740s. Yet a completely new astronomic and geodetic foundation was needed before those maps could be united into a single national picture (Goldenberg and Postnikov 1996, 36).

The key figure in this transition was Joseph-Nicolas Delisle. The gifted French astronomer arrived in St. Petersburg in 1726 to oversee astronomic, geographic, and cartographic work at the Akademiya nauk. His role in Russian cartography has been much debated. Some attribute to him a new era in Russian mapmaking. Others accuse him of two decades of excuses and delays in compiling the Akademiya nauk's *Atlas Rossiyskoy*. Delisle spent fifteen years drafting numerous training and management proposals and a cumbersome program attempting to combine astronomic, geodetic, and cartographic work. These proposals undoubtedly had important theoretical and methodological value, but they bore little relation to the actual situation on the ground. An enormous, almost entirely unmapped country lay waiting. Delisle wanted to implement a triangulation network like the one developed by the Cassinis in France as the basis for putting together individual field surveys. But triangulation was impractical, requiring too much time and effort. As Delisle's colleague at the Akademiya nauk, Euler, expressed it: "Surely it would be possible to draw perfect maps if the whole of the Russian Empire was triangulated. But any rational man, realizing that such an undertaking could not be carried out in fifty years, would agree that the published maps are better than none at all" (*Materialy dlya istorii* 1895, 8:501). Delisle's and other European classic notions of

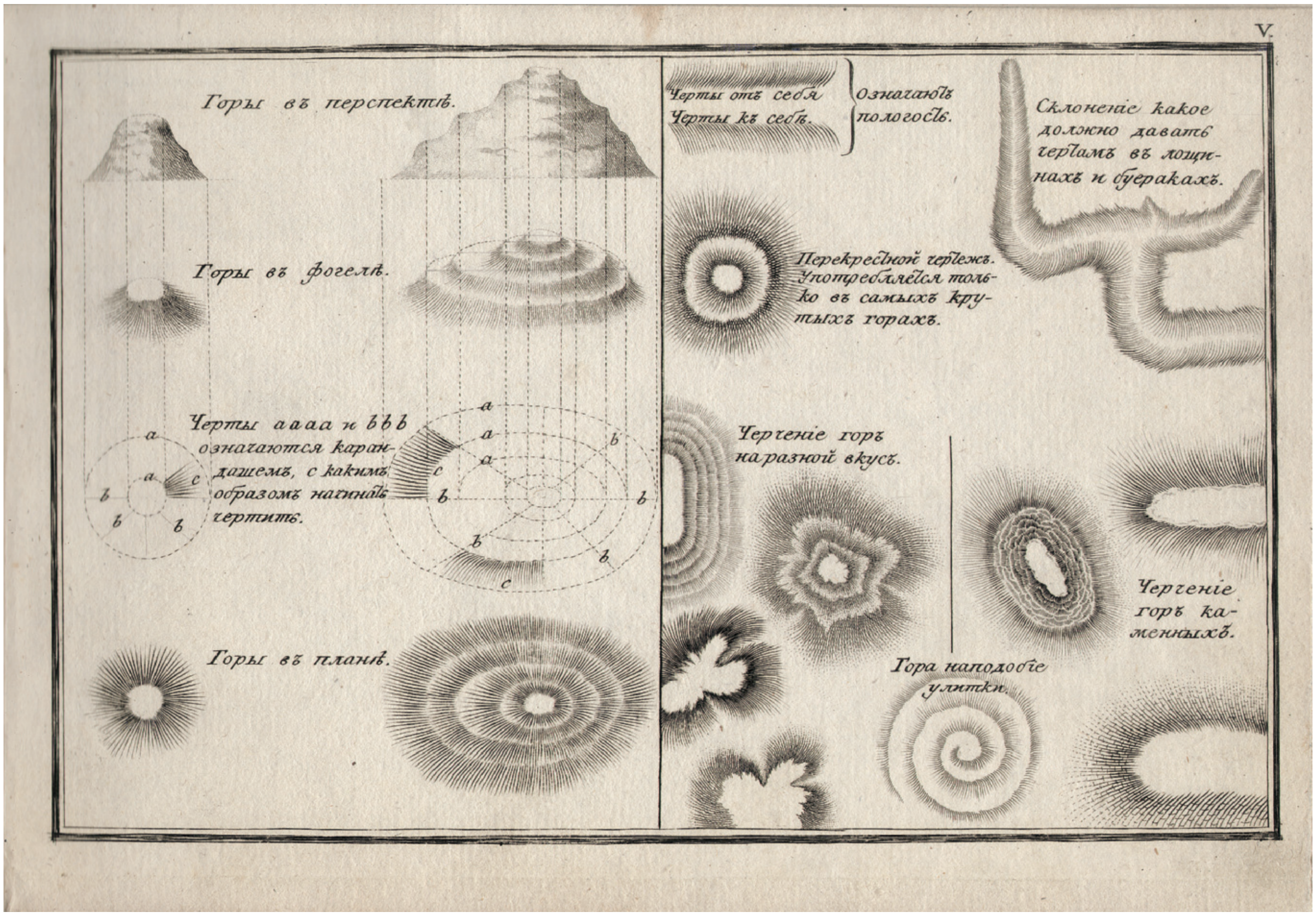

FIG. 41. SEMËN LUKIN, METHODS OF RELIEF DEPICTION, [179–]. From Lukin's basic study in mapmaking, *Nachal'noye osnovaniye situatsii, zaklyuchayushcheye v sebe vse, chto izobrazhaetsya na topograficheskikh, chastnykh kartakh i voennykh planakh v pol'zu uprazhnyayushchikhsya v sey nauke* (Moscow), table V, showing the different methods of relief depiction practiced by the Russian military at the end of the eighteenth century, as maps were prepared for the war ministry.
Size of the original: 16 × 23 cm. Image courtesy of the Rossiyskaya gosudarstvennaya biblioteka, Moscow (Cartographical Department, Code No. Ko 108/IX-40).

geodesy and cartography were accepted in theory and education, but most would not be used in Russian surveying until the late eighteenth century and mainly by military topographers. As in other European countries, triangulation would become the main method of geodetic control in Russia in the nineteenth century.

The most impressive results of Petrine surveying were Kirilov's maps and the *Atlas Rossiyskoy*, which finally appeared in 1745. Kirilov began his grand project to publish an atlas and a general map of the Russian Empire at the height of senate surveying and just as Delisle appeared on the scene. Originally intended to comprise three volumes, each with 120 printed maps, the *Atlas vserossiyskoy imperii* was overambitious in scope. Only thirty-seven maps were published, twenty-eight of which have survived. Kirilov published them in sets in 1731, 1732, and 1734, but no others appeared, and the grand atlas was never completed. Four copies of these sets of maps, known as the Kirilov atlases, along with eleven separate sheets, have survived. The *Atlas Rossiyskoy*, published by the Akademiya nauk, was Delisle's crowning achievement before returning to Paris in 1747. Certainly it provided a more complete picture of the whole country than Kirilov's maps had, but it had flaws. Many of its shortcomings resulted from the Russian government's policy of secrecy regarding geographical discoveries such as those of the Kamchatka Expeditions. Moreover, there was not at that time in Russia any central general map storage institution comparable to the Dépôt des cartes in France. Not until the next large-scale survey and cartographic effort, the General'noye mezhevaniye, which began under Catherine II in 1765, did the coordination the Russians had long sought come into being.

Further cartographic efforts manifest in the Petrine reforms were the changes to the military hierarchy and training institutions. An army charter of 1716 established a special officer, the quartermaster general, who was responsible for compiling maps of battles and for planning military campaigns. The Shlyakhetnyy kadetskiy korpus, an aristocratic cadet corps founded in 1731, became a center of cartographic education with a curriculum that emphasized topographical map training for infantry officers. The needs of the state were met in 1763 with the creation of a general staff that compiled maps for the war department, Voennaya kollegiya. By the 1760s and 1770s, the general staff was producing teaching materials for training staff members (fig. 41), including a text on practical geometry by Stepan Ivanovich Nazarov (1761) and standardized keys for symbols (Postnikov 1996, 46–48).

Administrative cartography in Russia, at least during the first half of the century, had as its main goal the compilation of a general map (or atlas) based on reconnaissance surveys with inadequate geodetic controls, consisting mainly of astronomically determined coordinates of latitude. As a result of these surveys, a mass of cartographic and descriptive materials were collected, which survived mainly in manuscripts and are reflected in a number of printed maps and two main atlases of the country by Kirilov and the Akademiya nauk. This was a transitional period between the traditional Russian practice of *chertëzhi* and surveys and mapmaking according to the European scientific practices of mathematical geography.

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see also: Delisle Family; Euler, Leonhard; Kirilov, Ivan Kirilovich; Russia; Tatishchev, Vasiliy Nikitich

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Administrative Cartography in Spain. Throughout the eighteenth century, administrative cartography developed in Spain in three distinct areas: large-scale local cartography of parcels, plots, and fields (cadastres, hydraulic works, and irrigation canals); maps of administrative boundaries (bishoprics, provinces, judicial counties, and municipal districts); and maps of frontiers.

From 1714, the reform-minded Bourbon monarchy created diverse cadastres that evolved into large-scale local cartography. The Spanish Crown initially obtained cadastral information for the territories of the old Crown of Aragon, precisely those political forces that had opposed the installation of the Bourbon dynasty. The cadastre of Catalonia began in 1715 under the supervision of the *intendente* José Patiño (Catastro de Patiño). Although most preserved documentation on Catalonia lacks plans of parcels, some municipalities, such as Solsona, were the subject of large-scale mapping. In order to expedite mapping, in 1728 the Spanish Crown created a Cuerpo de Geómetras, which combined two kinds of specialists: the *geómetras* (geometrists) and the *expertos* (experts) (Burgueño 2009). Although cadastres were created for the remaining territories of the old Crown of Aragon, current historical research has not revealed whether they included plans of parcels.

In 1749, Zenón de Somodevilla y Bengoechea, marqués de la Ensenada, began production of two cadastres for the Crown of Castile: the Única Contribución and the Planimetría General de Madrid. The former, also known as the Catastro de Ensenada, affected all the territories of the old Crown of Castile, with the exception of the *forales* (counties with their own distinct fiscal and administrative rights) of Navarre and Basque Country. Work was interrupted in 1754 following Ensenada's fall from power. Nonetheless, between 1749 and 1754 information on nearly 15,000 municipalities of the Crown of Castile had been compiled for fiscal purposes, although reform of the tax code was not completely achieved. The quality of the resulting cadastral plans varied substantially among provinces, from carefully measured municipal boundaries to schematic drafts (Camarero Bullón 2007).

Ensenada's second cadastral effort beginning in 1749 had greater success. Having decided to reform the local tax (the *regalía de aposento*, or right of lodging, implemented by Felipe II for Madrid, 1561), Ensenada commissioned a group of architects, including Nicolás de Churriguera and Ventura Padierne, to inspect all houses in Madrid between 1750 and 1751. The *visita general* resulted in 567 parcel plans at ca. 1:300. The same architects created the official Planimetría General de Madrid between 1757 and 1762, including a new group of parcel plans at different scales, in six volumes, accompanied by the manuscript "Libro registro de las casas de Madrid" (also in six volumes). Its accuracy ensured that the Planimetría General de Madrid was the best collection of parcel plans of eighteenth-century Spain. The organization of this survey was based on the *Topographia de la villa de Madrid* (1656) by Pedro Teixeira Albernaz at ca. 1:1,840. The blocks of buildings drawn in this old plan were used to organize the Planimetría General such that each block of buildings (*manzana*) corresponded to one parcel plan (557 *manzana*s total) (Camarero Bullón 1989).

During the second half of the eighteenth century, many state-sponsored hydraulic works required large-scale cartography. The "Plano topográfico de la Albufera de Valencia" (ca. 1:36,304), initially attributed to Joan Baptista Romero, but which was made by an unknown cartographer after 1780, exemplifies such a land-measuring project by Valencian land surveyors (Faus Prieto 1995, 90–96; Sanchis Ibor 2001, 24). The "Plano ignographico: Que figura el ambíto del Estanque de Castellón según su actual estado" (1763) by Josep Ribas demonstrates similar hydraulic activity in Catalonia. The preparation of this map was ordered by the cathedral chapter of Girona Cathedral to resolve a land dispute with the Benedictine monastery of Sant Pere de Rodes (Ribas i Torres 2001, 64–72); the maps are now stored in the archive of Girona Cathedral.

In fact, the Catholic Church was another administrative body reliant on maps, using them to reinforce ecclesiastical boundaries, to resolve disputes over those boundaries, and to show the territorial power of the bishop. Between 1662 and 1797 at least thirty-two different maps of twenty-six bishoprics were produced by private surveyors. A series of six maps corresponding to the bishoprics of Barbastro, Huesca, Jaca, Tarazona, Teruel, and Zaragoza were published for the first time in the 1662–65 Latin edition of the *Atlas maior* of Joan Blaeu, who used rich geographical information from the *Descripcion del Reino de Aragon* (ca. 1:276,000) published in 1619 by the Portuguese cartographer João Baptista Lavanha. The publication of these maps was exceptional in the panorama of Spanish cartography at that time, drawing their basic content from Lavanha's Aragon map (Hernando 1996, 69–70). The *Toletvm hispanici orbis vrbs, augusta*, a map of the archbishopric of Toledo (ca. 1:592,000), was published in 1681 by order of the cardinal Luis Manuel Fernández de Portocarrero, head of the Spanish Catholic Church and chief of the Castilian party that established the dynasty of the Bourbons in Spain in 1700.

After a long lull in production of ecclesiastical cartography, historian and Augustine friar Enrique Flórez de Setién published his magnum opus, *España sagrada: Theatro geographico-historico de la Iglesia de España* (27 vols., 1747–72). Tomás López engraved maps of several bishoprics for this work from the designs of various cartographers, including royal archivist Francisco Xavier de Garma y Durán (*Mapa del Obispado de Barcelona*, ca. 1:290,000) and geographer José Cornide de Folgueira y Saavedra, who supplied maps of the bishoprics of Orense (1763) and Mondoñedo (1764). López prepared and engraved a map of Toledo (fig. 42) produced from the information gleaned from geographical questionnaires (Jiménez de Gregorio 1966).

Another sort of ecclesiastical map was the parish plan. In the archive of the Barcelona bishopric are plans of the parish of Sant Genís de Vilassar (1777), Santa Maria de Foix, and Santa Maria de Lavit, made during the eighteenth century. The plans were prepared chiefly by order of Barcelona's bishop to resolve disputes within one parish over moving or preserving the location of the parochial church or to maintain the independence of the parish (Puigvert i Solà 2001, 40–41).

A diverse and complex state territorial administration required specific cartography of regional territories. Tomás López prepared most of the maps of the provinces derived from the old kingdoms of Castile and Aragon and the Basque fiefdoms. Between 1765 and 1786, López engraved and printed maps of the eighteen provinces at several scales, and he authored sixteen maps of *partidos judiciales* (judicial boundaries) between 1784 and 1794. In contrast to Castile and Aragon, the *corregimientos* (counties) of 1716 in Catalonia were the basis of territorial organization in the later eighteenth century. Oleguer Taverner i d'Ardena, comte de Darnius, compiled maps of several *corregimientos* between 1716 and 1726 (fig. 43) (Montaner 2007) as did Josep Agustoni ("Mapa del corregimiento de Cervera, principado de Cataluña," ca. 1:458,000, 1793). Agustoni used the maps of Catalonia of Josep Aparici and Tomás López as sources for his map, which was ordered by the chief of the *corregimiento*, Jaime Doile y Gueran, to enhance political control of the territory and for use by the court of justice and for fiscal purposes (Burgueño 2001, 402–3).

In general, municipal lawsuits or jurisdictional disputes of the landed gentry generated the plans of municipal boundaries, for example, the anonymous "Plano en que consiste el término de Almacellas con sus confrontasiones" (1690) and, most notably, the *Huerta, y contribución particular de la ciudad de Valencia* (1695,

FIG. 42. *MAPA GEOGRÁFICO DEL ARZOBISPADO DE TOLEDO,* TOMÁS LÓPEZ, MADRID, 1792. One map in four sheets engraved by López, ca. 1:530,000. An example of administrative cartography employed by the church, this map was produced with information gleaned from the geographical questionnaires that went to all parishes of the diocese of Toledo in 1782 on the order of cardinal Francisco Antonio de Lorenzana, archbishop of Toledo.
Size of the entire original: 77 × 80 cm; size of each sheet: 38.5 × 40.0 cm. Image courtesy of the Biblioteca Nacional, Madrid (GM. Mr/2).

ca. 1:23,800) by the Jesuit Francisco Antonio Cassaus, engraved by Ascensio Duarte, which is one of the first Spanish maps to show municipal boundaries of one borough resulting from the organized marking of boundaries. In the eighteenth century, the mathematician Antonio Bordázar de Artazu surveyed the municipal boundaries of the city of Valencia, known from the Middle Ages as the Particular Contribución, between 1735 and 1743; the land surveyor José Rispo continued the work in 1765 (Faus Prieto 2009). This early survey was made by order of the municipal council of Valencia as consequence of the *equivalente*, or Valencian cadastre, established in 1714 by the Bourbon monarchy. It aimed to resolve the territorial disputes arising among the municipal council of Valence, the royal authorities, and individuals, which resulted from the new fiscal duties imposed by the Bourbon regime (Faus Prieto 1995, 72–81). On the other hand, a court battle between the municipality of Vilanova i la Geltrú and the municipality of Cubelles for grazing rights and municipal boundaries, resulted in the "Plano del término de Villanueva y Cubellas exactamente levantado en que se hallan en su devida situación los pueblos," prepared before 1767 by an anonymous cartographer (Burgueño and Mercè Gras 2014, 53–55).

Toward the end of the eighteenth century, the Spanish state focused on mapping the national frontiers. Created in 1784, the Comisión Hispano-Francesa de Límites, also

FIG. 43. "CORREGIMIENTO DE BARCELONA" [1716–20], MANUSCRIPT BY OLEGUER TAVERNER I D'ARDENA, COMTE DE DARNIUS. The *corregimientos* of 1716 in Catalonia were the basis of territorial organization in the later eighteenth century. Size of the original: 19 × 19 cm. Image courtesy of the Institut Cartogràfic de Catalunya, Barcelona (RM.250106).

known as the Caro-d'Ornano Commission, was charged with mapping the border with France along the Pyrenees, among other tasks. *Mariscal de campo* Ventura Caro presided over the Spanish commission, which collaborated with the French commission to produce the multisheet "Mapa topografico de los Montes Pirineos" (ca. 1:14,000) between 1786 and 1791 (see fig. 123) (García Álvarez and Puyo 2015, 9–11). Boundary surveying also took place along the long frontier between Spain and Portugal, with whom Spain maintained very tense relations throughout the eighteenth century. The "Mapa o carta geografica de la línea de demarcación que divide los Reynos de España y Portugal," ca. 1:428,000, by military engineer Antonio de Gaver, illustrated his general reconnaissance of the Hispano-Portuguese boundary in 1750, known from the copy made by Cayetano Zappino in 1797.

Throughout the eighteenth century the new Spanish Bourbons undertook several projects to improve and modernize the administrative cartography of Spain. This policy of modernization began with the establishment in 1715 of the cadastre in the lands of the old Crown of Aragon, producing a few interesting cadastral plans of Catalonia. When Ensenada became head of the Spanish government, he ordered the general cadastre for the old Crown lands of Castille in 1749, as well as the completion of a cadastre of wealthy Madrid, the Planimetría General de Madrid. Despite these beginnings, the effort to create a general map of Spain similar to the Cassini map of France failed. The prolific cartographical contributions of the mapmaker Tomás López filled, in part, the cartographic lacunae resulting from this failure.

FRANCESC NADAL

SEE ALSO: López de Vargas Machuca, Tomás; Spain

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Administrative Cartography in Spanish America. During the last decades of Habsburg rule (1650–1700) and under the Bourbon dynasty (1700–), the Spanish Crown sought to rationalize and render uniform its institutions and methods of government, to improve defenses against encroaching European empires, and to raise revenues. This agenda increased demand for, creation of, and reliance on maps as tools to represent and communicate knowledge about Spanish America by and to royal officials on both sides of the Atlantic. Administrators relied increasingly on maps to divide secular and religious jurisdictions, represent major crops, resolve territorial disputes, and implement fiscal policies.

To acquire information presented in maps, Crown agents relied on traditional administrative practices—in particular officials' mandated *visitas* of their military, civil, and ecclesiastic jurisdictions and production of *relaciones geográficas*, reports detailing geographic, demographic, economic, political, ecclesiastic, and other information. However, they increasingly demanded maps by mapmakers trained in mathematics and surveying. European-born scientists, military engineers, ship pilots, and Jesuit missionaries were the most prolific of Spanish America's cartographers, while a growing number of Spanish American (Creole) savants could and did execute maps of private land and protonational spaces. Topographic maps highlighting disputed public and private estates, internal city districts, fortifications, roads, postal routes, coastal profiles, and hydrographic soundings constitute most of this cartographic repertoire.

Until the late eighteenth century, most administrative maps were created and distributed in manuscript form, often as part of extensive court cases or reports that relied as much on oral testimony and descriptions of site visits (*visitas de ojos*) as on graphic representation. Reflecting Spanish categories, these were topographic or iconographic maps depicting a single jurisdiction (such as a city, parish, province, or kingdom) or relating to defense (plans of coasts, roads, waterways, or fortresses) or settlement (new missions, frontier areas); they differed from chorographic maps showing a *país* or region or general maps of more extensive terrain (López 1775–83, 1:5–6). Maps meant for daily use or imperial decision making ranged from building plans and schematic diagrams to painted drawings to technically sophisticated topographic maps. Increased mapping by state agents helped the Spanish Bourbons plan reforms and "enabled the imagination of a different reality, more orderly than that existing, and that sometimes the viceregal administration succeeded in modifying" (León García 2009, 445–46) (fig. 44).

VISITAS In the sixteenth century, the Crown learned about its American territories by sending royal officials on *visitas*, or inspection tours. The eighteenth-century increase in administrative cartography began with scientific expeditions under Felipe V (r. 1700–1746) and expanded with more practical bureaucratic, military, and ecclesiastic *visitas* dispatched by Carlos III (r. 1759–88) and his successors to reorganize and improve colonial

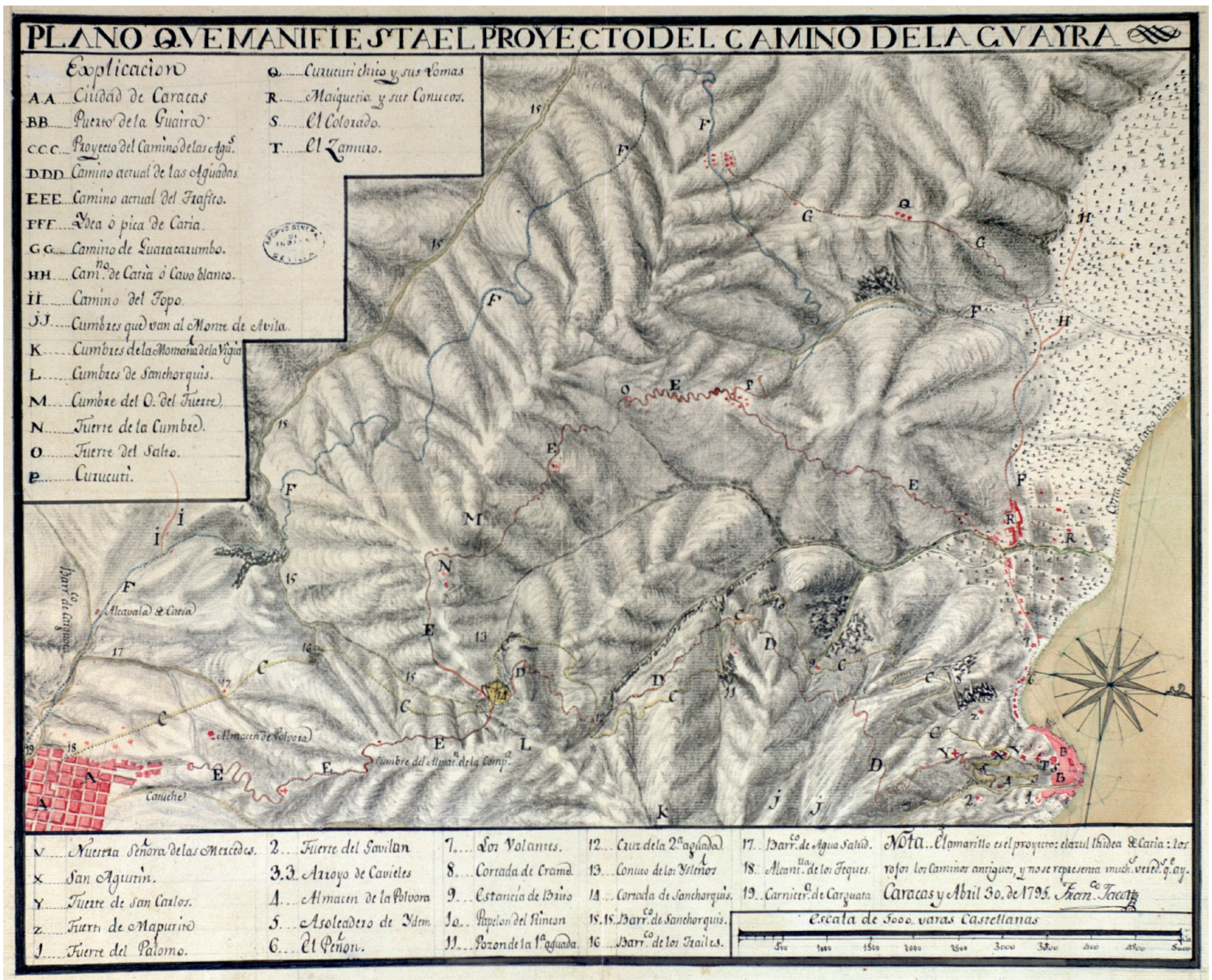

FIG. 44. FRANCISCO JACOT, "PLANO QVE MANIFIESTA EL PROYECTO DEL CAMINO DE LA GVAYRA," 1795. Manuscript, scale of 5,000 varas castellanas = 13.7 cm (ca. 1:30,732). The plan to open a road into Venezuela was submitted with a letter from the Consulado de Caracas, 12 May 1795.
Image courtesy of España, Ministerio de Cultura y Deporte, Archivo General de Indias, Seville (MP, Venezuela, 235).

administration. Most scientific expeditions—whether focused on astronomy, botany, or hydrography—included military or naval engineers trained as cartographers, as did military *visitas*. The engineers mapped from the Caribbean to the Amazon, helping to develop defense strategies and to keep central authorities informed. Agustín Crame, *visitador general de las fortificaciones de América* in the 1770s, prepared detailed plans of fortified cities and isolated forts to improve defenses in the West Indies and Central America (Sanz Camañes 2004, 384). Often working with missionaries who participated in expeditions that sought greater religious and secular control, military engineers like Nicolás de Lafora and José de Urrutia promoted Spanish administration of frontier and borderland areas by creating extensive maps based on astronomic observations and territorial measurements that facilitated communication between military officers and local governors to report on progress in efforts to limit indigenous threats. Lafora and Urrutia's maps and documents from the 1766–68 expedition of Cayetano Pignatelli, third marqués de Rubí, influenced the subsequent policy of establishing settlements and a defense strategy that relied on forts (*presidios*) as well as missions in New Spain's northern borderlands (Reinhartz 2005, 66–68), but served as a general tool of governance in which church and civil officials collected information by traveling and writing reports that increasingly included maps.

Franciscan and Jesuit mathematicians and surveyors conducted separate religious *visitas*, mapping mission areas from Alta California to Paraguay. They contributed to administrative mapping by creating maps that helped religious and secular authorities govern and conquer and by training colonial residents in surveying techniques. The Jesuit order emphasized the natural sciences in their courses that trained colonial students such as José Antonio de Alzate y Ramírez. Jesuit topographic maps respected conventional symbols, incorporated latitude and longitude often determined through astronomical observations, and informed their audience about South American interiors and New Spain's peripheral areas. Their maps of modern California, Argentina, and Paraguay depicted not only rivers and settlements, but abandoned missions, autonomous Indian communities, and select natural and economic features, such as salt pans. As the Puebla-born Jesuit Miguel Venegas wrote in his natural history, *Noticia de la California* (1757), "such maps, when accurate, are the principal advantage of these enterprizes" (Venegas 1759, 2:71). Venegas's text highlights the important role of the religious orders as Crown agents, the possible limits they had on influencing policy, and the collaboration between religious and military cartographers. The expulsion of the Jesuits from Spanish America in 1767 left the task of creating historical-geographical descriptions to other monastic orders and secular clergy, who lived uncloistered among principally nonindigenous parishioners.

Throughout the century, the church produced or used cartography for evangelization and administration, improving knowledge of terrain and inhabitants of Spanish America's inland areas as the military focused on coasts and frontiers. Bishops and secular authorities used or created maps to administer or change parish and bishopric jurisdictions. In 1768–70, the *visita* of Archbishop Pedro Cortés y Larraz to the parishes of present-day Guatemala and El Salvador produced an extensive "Descripción geográfico-moral" (Cortés y Larraz 2001) of the diocese illustrated with several painted parish maps (fig. 45). As part of the project of the archbishop of New Spain to redistrict indigenous parishes in Mexico City, Alzate y Ramírez produced a map as a proposal (Mundy 2012, 51–52). Similarly, in 1779, New Spain's *audiencia* (high court) had a military engineer create a geographic map of the archbishopric to identify parishes to assign to the new bishopric of Nuevo León (Seville, Archivo General de Indias [AGI], MP-Mexico, 352).

Starting in the 1760s, the Crown dispatched civilian *visitadores*, responding in part to news of corruption and abuses contained in military reports, such as Jorge Juan and Antonio de Ulloa's *Noticias secretas*. The *visitas* by José de Gálvez to New Spain (1765–72), José Antonio de Areche to Peru (1777–87), and Juan Francisco Gutiérrez de Piñeres to Nueva Granada (1778–83) not only led to improved tax collection (and some serious revolts) and recommendations for military reform, but accelerated evaluation and overhaul of territorial jurisdictions with the information acquired through *relaciones geográficas* in the 1780s. The resulting new orders for governors made mapping integral to their responsibilities.

RELACIONES GEOGRÁFICAS While military engineers and religious administrators introduced and applied new cartographic methods, the traditional sixteenth-century *relación geográfica*, or "mapping by questionnaire," continued, evolving to reflect Enlightenment preference for firsthand accounts based on proven, reliable knowledge and transitioning from the work of untrained cartographers to demanding that of trained mapmakers. The consistent inclusion in reports of maps as a form of knowledge for governance was concomitant with an understanding that maps were incomplete without corresponding political, demographic, and economic information.

On 19 July 1741, the Council of the Indies dispatched a royal *cédula* (decree) to all overseas territories instructing viceroys to ask governors to assemble information about the numbers and names of settlements, their residents, and the progress of missions in conquest and con-

FIG. 45. "MAPA DEL CURATO DE ZACATECOLUCA," 1768. This manuscript watercolor map was one of dozens to accompany the *visita* of Archbishop Pedro Cortés y Larraz in Guatemala in 1768. The impressionistic map of the parish of Zacatecoluca, in today's El Salvador, emphasizes natural features as well as settlements. Size of the original: 20 × 33 cm. Image courtesy of España, Ministerio de Cultura y Deporte, Archivo General de Indias, Seville (MP, Guatemala, 92).

version, presumably to create intendancies as the standard civil jurisdiction and also to extend control over unconquered territory. While the *cédula* emphasized the need for "certain knowledge" to govern effectively, it did not specify the inclusion of maps nor a preference for trained cartographers (Solano 1988, 141–42). Maps were nonetheless included in some responses (fig. 46). However, responses to the decrees were uneven, with most maps and reports coming from New Spain and Guatemala.

New Spain's viceroy commissioned José Antonio de Villaseñor y Sánchez to compile informants' answers to his extensive questionnaire as well as their maps into the two-volume *Theatro Americano* (1746–48) (Carrera 2011, 50–56). This work prompted a second royal *cédula* (2 September 1751) instructing the viceroy and *audiencia* judges in Peru to create a similar resource. Instructions issued in 1754 and 1755 by Chile's captain general and *audiencia* suggest a changing culture by asking governors to identify the limits of individual jurisdictions and to state distances from the sea or mountains and between settlements (Solano 1988, 144–54).

In Carlos III's reign, the requests for information came both in specific *cédulas* and more general regulations (*ordenanzas*), demanding increasingly precise data, maps, and eventually trained mapmakers. The questionnaire sent by Ulloa in 1777 for the viceroy of New Spain, directed to trained secular and religious literate persons, sought latitude and longitude of principal cities and topographic maps of the provinces, and it provided directions for measuring distances from capital cities and even determining temperatures (Solano 1988, 177–83).

Crown projects to redistrict Spanish America were largely complete by 1786. The Viceroyalty of Peru was divided into three (Peru, New Granada, and Río de la Plata) and consolidated multiple internal districts into intendancies. Further questionnaires asked about results. In 1786, the Crown's *Ordenanza de intendentes* for New Spain and Guatemala instructed intendants (for "proper administration") to acquire "exact and local

FIG. 46. JOSÉ VALIENTE, "MAPA DEL TERRITORIO Y PUEBLOS CORRESPONDIENTES A LA JURISDICCIÓN DE CUAUTLA AMILPAS, LIMÍTROFE CON EL MARQUESADO DEL VALLE," 5 APRIL 1743. Manuscript, scale of 20 [leguas] = 37 cm (1:301,227). The bird's-eye view, which shows a village jurisdiction excised from surrounding countryside, accompanied a report fulfilling the request of the 19 July 1741 royal *cédula* seeking a *relación geográfica* of all Spanish American settlements. Libro 4, fol. 266.

Size of the original: 43 × 59 cm. Image courtesy of España, Ministerio de Cultura y Deporte, Archivo General de Indias, Seville (MP, Mexico, 144).

knowledge" of each district and to assign engineers "of entire satisfaction and intelligence" to form topographic maps of each province to identify and mark its boundaries, mountains, woods, rivers, and lakes. The Crown ordered the engineers to provide information on climate, minerals, animals, vegetables, industry and commerce, rivers useful for transport, the state of bridges and roads, and the location of woods useful for boat building or European commerce. It also asked for an annual report with the engineers' reports and results of the intendants' *visitas* with "all the news conducive of conservation, growth, and happiness" ([Spain] 1786, 65–68 [articles 57–58]). With the *ordenanzas*, the Crown emphasized that good administrators would have and use maps in their routine work, a dictum followed by Cuzco's intendant, Benito de la Mata Linares, in 1786, who compiled a notebook with manuscript maps of the jurisdiction's newly established *partidos* (AGI, MP Peru, Chile 89–98).

LOCAL ADMINISTRATION Locally, city officials, merchants' guilds, and residents throughout Spanish America increasingly demanded maps for property and jurisdictional mapping as well as for reform and public works projects. While military engineers continued this work, the *agrimensor*, or civilian land surveyor, also contributed to a proliferation of printed maps meant for public as well as official consumption.

Eighteenth-century military engineers and marine pilots collaborated closely with local authorities. Military cartographers produced dozens of maps contributing to major public works such as road building, city planning, public edifices, relocation after natural disasters, and drainage, including the two-century-old project to prevent regular flooding in Mexico City (Candiani 2014). The maps also helped government officials learn to include graphic representation as an administrative tool, for instance by contributing cartography in civic disputes over land distribution. In Buenos Aires an extensive judicial case centered on the city council's right to assign community lands (*ejidos*) to residents and discovered that no maps had been used to make initial assignments. In 1742, the Crown reprimanded the council's actions and asked the governor for a city plan, resulting in the creation of two maps that used scale and conventional graphic codes (Madrid, Servicio Histórico Militar, 6357, E-18-2, and 6267, E-18-2). The example demonstrates that local authorities could administer without graphic support, but that the Crown increasingly demanded topographic plans or similar documents for use by royal administration agents. By 1768, Buenos Aires passed from a "notarial" form of record keeping to a "graphic" one, and produced the first of several plans (Favelukes 2009, 70–71). For city fathers, maps also became symbols of authority. The city council of Asunción (Paraguay) in March 1793 asked military engineer Félix de Azara to create a map to hang on the wall in their meeting room "to serve as instruction for current events" (Azara 1904, XXXVII–XXXVIII).

Civilian surveyors also became important producers of maps for the administration of public and private property and to adjudicate land claims, although it is not clear that maps in judicial cases—usually inserted in the middle of other forms of textual testimony—actually influenced decisions. The role of property surveyor expanded from ad hoc measurer to public servant working for the city council, examined and certified by a competent authority. Techniques changed from mapping perimeters to detailed measurements of property limits. The surveyor's roles included testimony in land cases when issues such as subdivision of the city's lands and conflict over limits of hacienda perimeters and municipal jurisdictions proliferated, as in Havana starting in the 1720s (Venegas Fornías 2002, 34–35). Map holdings in Spanish archives suggest that professional surveyors were most active in Cuba, Mexico, Florida, and Louisiana. In Mexico alone, however, the archives attest to a growing number of eighteenth-century judicial cases that relied on surveyors' reports and maps for decision making. Surveys accompanied disputes between individual landowners or villages competing for public lands, the demands of Indian communities for rights to transit private lands, and property value evaluation to permit adjudication of an inheritance or debt. Surveyors were supposed to do a *visto de ojos* (eyewitness account) to identify boundaries and landmarks, to learn and listen to names, to identify where cattle grazed, and to undertake land surveys that could represent the land in measured geometric shapes to facilitate the calculation of surface area (Hernández Franyutti 2006). Spain's Archivo General de Indias and Mexico's national archives house maps ranging from the relatively straightforward Ignacio Castera map of the Mazapa hacienda (fig. 47) (Trabulse 1983, 88–89, 90–93) to more elaborate plans, like José Martín Ortiz's map of a disputed hacienda that located fields growing sugar, corn, and wheat as well as the buildings used to process them (see fig. 696). The increasing demand for graphic representations, not only to accompany other forms of testimony but to document spatial practices, indicates the map's growing authority as a tool in private and public venues. Additionally, it suggests increased cartographic literacy both among royal administrators and agents and also among Spanish America's diverse residents.

Local authorities also included maps with recommendations for reforms and redistricting to avoid certain perils. When Guatemala City was destroyed by an earthquake in 1773, the captain general saw an opportunity

FIG. 47. IGNACIO CASTERA, "PLAN IGNOGRAFICO DE LA HACIENDA DE MAZAPA," 30 JANUARY 1787. This plan of a hacienda in Texcoco, near Mexico City, shows increased sophistication in mapping private property by emphasizing the accuracy of geometric calculations with the surveyor's table and tools laid out lower right.

Size of the original: 27.0 × 40.3 cm. Image courtesy of the Archivo General de la Nación, Fondo Hermanos Mayo, Mexico City (Tierras, vol. 2455, cuaderno 10, exp. 1 F. 80).

to relocate the city and end a century-long stalemate with Creole elites on the city council over the city's territorial jurisdiction. He hired military engineer Luis Díez Navarro to plan the new capital city in a modified grid that laid out which civil, religious, and military institutions and individuals would get choice blocks around the city's principal and auxiliary squares (Hardoy 1991, 232–33). He also wanted Díez Navarro to measure and map the valley in *mapillos* and *planillos* (little maps and plans) depicting the new, reduced city jurisdictions. The earthquake and new cartography essentially handed the captain general a victory that the city's arguments based on practices from time immemorial could not overcome (Madrid, Archivo Histórico Nacional, legajo 20953, pieza 63). More commonly, late eighteenth-century city officials mapped to expand policing or sanitation projects. From Mexico City (1750, 1782, 1793) and Lima (1768) to Guatemala (1791) and Buenos Aires (1795), cities seeking to improve policing delimited districts (*quarteles; cuarteles*) with *alcaldes de barrio* (neighborhood watches) to patrol streets and track residents for taxation and other purposes; some cities also named streets and numbered houses for ease of administration (Venegas Fornías 2002, 42; Favelukes 2009, 80). Some manuscript maps were engraved for *alcaldes* to use on patrol or in courtrooms and to inform the king of these innovations. Military engineer Diego García Conde's 1793 Mexico City plan became an obligatory reference for nineteenth-century tracings and was reproduced not only in Spain but England (León García 2009, 449).

Most administrative maps were manuscripts, although as the century progressed they were increasingly printed for regular use. In Spain, Juan de la Cruz Cano y Olmedilla's ten-year project to map South America produced *Mapa geográfico de America meridional* (1775) (see fig. 765) in time for the Council of the Indies to consult when establishing new viceroyalties and intendancies. Twenty years later, governors heading to South

American posts still wanted the map; infantry lieutenant colonel Andrés Buggiero, leaving for Chiquitos (Buenos Aires) in 1798, requested a copy of the Cruz Cano y Olmedilla map, which he knew had been given a year earlier to the new governor of Cordova de Tucumán (AGI, Fondo Estado, 76, N. 68). By century's end, maps were becoming decision-making tools, not just graphic representations of knowledge.

In the Americas, printed maps were both decorative and functional. Two elaborate engraved examples from New Spain are *Mapa y tabla geografica de Leguas comunes* (1755) by José Nava of Puebla de Los Angeles, with tables of distances between cities, and Alzate y Ramírez's large (five by six feet) *Nuevo mapa geográfico de la América septentrional española* (1767). Where the former gave pride of place to tabular representation that dovetailed with Bourbon interest in "re-spatializing" the Americas for administrative purposes, the latter was a graphic representation that, while repeating errors in previous cartography and mathematical miscalculations, reflected growing localist sentiment about New Spain as a distinct place (Carrera 2011, 59–60).

Local institutions increasingly published works for general audiences, such as newspapers and the *Manual y guía de forasteros* issued by local *consulados de comercio* (merchants' guilds). The *Calendario manual y guía de foresteros en México* by Felipe de Zúñiga y Ontiveros (1791) included a Mexico City plan by Manuel Agustín Mascaró. Hipólito Unánue's 1793 *Guía* included a 1792 viceroyalty map by a Creole, Andrés Baleato (fig. 48). Resident Spanish surveyor Antonio López Gómez prepared the first map of Cuba published in the colony; it appeared in a 1793 *Guía* (Venegas Fornias 2002, 55). By the 1790s, most regional capitals published a weekly semiofficial newspaper including information on local political and natural history, geography, and demography. Occasionally, these publications included a map such as the plan by an *alcalde mayor* (governor) of a newly finished road facilitating commerce with Mexico in the *Gazeta de Guatemala* (1800). The Sociedad Academica de Amantes de Lima paid to print Friar Manuel Sobreviela's map of the Pampas de Sacramento area in the *Mercurio Peruano* "at great expense," in part because a resident merchant was promoting fuller Spanish control and exploitation of quinine found there (*Mercurio Peruano* 104, 1 January 1792, 6). Such maps served administrative functions and increased Creole identification with the new intendancies and viceroyalties as *patrias chicas* (local homelands), a distinction that influenced the autonomist movements, which from 1808 started many on the road to political independence.

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SEE ALSO: Spanish America

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FIG. 48. ANDRÉS BALEATO, *PLANO DEL VIRREYNATO DEL PERÙ.* Published in *Guia política, eclesiástica y militar del Virreynato del Perú,* vol. 1 (1793), opposite p. 1. José Vázquez, engraver, Lima. This printed "plan" of the Viceroyalty of Peru shows a transition to a broader public audience for maps, helping late colonial residents and officials see the Viceroyalty of Peru as a series of political districts and as a whole. Size of the original: 14.0 × 31.5 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (C2 1795 Un).

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Administrative Cartography in Sweden-Finland. The rapid growth of Sweden-Finland in the seventeenth century, both within the Scandinavian peninsula and around the Baltic, significantly stressed the burgeoning state. After 1680, two institutional changes had lasting effects on the management of the countryside: the *reduktion* (a resolution passed by the Diet that all former Crown lands were to be restored to the Crown), prompted by considerations of revenue, and the *indelningsverk* (allotment system), prompted by manpower.

In the Baltic, the Estonian and Livonian nobility lived on their estates, encompassed by an enserfed peasantry. They performed the important function of furnishing commanders for the Swedish armies. In this way, they acquired naturalization as Swedish nobles. During the seventeenth century the transference of lands from the Crown to the nobility had proceeded at an ever-accelerating rate. Around 1650 about two-fifths of the land of Livonia was in the hands of the Swedish nobility. As a consequence of this alienation of land, the Crown became short of money. It had become evident that Sweden was unable to maintain a military strength commensurate with the country's ambitions as a great power. In 1680 the *reduktion* was enacted. Eventually three-quarters of the farms alienated to the nobility were returned to the Crown.

This generally decreed confiscation of enfeoffed Crown property made the geometrical mapping of the entire Swedish realm a matter of urgency. The Baltic provinces were systematically mapped during the period from 1681 to 1710, known as the Great Cadastre (*arklu revīzijas*), from a base in Riga. A similar mapping project was later carried out in Pomerania. Special geographical maps were drawn in connection with the *reduktion*, the *fredsmilskartor* (literally "maps showing a mile of rights and privileges"). These maps described the areas around castles or royal estates that royal prerogative held to be Crown property but that had been sold off illegally starting in 1655 in an early attempt of *reduktion*.

A new system for the financial support of the army was introduced in 1682. Under *indelningsverket*, lands that the Crown had reclaimed from the nobility or had otherwise acquired were granted to military officers and their families. In 1688, a further requirement was added to the legal process necessary for establishing such allotments; specifically, an official surveyor had to measure, map, and describe each homestead before taxes and other rights were assessed. As a result, the number of official surveyors working in Sweden proper rose significantly in just ten years, from about thirty in 1688 to about seventy in 1697 (Örback 1990, 128). Eventually, three thousand residences for officers were surveyed and established in Sweden and five hundred in Finland.

A fixed number of regular soldiers was also required from each province, and they were supported by local groups of men of military age (i.e., up to age forty) in return for freedom from conscription. Ordinary soldiers and their families were provided with a cottage and a small holding (*soldattorp*, soldier's croft), and they were expected to work the land of the peasants or landown-

FIG. 49. CARL GIDEON WADMAN, "CHARTA ÖFVER FRÄLSEHEMMANEN SKURUP, HYLTEBERGA, SANDÅCKRA, SARITSLÖF OCH ÄNGAMÖLLAN, UNDER SVANHOLMS SÄTESGÅRD," 1785. Manuscript; ca. 1:20,000. Map of redistribution of land on Rutger Macklean's Svaneholm estate in the parish of Skurup in Skåne, the progenitor of the *enskifte* system that eventually was used over large parts of Sweden.

Size of original: 45 × 39 cm. Image courtesy of Kungliga biblioteket, Stockholm (KoB 2 / Svanholm, Ex. A).

ers when not needed for military duties. Around the coast, the seamen for the navy were supported in a corresponding way by a *båtmanstorp* (seamen's croft).

The appointment in 1683 of Carl Gripenhielm as director general of the national land survey effectively turned it into an independent department, Lantmäterikontoret, although it would remain formally under the Kammarkollegium (Crown lands judiciary board) until 1827. Gripenhielm made several structural reforms. Starting in 1696, regional offices of Lantmäterikontoret were established in provincial capitals. Before that, in 1687, Gripenhielm distributed a standardized list of about ninety different symbols and terms for use on survey maps, and in 1688 he issued further instructions to standardize and regulate the process of surveying. Further reforms in 1725 fixed the scale of new field work at 1:4,000; all of these standards were enshrined within a comprehensive law reform of 1734 (Örback 1990, 128–29).

Surveyors would play an important role in the substantial town planning that took place throughout the Swedish realm. In the seventeenth century, however, the fortification engineers made the large majority of plans, even in nonfortified towns, and some were also produced by architects. These included Erik Dahlbergh, chief of Fortifikationen (fortification administration) and quartermaster general after 1676, who in addition to his fortification works drew many buildings, and Carl Hårleman, who would become director general of Överintendentsämbetet (national board of public building) in 1739 (Ahlberg 2012, 81–85).

Pursuit of industrializing policies during what in Swedish history is called Frihetstiden, the Age of Liberty (1718–72), required new maps, so in 1735 Lantmäteriet was granted the right to print regional maps. One of the earliest results was the publication in 1747 of the first printed map of all of Sweden since 1626 (see fig. 324).

The drive for economic improvements included agriculture, prompted by foreign reforms in land tenures and farm organization. As early as the 1730s certain surveyors and many landowners were working actively for a change. Jacob Faggot, head of Lantmäteriet, proposed that his surveyors should, when surveying each community, reorganize the fields fragmented into many narrow strips into as few large fields as possible, thereby giving fewer holdings to each farm, increasing agricultural production, and supporting an increasing population. The preliminary order in 1749 was ratified in the *Storskifte* Act of 1757 and again in 1762 and 1766. (Also in 1749, Sweden set in motion the world's first modern population census, *Tabellverket*, completed nationally around 1755; the census eventually revealed a slow growth of population and its lists served as a residence record.) In 1783 new regulations for land surveying in the kingdom (*Kongl. Maj:ts nådiga förordning, om lantmateriet i riket*) collected all orders and laws concerning land surveying, and the previous Survey Acts were cancelled. Henceforth, the central office in Stockholm was called Generallantmäterikontoret.

Another redistribution form, the *enskifte* (single holding), in which the holdings of every part owner and all infields were collected into one continuous area, existed alongside the *storskifte* (large holding). The impulse for the *enskifte* was the early and radical redistribution scheme known as *mackleanskifte* after its creator, Rutger Macklean (fig. 49). The first *Enskifte* Act, of 1803, was initially restricted to Skåne (Scania) and extended to the rest of the kingdom in 1807, with the exception of Dalarna (Dalecarlia) and Norrland.

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SEE ALSO: Sveriges Lantmäteriet (Swedish Land Survey); Sweden-Finland

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Administrative Cartography in Switzerland. No comprehensive compendium of administrative maps produced in Switzerland exists. Such maps are usually in manuscript, and many are still slumbering away unexplored in archives. Only the maps of the cantons of Bern and Jura have comprehensive published catalogs. Printed registers of tithe plans exist for Thurgau and Zurich.

Switzerland was a confederation of states comprising thirteen cantons as well as allied and subject territories, and administrative operations rested with the individual canton or territory. Administrative maps were primarily created by the urban cantons, of which Bern was the most important. It was the biggest urban republic north of the Alps and also encompassed Vaud and the larger part of Aargau until 1798. In the alpine regions, maps were rarely produced.

Only a few cantons commissioned maps of their entire territory for administrative purposes. Zurich ordered Hans Conrad Gyger to produce ten military quarter maps (*Militärquartierkarten*) in 1644–60, and Georg Friedrich Meyer created maps of the administrative units for Basel in 1678–81. But the state of Bern did not generate its own map, although it did commission Samuel Bodmer to conduct a survey of its boundaries between 1705 and 1717.

The administrative need for maps centered on the sources of tithes and ground rents, which constituted a considerable part of state revenue before 1798 and were recorded in rent rolls. Because of increasingly confusing circumstances of ownership and the desire for greater legal security concerning the more accurate measurement of land and its value, graphic plans were added to these records from the mid-seventeenth century onward. Some civic institutions developed, such as the Chambre des Fiefs in Geneva, that required graphic plans and insisted on their utility as long-lasting documents (Zumkeller 1992, 83–85). Thus tithe and property plans constitute the largest portion of administrative maps. The plans differ by region and their design changed over time. The scale of most of the plans ranges from 1:1,000 to 1:4,000.

In French-speaking Switzerland, the maps were often cadastral plans, in distinct styles, bound into atlases. The individual plans specified the name of the landowner, agricultural use, and acreage; later, reference to property registers, the liege lord, and property revenues also were included. The parcels were drawn by sight (*à vue*) as ground plans, but individual buildings were also depicted three-dimensionally. By the end of the seventeenth century, geometrically surveyed plans using angle-measuring instruments, compass, plane table, and chain began to supersede the plans by sight, reflecting the changed circumstances of surveyors' training and the increasing need for greater accuracy in determining land value.

In French-speaking Switzerland, the plans' creators were initially sworn state officials who were in charge of determining responsibility for payment of tithes and who were often notaries, such as Pierre Rebeur in Vaud and Jacques Deharsu in Geneva. Pierre Rebeur's son Jean-Philippe made plans of Lausanne at a very young age before leaving the city and becoming a tutor, assessor, and Hofmeister (fig. 50). In the eighteenth century, the commissioners worked on the preparation of the plans with well-educated geometricians such as Georges Christophe Mayer and his son Pierre Mayer in Geneva in the eighteenth century (Zumkeller 1992, 88, 91–92).

In German-speaking Switzerland, the surveyed tithe plans show the division of farmland and its use. The earliest known tithe plan (1639) originated with Hans Conrad Gyger (only preserved as a copy; Zurich, Zentralbibliothek, MK 235). In Thurgau the first plan dates back to 1687 (Frömelt 1984, 219, gives 1640, plan of Diessenhofer by Mentzinger) and in Bern to 1688 (Wälchi 1995, 18). In addition, estate plans also were drawn up early on. Later, cadastral plans were created as well (e.g., 1689–92 for Sissach by Georg Friedrich Meyer [see fig. 698]), and from the mid-eighteenth century cadastral atlases exist comparable to those for the French-speaking region, especially for Bern (e.g., two atlases of plans by Johann Rudolf Küpfer, 1769–70, Bern, Staatsarchiv, Landshut, Landvogtei: Zehnt- und Bodenzinspläne des Schlosses Landshut), and sporadically appear in eastern Switzerland too (e.g., the work of Father Josephus Wech, from 1743; Frömelt 1984, 30, 272–75). Initially, the creators of the plans came from different professions. In the eighteenth century, as the production of tithe plans increased sharply, they were prepared by civilian geometricians, who in Bern were especially active in conjunction with the administrative expansion of the patrician state. Important authors of eighteenth-century tithe plans were Albrecht Knecht, Johann Ludwig Reinhardt, and Johann Adam Riediger in Bern (Wälchi 1995, 17–20), Johannes Nötzli in the Thurgau (Frömelt 1984, 29), and Johannes Müller, whose work in Zurich included fortification plans, topographic maps, and civil engineering work (Nüesch 1969, 38–39).

Due to fears of an impending shortage of wood, Bern promulgated forest legislation in the eighteenth century to establish sustainable forest cultivation practices. The forest plans that initially only measured circumference developed into forest cultivation plans that emphasized long-term utilization of the forests. Rivers and lakes were cartographically recorded in connection with their use. The diversion of the Kander River into Lake Thun, a massive improvement project (1711–14), was undertaken by the state of Bern, and maps were made by Bodmer and Johann Adam Riediger (Schneiter 2013). A modern road network emerged after 1742 in the Bernese canton and is reflected in extensive mapping.

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SEE ALSO: Switzerland

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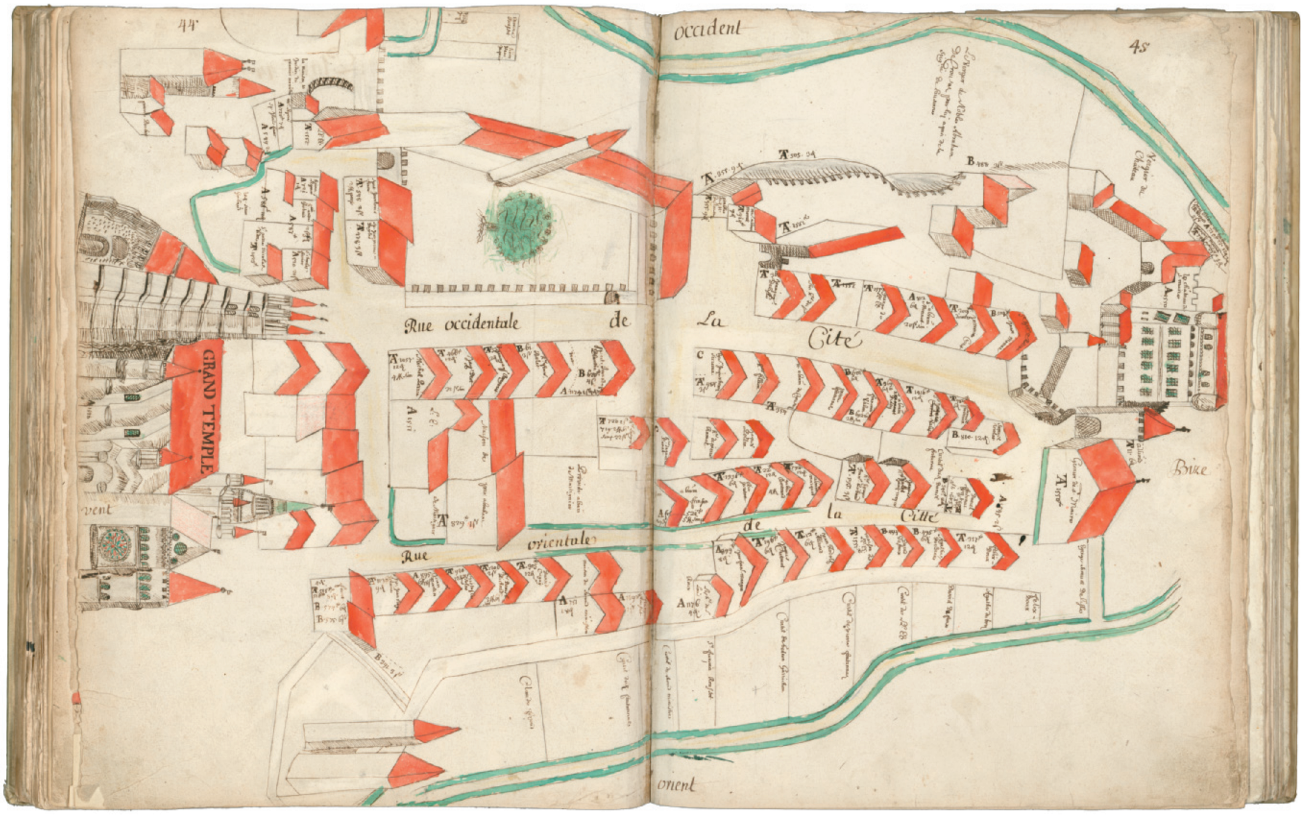

FIG. 50. CADASTRAL PLAN BY JEAN-PHILIPPE REBEUR OF LAUSANNE, 1679. Manuscript plans *à la vue*, 87 folios (without title and precise date). This plan shows the district of Lausanne between the Château Saint-Maire (right) and the "Grand Temple" (left). Under each red roof the name of the proprietor and the size of property is written. The folios shown are in one of three large *terriers* (estate registers) that were made between 1665 and 1680.

Size of the original: 49.5 × 72.0 cm. Image courtesy of the Archives de la ville de Lausanne (plan cadastral Rebeur, inventaire Chavannes C 351, fols. 44–45).

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Admiralty Hydrographical Office. See Hydrographical Office, Admiralty (Great Britain)

Allegorical and Satirical Maps. Allegorical and satirical maps are, by their very nature, elusive. They neither portray real geographic landscapes nor seem to clarify and define the physical world around us. Instead, they elude our gaze, toy with our expectations, and slip just out of our critical grasp. They look like maps, to our knowing eye, and they seem to tell us things. And yet they are not quite like the maps we are accustomed to, and what they seem to tell us is not entirely clear. These are qualities that make them *figurative*, a term that in the present context must not be limited to its strictly etymological sense of "giving form or shape to" (from the Latin, *figura*), according to which any map might be understood to be a form-giving figure. We must here understand *figurative* in the sense given to it by rhetorical and literary tradition, wherein language, whether verbal or visual, signifies by diverging from—indeed, by eluding—a meaning more conventionally understood to be literal, ordinary, or natural. When a poet speaks of "love" by referring metaphorically to a "rose," as in Guillaume de Lorris and Jean de Meun's thirteenth-century "Roman de la Rose," we are led away from our concrete notion of the pleasantly scented flower and toward the more abstract concept of the sensual passion. The distinction is an important one because as a form of figurative expression, the allegorical maps that appeared in Europe during the early modern period, along with their closely related cousins, satirical maps, point us beyond the images figured on their surface to a conceptual place that often has little to do with what they show us.

But these figurative maps are also not, strictly speaking, "imaginary maps," conceived and printed to accompany books such as Robert Louis Stevenson's *Treasure Island*, A. A. Milne's *Winnie-the-Pooh*, or J. R. R. Tolkien's *Lord of the Rings*. In works like these, maps are brought in to help us make sense of things, to establish a connection between what we see and the fictional world where the story unfolds, and to create and sustain wonder and desire, like a Renaissance map showing the European observer the coastlines of the New World. The maps of Milne's Hundred-Acre Wood or Tolkien's Middle-earth may be figures of explicitly imaginary places, but we nonetheless do consider them—and are meant to consider them—as deriving from a familiar correspondence between what they show us and what we understand the landscapes they portray to be like, just as we expect a map of Uummannaq, Greenland, to tell us something about the boundaries, geographic shape, and topographic features of the town of Uummannaq, whether we have been there or not. Imaginary maps map imaginary places, but they rely still on a fundamental sameness, a basic unity of meaning between the graphic design of the map itself and the world to which we imagine it to refer.

A work like *A New Map of the Land of Matrimony* (fig. 51), for example, takes its visual and conceptual authority from allegory, an ancient rhetorical figure that explicitly emphasizes difference and otherness, that makes *elusiveness* a basic unit of its formal design. The *Land of Matrimony* map presents coastlines, islands, capes, rivers, and other recognizable cartographic features, but it cannot imitate love or matrimony visually

FIG. 51. *A NEW MAP OF THE LAND OF MATRIMONY* (LONDON: JOSEPH JOHNSON, 1772). Engraved by Joseph Ellis. An exemplary eighteenth-century "marriage map." Size of the original: ca. 28 × 35 cm. Image courtesy of the Map Collection, Yale University Library, New Haven (1an 1772).

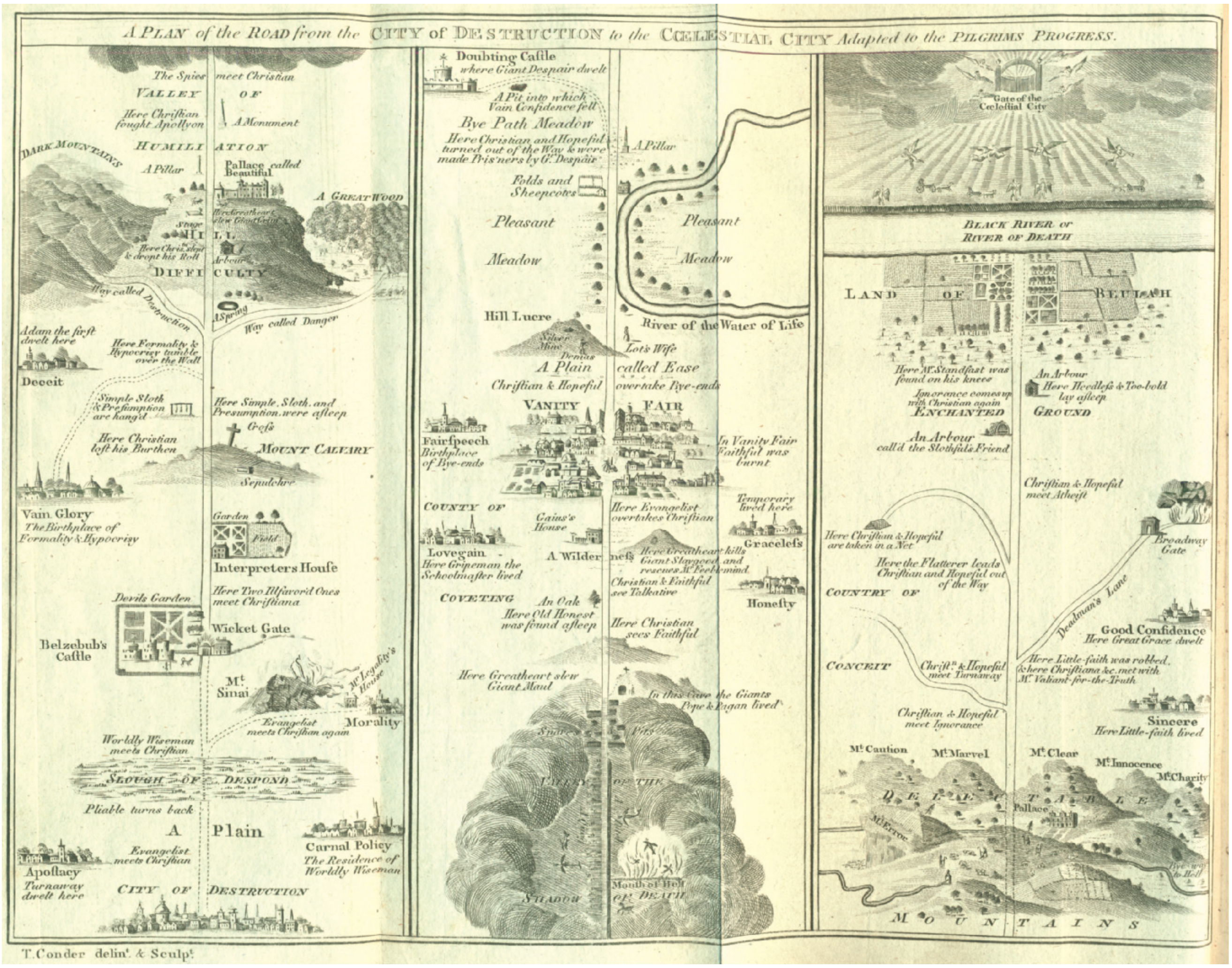

FIG. 52. JOHN BUNYAN, *A PLAN OF THE ROAD FROM THE CITY OF DESTRUCTION TO THE CŒLESTIAL CITY* (LONDON, 1778). An allegorical map printed in Bunyan's *The Pilgrim's Progress from This World to That which Is to Come,* new ed. (London: H. Trapp and A. Hogg, 1778), pt. 1, facing 1. Size of the original: ca. 19.5 × 25.0 cm. Courtesy of Special Collections, Kenneth Spencer Research Library, University of Kansas Libraries, Lawrence.

because these are of course abstract concepts. Similarly, John Bunyan's *A Plan of the Road from the City of Destruction to the Cœlestial City* (fig. 52) shows hills, meadows, and valleys but does not immediately tell us anything about the nature of salvation. Instead, we are required to discover indirect associations between the map—with its "straight and narrow" road leading from the City of Destruction to the Cœlestial City and its tempting detours into Vanity Fair, a Plain called Ease, and Hill Lucre—and Bunyan's Protestant allegory of Christian perseverance and faith. On this map, mountains signify difficulty, villages connote temptation, and castles convey doubt. Like all allegories, the Bunyan allegorical map gestures toward another field of abstract meaning, which emerges indirectly through procedures of deciphering or reading. Bunyan's allegory and its accompanying map had enormous influence during the eighteenth century and inspired any number of related spiritual itineraries. The map printed with George Wright's 1775 *Walking Amusements for Chearful Christians*, *The Journey of Life, or an Accurate Map of the Roads, Counties, Towns &c. in the Ways to Happiness & Misery*, directly imitates the Bunyan example in nearly every formal and thematic respect.

Derived from the Greek *allos* (other) and *agoreuein* (to speak), allegory is a form of narrative, dramatic, or pictorial representation of events that refer to a secondary set of usually abstract meanings and ideas. In many of its complex forms, the secondary meaning is direct and presumably intended by its author, as in the Aesopic tradition of fable wherein the actions of animals convey specifically human moral lessons. At other moments, allegory is thought to be the indirect product of an act of critical interpretation. The heroes of Homer's epic poems, for example, were often read during the Renaissance as the allegorical portrayal of human qualities such as valor or anger. In its basic simplified terms, allegory is a manner of "other-speaking," a form of representation that takes its poetic force from the difference established between what is directly portrayed and what is indirectly conveyed (Whitman 1987, 1–13). Allegory can, in this respect, seem paradoxical: it relies on a *correspondence* between what is said and what is meant, while simultaneously creating a *disjunction* between words and their object of reference. Aesop's grasshopper is a grasshopper on the one hand, but a figure of improvidence on the other. Such, too, is the allegorical map. The three small landforms of Danglers Island and its separation from the coast of Matrimony on the *Land of Matrimony* map refer us directly to a problem of geographic distance in cartographic terms, but, at the same time, it turns us aside toward the abstract notions of delay and procrastination associated with lovers slow to enter into marriage (Cape Shilly Shally, the map also calls it).

The *Land of Matrimony* map demonstrates as well how allegory naturally slides over into satire. The didactic style of allegory in *The Pilgrim's Progress* becomes satirical critique in the marriage map. And like the other-speaking mode of allegory, satire involves a conceptual mechanics of distancing whereby the reading or viewing self is distinguished from another, in this case the object of satirical ridicule. As the English satirist Jonathan Swift put it in 1704, "Satyr is a sort of Glass, wherein Beholders do generally discover every body's Face but their Own; which is the chief Reason for that kind of Reception it meets in the World, and that so very few are offended with it" (Swift 2010, 142). Satire is a deforming mirror in which we watch others engage in deviations from the public norms that we—disapproving observers—uphold. The characters of satire, Swift suggests, are always someone else. And yet the wit and irony so often associated with satire, which protect the satirist against the charge of gratuitous aggression, derive from the same doubling impulse provoked by allegory. The satirist says one thing and means another but, at the same time, goes farther than the allegorist to anchor meaning in a critical, even caustic act of demarcation (Bogel 2001, 41–83). The coastlines of the *Map of the Land of Matrimony* do not really refer to coastlines, of course, and yet the cartographic shapes they depict carry decisive meaning: the Ocean of Love is filled with the rocky shoals of Jealousy; Matrimony itself is a vast, empty plain.

It makes good historical and epistemological sense, then, that a vogue for figurative mapmaking in the form of allegorical and satirical maps should emerge during the early modernity of cartographic practice, between roughly 1500 and 1800 (Conley et al. 2007; Reitinger 1999b; Senter 1977; Van Delft 1985). Prior to the sixteenth century in Europe, the very notion of an allegorical map would have had very little meaning. All medieval *mappaemundi* were, to an important degree, allegorical in the sense that they conveyed something other than the landscapes they represented. Isidore of Seville's well-known *mappamundi*, the first map printed in Europe in a 1472 edition of Isidore's *Etymologiæ*, is far more an emblematic portrayal of a spiritual kingdom than it is a cartographic representation of the physical world. The familiar T-O design of Isidore's world map associates the topography of the *orbis terrarum* with a specifically Christian iconography. The Mediterranean Sea, the Tanais River, and the Nile River—the three bodies of water that form the T in this east-oriented map—describe the holy cross. The inhabited world and the body of Christ are joined; cartographic representation and Christian theology are one. As in Isidore's map, medieval *mappaemundi* often had little practical function. Abstract concepts of distance and scale, as well as principles of graphic standardization, were to become important features of later cartography but remained little practiced during the Middle Ages (Edson 1997, 1–17). With the rediscovery of Ptolemy's *Geography* in the early sixteenth century, a renewed emphasis on systematic observation and measurement created expectations of geometric accuracy in the printed maps that soon circulated throughout Europe. Allegorical maps were thereafter those maps with visual characteristics that, in contrast to the maps of the new cartography, pointed beyond the topography they represented to a wholly other realm of meaning.

Despite their figurative design, these maps were not mere curiosities. As they maintained rhetorical affiliations with an older medieval style of symbolic mapping that contrasted strongly with the newly mathematical design of more conventional maps, allegorical and satirical maps nearly always engaged contemporaneous social polemics. They drew simultaneously on a cartographic vocabulary of limits and borders to bring conceptual focus to the debates they confronted and an allegorical procedure of other-speaking that imagined how those debates might be differently cast (Peters 2004, 17–44). An example of this tradition is François de Callières's 1688 map, known as the *Carte de la guerre poétique* (fig. 53), printed with his allegorical history of the scholarly debate about the nature of early modern European aesthetics known as the "Quarrel of the Ancients and the Moderns" (Callières 1971). Callières, a royal ambassador to Louis XIV and best known for his 1716 treatise *De la manière de négocier avec les souverains*,

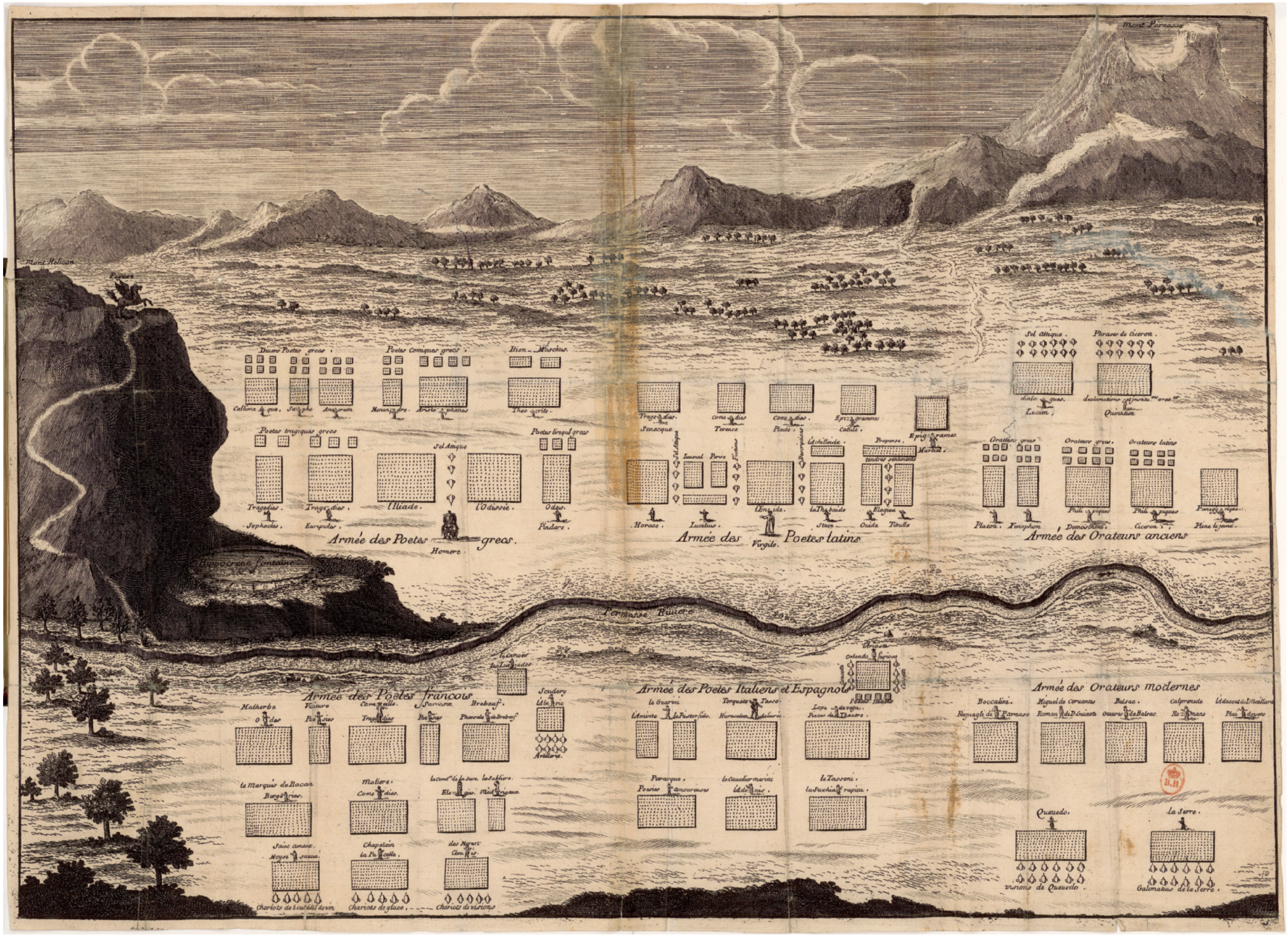

FIG. 53. FRANÇOIS DE CALLIÈRES, *CARTE DE LA GUERRE POÉTIQUE NOUVELLEMENT DÉCLARÉE ENTRE LES ANCIENS ET LES MODERNES* (PARIS, 1688). A French cartographic satire of a scholarly debate. The map follows the title page of Callières's *Histoire poëtique de la guerre* (1688).
Size of the original: ca. 33 × 46 cm. Image courtesy of the Bibliothèque nationale de France, Paris.

uses the combined languages of military cartography, allegory, and satire to portray a theoretical battle between partisans of what was known during the period as the "Ancients"—those seventeenth-century writers who promoted the authoritative imitation of ancient knowledge—and the "Moderns"—those who understood Renaissance humanism to have opened the way for a new form of innovative thought. The map depicts the land of Parnassus, the mythological home of the Muses and Apollo, god of poetry and the arts, as a vast plain bisected by a river flowing horizontally across the map and surrounded by several chains of mountains. It is from the elevated site of one of these mountains that the viewer of the map observes the spatial deployment of the two armies opposed to each other across the river. The army of the Ancients is led by General Homer and is made up of battalions of comic verse, lyric poetry, and tragic drama, each commanded by the appropriate captains: Aristophanes, Pindar, Euripides, and so on. The Moderns, by contrast, choose Pierre Corneille, the prominent seventeenth-century French dramatist, as their general; their troops are composed of eclogues, commanded by the poet Honorat de Bueil Racan, novels by Gautier de Coste La Calprenède, oratory by Jean-Louis Guez de Balzac, and so on. Using the language of military and boundary mapping to show how borders bring together and unify as much as they separate and distinguish, Callières the negotiator argues that battles pitting opposing groups against one another are always doomed, and that vehement debate may be resolved when each side acknowledges its common ground with the other (Peters 2004, 180–97, 209–11).

Callières's map itself draws upon a number of visual traditions, including, in addition to cartography proper, the vocabulary of landscape painting, the city view, and depictions of military campaigns. Moreover, it stands at the intersection of several influential currents of European satire. Most immediately, the Callières map gave rise to Swift's *Battle of the Books* (1704), which it directly influenced. Swift's allegory does not include a map like that of Callières, though the story itself gives cartographic form to the comic debate about the nature of poetic language by turning the King's Library at St. James into an Apollonian battlefield: "The *Guardian* of the *Regal Library* . . . had been a fierce Champion for the *Moderns*, and in an Engagement upon *Parnassus*, had vowed, with his own Hands, to knock down two of the *Antient* Chiefs, who guarded a small Pass on the superior Rock" (Swift 2010, 147). But the association of cartography and satirical language found in Swift and Callières also refers us backward in time to Bernard Le Bouyer de Fontenelle's "Description de l'Empire de la poësie" (first published in *Mercure Galant*, January 1678, 147–68), also known to have influenced Swift, and to an earlier allegorical map of the Ancients and Moderns controversy in the 1658 *Novvelle allégoriqve ov histoire des derniers trovbles arrivez av Royavme d'Eloqvence* by French writer and lexicographer Antoine Furetière. The connection also points back to what was certainly the most well-known and influential allegorical map of the seventeenth century, Madeleine de Scudéry's so-called *Carte de Tendre*, published in 1654 in the first volume of her ten-volume heroic novel *Clelie, histoire romaine* (1654–60).

Scudéry's *Carte de Tendre* (fig. 54) invents the most popular theme of the allegorical and satirical maps produced during the seventeenth and eighteenth centuries: the peripeties of love and marriage. The novel in which the map was first printed recasts familiar events of Roman history in the coded and precious idiom of seventeenth-century literary salons. An obvious roman à clef whose characters were easily recognizable to contemporary readers, Scudéry's novel portrays historical figures engaged not in the great events of ancient Rome, but in a series of lengthy, often fussy conversations on topics ranging from political ambition, national identity, and kingship to the nature of secrets, jealousy, and, indeed, love and marriage. Despite their undeniable popularity in the seventeenth century, Scudéry's novels were criticized by some for engaging in, on the one hand, mind-numbing frivolity (what were Roman heroes doing chatting with women about love?) and, on the other, an effeminization of the Roman and the French seventeenth-century man (what were these men doing merely talking in the first place when they ought to have been engaging in heroic actions?). Moreover, like Scudéry herself—a woman author who took the highly unusual step of choosing not to marry—the novel advocates a decidedly subversive concept of marriage. The eponymous Clélie receives encouragement from her mother to disregard her father's wishes and marry the man whom she loves and whom she has chosen for herself, rather than the man who is the politically logical choice but whom she does not love. As on the *Carte de Tendre*, much is made in the novel of *inclination*, a notion suggesting both a kind of love at first sight and a woman's self-determined affection for the object of her love.

On the *Carte de Tendre*, *inclination* is transformed into a river—the Inclination Fleuue—that runs through the center of the map from the bottom, where it flows through the town of New Friendship (Nouuelle Amitié), to the top, where it empties into the rock-strewn Dangerous Sea (La Mer Dangerevse). The map is an allegory of love and desire, and the paths it describes, each originating in the town of New Friendship, enact cartographically the stages of courtship. Suitors may move from New Friendship through towns representing a lover's favors—Love Letters (Billet Doux) and Pretty Verse (Iolis Vers)—or states of being on the course of the lover's po-

FIG. 54. MADELEINE DE SCUDÉRY, *CARTE DE TENDRE* (PARIS, 1654). Engraved by François Chauveau. Probably the most influential allegorical map made during the seventeenth and eighteenth centuries.

Size of the original: 17 × 23 cm. Image courtesy of the Bibliothèque nationale de France, Paris.

tential progress—Negligence and Tepidness (Tiédeur). Should their behavior not impress, they might end up in the Lake of Indifference (Lac d'Indiference), recognizable by its placid surface, rather than in the desired Tenderness on Inclination (Tendre sur Inclination).

Throughout the novel, it becomes clear that women control men's movement in the land of Tendre, movement that is never inevitably linear. Suitors might never make progress at all; they might turn in circles or become lost entirely. In this respect, cartography and allegory are put in the service of Scudéry's thinking about courtship and marriage. Like the map itself, which as an allegory points to another meaning beyond its physical topography, women in the novel are encouraged to reimagine and to think "otherwise" about their social roles. Cartography affords women a language of delineation and emplacement—the means to locate the terms of an authority in courtship—while allegory, as a reimagining of the language of cartography itself, provides a model of reading that allows the women in the novel to define what those terms mean. Allegorical cartography is thus here fully implicated in evolving notions concerning women in art and society in seventeenth-century France (Peters 2004, 83–116).

The influence of Scudéry's allegory of love and desire may be detected in European allegorical and satirical maps throughout the seventeenth and eighteenth centuries. The German publisher Matthäus Seutter included a map showing the *attaques de l'amour* in his *Atlas novus* (fig. 55). This bilingual map in German and French describes, as the legend says, a "method of defending and preserving one's heart against Love's attacks." It combines both the battle plan of Callières's allegory—a military fort surrounded by a Glacial Sea (La Mer Glacee) and assaulted by the cannon blasts of pleasure and desire—with Scudéry's cartographic language of negotiated seduction. Maps like the French *Carte de l'isle du mariage* (1732), modeled on Eustache Le Noble's narrative *Carte de l'isle de mariage* (1705), derive from the many European satirical treatises on the subject of marriage, which date at least to 1663 and the "La carte dv mariage" (in *Oevvres diverses*, 1663) by Charles Sorel, a French writer and critic who knew Scudéry's *Carte de Tendre* well. Sorel's satire of love and marriage set the stage for a debate on whether happiness in marriage was possible, a question that was often answered with a resounding no. The 1732 map of the Island of Marriage gives us I. du Mariage figuring the institution of matrimony, surrounded gloomily by a Sea of Melancholy (Ocean Melancolique) and smaller islands of Madness (I. de la Folie), Lawsuit (I. des Proces), and Divorce (I. du Divorce).

In eighteenth-century England, however, a newly optimistic attitude characterized the debate, and the 1748 allegorical *A Map or Chart of the Road of Love* (fig. 56) exemplified the attempt to reconcile love and marriage. This map, like the others, draws on the principles of cartographic and allegorical depiction to chronicle visually shifting concepts of marriage in eighteenth-century England. The map represents a clear shift in emphasis from earlier maps of marriage, which had argued that love and marriage would forever be mutually exclusive. *Road of Love* refashions the social parameters of marriage by imagining a linear path from the starting point

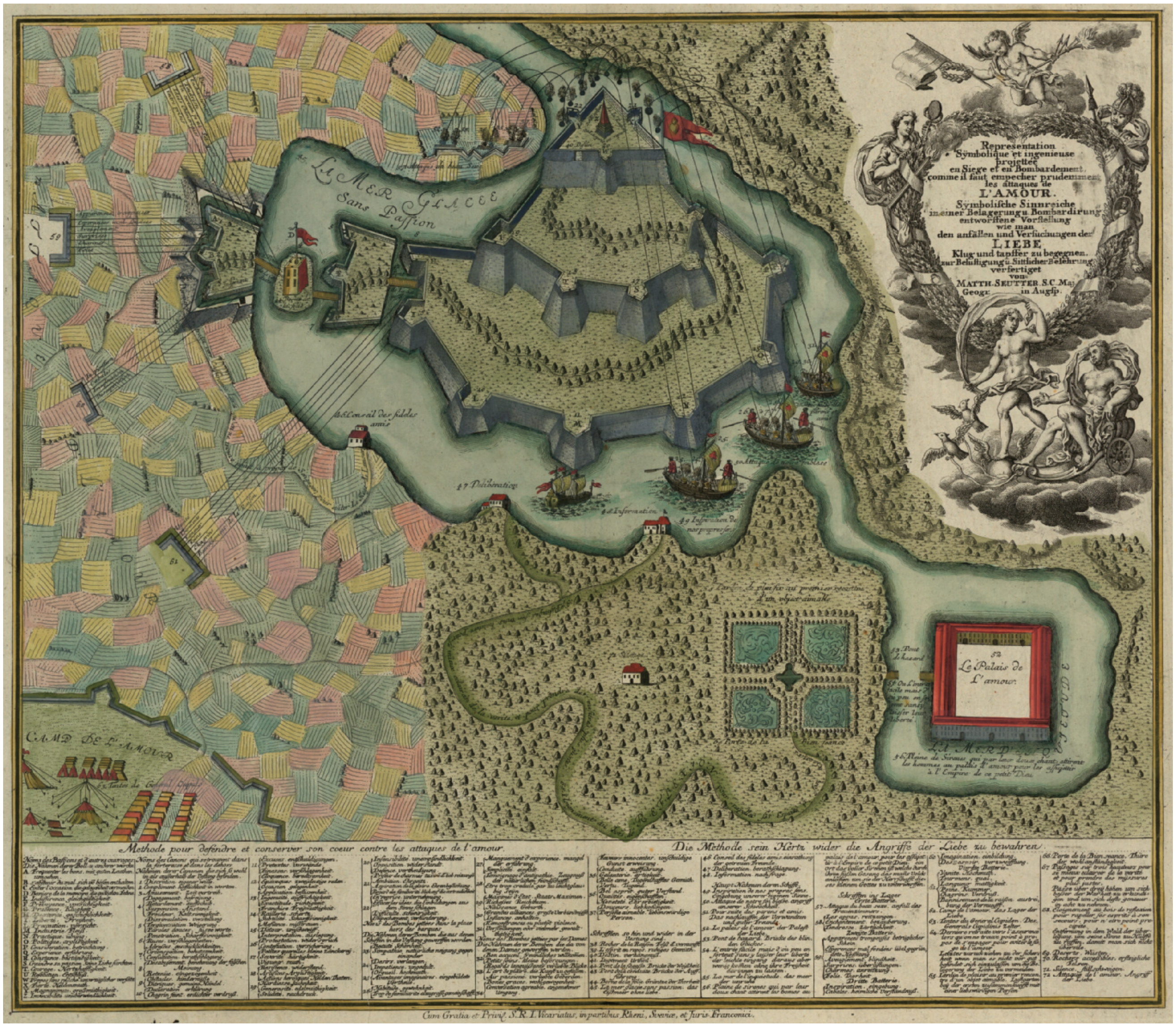

FIG. 55. MATTHÄUS SEUTTER, *REPRESENTATION SŸMBOLIQUE ET INGENIEUSE PROJETTÉE EN SIEGE ET EN BOMBARDEMENT COMME IL FAUT EMPECHER PRUDEMMENT LES ATTAQUES DE L'AMOUR = SŸMBOLISCHE SINNREICHE IN EINER BELAGERUNG U. BOMBARDIRUNG ENTWORFFENE VORSTELLUNG WIE MAN DEN ANFÄLLEN UND VERSUCHUNGEN DER LIEBE.* From his *Atlas novus*, 1745.
Size of the original: ca. 49 × 56 cm. Image courtesy of the Map Collection, Yale University Library, New Haven (1an 1730).

FIG. 56. "T.P.," *A MAP OR CHART OF THE ROAD OF LOVE, AND HARBOUR OF MARRIAGE* (LONDON, 1748). Later imprint published by Robert Sayer.

Size of the original: 18 × 30 cm. © The British Library Board, London (Cartographic Items Maps CC.2.a.16).

of the Sea of Common Life, along the Road of Love, through the Fruition Straits, between Cape Ceremony and Cape Extasy, through the Harbour of Marriage, around the Rocks of Jealousy, Whirlpool of Adultery, and Cuckold's Point, and at last into Felicity Harbour. In the author's conception, marriage is not an island, as it had been in Le Noble's work or the 1732 map, surrounded by open water where lovers could drift through an archipelago of marriage-threatening obstacles. Instead, it is a narrow sea linking love to marriage and marriage to happiness (Reitinger 1999a; 1999b, 114–25).

Even as they look back to an older process of mapping concepts imagined in spatial contexts, allegorical maps such as Bunyan's, Scudéry's, and Sayer's remind us that all maps, no matter how ostensibly scientific, refer to an often ideologically framed set of ideas about the world. Moreover, as an important moment in the early modernity of cartographic practice, the vogue for allegorical cartography in the seventeenth and eighteenth centuries also reminds us that many of the expectations we impose on early modern maps are products of our own modernity rather than properties of early maps themselves. In important ways, every map points beyond the objects it represents; in important ways, every map is an allegory.

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SEE ALSO: Consumption of Maps; Map Trade; Metaphor, Map as; Public Sphere, Cartography and the

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Altimetry. See Height Measurement: Altimetry

Anich, Peter. Born in 1723 in Oberperfuss near Innsbruck, Peter Anich managed the paternal farm all his life, explaining his nickname, the Tyrolean *Bauernkartograph* (peasant cartographer). His first works were vertical sundials on churches and residential houses (eight have been preserved, dating from 1745 to 1759) and pocket sundials. In 1751 on Sundays and on holidays he began to receive private lessons in mathematics, surveying, and astronomy from Ignaz von Weinhart, a Jesuit and professor of mathematics at the University of Innsbruck. On von Weinhart's commission, Anich created two large manuscript globes: a celestial in 1755–56, a terrestrial in 1757–59 (both in the Tiroler Landesmuseum Ferdinandeum, Innsbruck). Each ca. one hundred centimeters in diameter, they were derived from the work of Johann Gabriel Doppelmayr and Johann Matthias Hase. Working from these "big" globes, Anich drew and engraved gores for a smaller pair of globes, ca. twenty centimeters in diameter, in 1758–59, the first printed globes produced and published in the territory of contemporary Austria.

Decisive for Anich's cartographic work was the transfer to Vienna of Joseph von Spergs, who dealt with regulating the Tyrol-Venetian border. In 1759 Anich surveyed the still unmapped region of southern Tyrol for Spergs's *Tyrolis pars meridionalis episcopatum tridentinum* (ca. l:121,000; copper engraved, 1762). In 1760 Anich was commissioned by the Repräsentations- und Hofkammer of Innsbruck to produce a map of northern Tyrol based on direct survey. His method of inserting existing detailed surveys into a new triangulation network and his use of instruments of his own invention and construction resulted in unprecedented precision and led to a commission for him to extend his survey to southern Tyrol. Anich acquired a competent colleague in Blasius Hueber, another peasant from Oberperfuss. When Anich died in September 1766 in Oberperfuss at age forty-three, Hueber completed the surveys on his own within three years. The publication of the map, along with a summary reference map, was completed by the Viennese engraver Johann Ernst Mansfeld toward the end of 1774, delayed by unresolved border issues, among other things.

Known as the *Atlas Tyrolensis*, the title on the reference sheet, the map title is *Tyrolis sub felici regimine Mariæ Theresiæ Rom. Imper. Avg. chorographice delineata*. Also known as the "Anich-Hueber map," it is regarded as the most important and well-known map from the eighteenth century produced and published in Austria, prestige derived from its amazingly exact depiction of the high mountain area with more than five hundred mountains mentioned by name, more than a thousand alps marked, and about fifty glaciers charted (fig. 57). More than fifty different symbols mark a

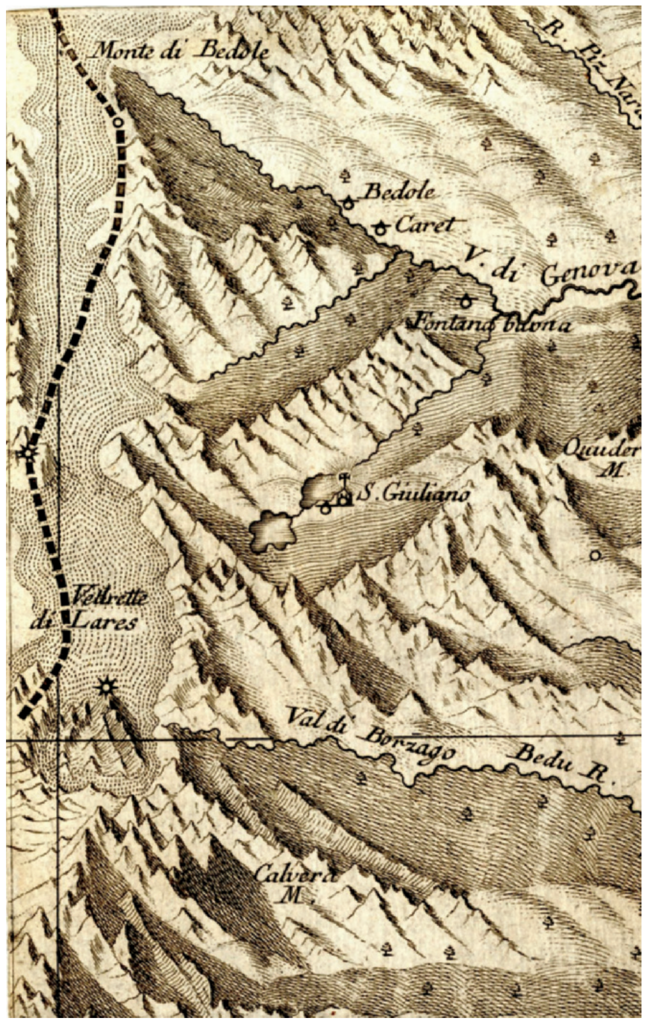

FIG. 57. DETAIL FROM PETER ANICH AND BLASIUS HUEBER, *TYROLIS SUB FELICI REGIMINE MARIÆ THERESIÆ ROM. IMPER. AVG. CHOROGRAPHICE DELINEATA* (VIENNA, 1774). Detail from sheet 17 showing glacier, relief shading, highest point of mountain (with a star), and alps signified by a circle with a caret atop. Copper engraving on twenty sheets; 1:104,000.
Size of each sheet: 65.0 × 49.5 cm; size of detail: ca. 16 × 10 cm. Image courtesy of the Woldan Collection, Österreichische Akademie der Wissenschaften, Vienna (Sammlung Wolden, K-III: OE/Tyr 159).

wealth of topographic and thematic detail (see fig. 84). A facsimile edition was published in the late twentieth century (Kinzl 1974).

The map was both so reliable and so reputable that the Austrian quartermaster general's staff was able to forgo the survey of the Tyrol when executing the Josephinische Landesaufnahme. Members of the Commission topographique of 1802 called it "one of the most beautiful topographical works of the century" ([Soulavie] 1802–3, 114). France's Dépôt de la Guerre had it reengraved in Paris in 1800–1801 on a scale of ca. 1: 140,000 and sold it publicly as its first printed map.

René Tebel

see also: Austrian Monarchy

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Antiquarianism and Cartography. The antiquarian was a "lover, collector and student of ancient traditions and remains" (Momigliano 1950, 290; on Momigliano's fundamental essay, see Miller 2007; Crawford and Ligota 1995). These were the men, Arnaldo Momigliano argued, who fashioned the tools that resulted in the revolution of historical method in the 1700s. Although members of a discipline who had been working with nonliterary evidence for at least 150 years, they proclaimed a new status for objects and images as the raw materials for reconstructing the past. Creating representations of landscapes, individual buildings, and ancient objects was a critical component of the antiquarian's work.

A simple definition of this spirited discipline does violence to its complexities and contradictions. There is no history of the early modern antiquarian and his practices (Haskell 1995; Schnapp 1997, 2013; Miller 2012). The antiquarian was an increasingly difficult character to pin down. Even antiquarians' definitions of the past varied. British antiquaries pursued their Druid, Roman, Saxon, and Goth ancestors via topographical regional studies and medieval texts; Frenchmen worked in libraries and the field searching for their Gaulish forebears; in search of Neolithic ancestors, German clergymen took the leading role in examining texts and tombs. Although antiquarians often belonged to the great borderless scholarly state that was the Europe-wide Republic of Letters, their work served local political needs. The great Greco-Roman controversy, a debate that erupted in the 1700s as to the relative superiority of Greek and Roman culture and art, developed along the lines of national languages and cultures.

In all corners of Europe, antiquarians sometimes worked in solitude, tucked away in libraries. But in the 1700s, the discipline favored the learned sociability offered by salons, academies, and museums. Academies like the Académie des inscriptions et belles-lettres (1663) in Paris, the Society of Dilletanti (1734) and the Society of Antiquaries (reestablished 1717) in London, and the Accademia Ercolanese (1755) in Italy flourished (Redford 2008; Kelly 2010).

Travel became an increasingly important way of studying ancient remains and places. A relatively new institution, the Grand Tour, brought visitors to Rome as well as to other ancient sites. The rediscovery of Herculaneum (1738) and Pompeii (1748) excited many. The geographical boundaries of antiquity also expanded considerably over the course of the century. Intrepid scholarly teams explored Greece, Turkey, Syria, Lebanon, and Egypt.

The practices on which antiquarians relied are complex. Important debates began in the 1600s about the nature of evidence. A number of antiquarians began to question the reliability of texts. (The Pyrrhonists, for example, were suspicious of classical texts and questioned whether it was even possible to know the past.) Objects became increasingly important as instruments of analysis. Particular emphasis was placed on "comparison, which is for the antiquarian that which observations and experiments are for the physicist," in the words of one eighteenth-century practitioner (Caylus 1752–67, 1:iii). However, despite the distrust that many antiquarians espoused, they still turned to texts as vital tools. In the 1700s, the importance of direct observation and gathering quantifiable data was often combined with new tools for measurement.

Alongside erudition, the other key component of the antiquarian exercise—imagination—survived as it had for centuries. Making the broken bits of the past whole was at the core of antiquarianism. As scientific disciplines increased their reliance on quantifiable data, this means for understanding phenomena slowly drifted into the antiquarian's sphere. The marriage between science and antiquarianism proved complex and hard to consummate. Giovanni Battista Piranesi moved between measurement and fantasy, fusing antiquarian imagination and modern mapmaking in especially imaginative ways. His 1762 *Ichnographiam campi martii antiqvae vrbis* plan is unusual in that it relies almost solely on planimetric cartography for a full reconstruction of imperial Rome (Piranesi 1762, pls. 5–10; Connors 2011). Measured surveys and imaginative conjecture, along with ancient and modern texts and archaeological exploration, served as the basis for this 1.350 × 1.170 meter image. The map appears as if it is engraved on stone, which casts a shadow, rather than printed on paper. Sturdy metal clamps appear to hold the "stone" map in place. This fictive tablet is composed of two sections, one large and one tiny, revealing the fragmentary and ruined nature of this image. Such trompe l'oeil effects like these appear regularly in antiquarian maps. The Campus Martius plan was part of a volume that included other images and a learned text (Minor 2015). There, plans, aerial views, architectural fragments, and maps coexist, sometimes on a single page. Visual compilations of this kind appear in a variety of antiquarian publications in the 1700s (e.g., Adam 1764; Stuart and Revett 1762–1816; Wheler 1682; Wood 1753, 1757; and Le Roy 1758).

In his plan of the Emperor Hadrian's villa, *Pianta delle fabriche esistenti nella Villa Adriana* (1781), Piranesi combined a range of imaging techniques to record archaeological data collected on site. Built between 118 and 134 A.D. on a hilly site just east of Rome, the villa, with its trove of sculpture, rich mosaics, and unusual architecture, fascinated antiquarians from the Renaissance onward. In Giovanni Battista Nolli's studio, Piranesi was introduced to modern surveying techniques, as well as to the possibilities of using cartography to record ancient and modern sites. Surveying and sketching the 120-hectare site was a giant undertaking, requiring Piranesi to make repeated visits throughout his career (Pinto 1993). Piranesi carefully measured individual nodes of the villa and then used triangulation to create the map. The plan was published by his son after Piranesi's death. When the first modern plan of the villa was drawn in 1905, it took forty engineering students six months to survey less than half of the area shown in Piranesi's plan. Assembled, Piranesi's six folio sheets are 3.114 × 0.705 meters and represent the villa at ca. 1:1,000. The plan covers an area that extends more than three kilometers from north to south. It includes a key with 434 separate entries that record the functions of the ruined architecture, descriptions of each feature, and the location of find-spots for works of art unearthed at the villa. Solid lines depict extant features, while lighter ones denote features that are conjecturally reconstructed. Dotted lines represent the elaborate subterranean system of passages, roads, and chambers that served the ground-level structures. The topography of the rugged site is also recorded, with shading to indicate ridges, hills, and valleys (light comes from several different directions in the map). Using an array of imaging techniques, Piranesi records extant features, reconstructs the parts of the villa that did not survive, and stratifies the layered terrain from the deepest subterranean chamber to the highest point on a hill. The layout and design of the map is no less complex. The compass rose inscribed on a Doric column drum and base along with the brick stamps that accompany the dedicatory inscription highlight the contrast between regular borders of the map sheets and the illusion of the map as fragment. It is presented as a chipped and worn segment, with metal clamps gripping it to a wall. For contemporary learned viewers, this certainly would have conjured up the ancient marble plan of Rome, the *Forma Urbis Romae*. Pieces of this enormous map carved in the third century A.D. were rediscovered in the sixteenth century (Bellori 1673). Hundreds of fragments were reconstituted in the Capitoline Museum in Rome by Nolli and Diego de Revillas, with assistance from Piranesi (Bevilacqua 2006, 25–26).

Piranesi's orthogonal visions were unusual. Maps were not the preferred means for depicting the sites of antiquarian interest in the early modern period. The *veduta* was. Part of the preference for *vedute* was practical; they did not require surveying or even extensive site visits. The *veduta* also allowed the antiquarian to engage in a key part of their discipline: to make the shattered fragments of the past whole again. The possibilities for describing structures like buildings and tombs, and making them distinguishable from modern constructions, required the creative use of ichnographic representations. Restoration, one of the hallmarks of the antiquarian exercise, could be established by recording a plan of any structure. But elevations, sections, and aerial views made it easier to present local people, architectural elements, vegetation, and other evocative details. Because of this peculiarity of the antiquarian exercise, maps did not replace vertical projection and aerial views but rather complemented them.

Mapmaking would seem a natural fit for a discipline obsessed with measuring architectural remains from the past. Architects, who provided visual records of measured space, played a critical role in creating images of ancient structures and cities. But even those who emphasized accuracy and measurement used the *veduta* as a tool to communicate their findings. In order to complete *The Antiquities of Athens*, the Englishmen James Stuart and Nicholas Revett stayed in Athens for more than three years excavating, measuring, and drawing.

According to their preface, each Athenian "antiquity" would be treated in a view "finished on the spot," followed by relevant plans and elevations recording "the measure of every Moulding," and images of sculpture (Stuart and Revett 1762–1816, vol. 1, preface, v, note a; Weber [Soros] 2006). Their *Greece, Archipelago and Part of Anadoli* map, which appeared "much more accurate than any yet published of that country" (vol. 3, preface, iv), was created using Stuart's surveys of the places he visited, a manuscript map of the Morea by a German engineer in the service of the Venetian state, and other travelers' accounts. The *Antiquities* also included measured site plans and *vedute*, as well as hybrid images like a panoramic view of Athens accompanied by a grid in which numbered and lettered coordinates along the border of the image allowed the reader to locate topographical features. While Stuart and Revett stressed empirical observation, their practices belie a reliance on both ancient and modern authors.

While surveying techniques along with improved instruments, such as the sextant and the octant, were available to assess ancient sites, even antiquarians interested in precise measurements did not always rely on them. The Irishman Robert Wood and the Englishmen James Dawkins and John Bouverie set out in 1750 to explore the East to see the "countries where architecture had its origin" (Wood 1753, publisher to the reader [2]) and "to read the Iliad and the Odyssey in the countries where Achilles fought, where Ulysses traveled, and where Homer sung" (Wood 1775, to the reader, v). Giovanni Battista Borra accompanied them and served as the expedition's draftsman. While examining the ancient city of Palmyra in central Syria, they created a map of the site. Wood used measuring tools, although how much of the site he was able to measure is unclear. He spent only five full days in Palmyra, but estimated the circuit of the ancient wall to be three miles. His hesitancy to identify structures accounts for the "confused ruins" and "Indistinct ruins of large buildings" that appear in the map's legend (Wood 1753, 41, pl. II).

Because of the length and the danger of his journey, Wood elected not to bring the expedition's heavy quadrant with him (Wood 1753, 38 and note c). He instead relied on Ptolemy's calculation of the latitude, just as he relied on ancient texts like Procopius to ascertain the history of the town. Earlier in their travels, Borra created a map of Sardis, the ancient city in western Turkey, in his notebook, using an instrument to measure angles on the site (Borra notebook, 27 May–2 June 1750, Joint Library of the Hellenic and Roman Societies, London) (Greenewalt 2003, 27, 30–31). Wood also produced plans of smaller areas of the site. Although he stressed his "principal care to produce things as we found them" (Wood 1757, 1), the descriptions that accompany the maps make clear that this was not the case. The description of the map of the Valley of Salt reports: "Nothing less entire than a column standing, with at least its capital, is marked. Almost the whole ground within the walls is covered with heaps of marble; but to have distinguished such imperfect ruins would have introduced confusion to no purpose" (Wood 1753, 41).

This example reveals the working procedure used at a number of sites. Many of the places that fascinated antiquarians in the 1700s were remote and difficult to visit, hindering the transport of heavy surveying tools, which only very well-financed groups could afford. The sites that interested antiquarians seemed to be growing larger in size and scale in the 1700s. Athens, Balbec, Pompeii, Palmyra, Split (Spalato, Spalatro), and Sardis were all cities, not single buildings. The urban scale of these places demanded images capable of expressing a wide variety of information.

As literacy moved down the social ladder and across the gender gap in the eighteenth century, the antiquarian's reader was no longer classifiable as a learned man. Observations were often presented to readers in a new form, the lavishly illustrated folios that cascaded out of printers' presses from London to Naples. The varied ways of discovering the past and illustrating results visually gave rise to diverse publications. Maps of ancient sites often combined measured plans, aerial views, vertical projections, and representations of ancient objects found on the site. The large folios produced by Piranesi, Stuart and Revett, and Wood were collected as luxury objects. Used by sophisticated consumers of images, the expectations of the scholars, architects, and patrons who pored over these volumes conditioned what they looked like. The process of creating images for the printing press also affected these illustrations.

Two groups at work at the same site can shed some light on the variety of approaches and outcomes. Both used maps as a means of recording some of their findings. Jacob Spon, an antiquarian and physician with a successful practice in Lyon, set out in 1674 to visit Greece. Spon approached antiquarian study by creating categories for arranging material. Topography came first, followed by architecture, inscriptions, coins, medals, cameos, statues, and painting. He began his visit to the East in Split (Spalato), the site of the Emperor Diocletian's great palace. Spon and Englishman George Wheler spent eleven days surveying "the place with more than ordinary diligence," according to Wheler (1682, 16). They measured parts of the palace, took notes in their journals, and made drawings. Both Spon's and Wheler's published accounts of their visit to the site include images. The first small engraving of Spalato in Wheler's *A Journey into Greece* (1682, 15) presents a view of the peninsula and the surrounding area, giving

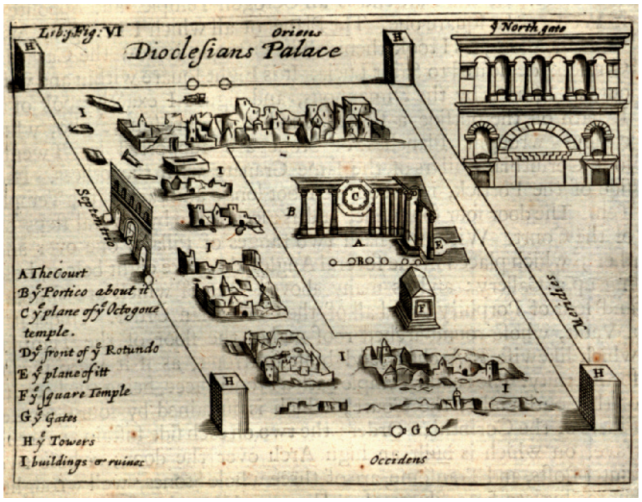

FIG. 58. GEORGE WHELER, VIEW OF DIOCLETIAN'S PALACE, SPLIT (SPALATO). While most of the structures on the sheet are shown in bird's-eye view, the "Octagone temple" is shown ichnographically, in a plan hanging from the portico of the palace. The north gate is shown in elevation. The temple sits just to the east of the portico, which would have blocked it in this image. From Wheler 1682, 17.
Size of the original: 9.0 × 12.3 cm. Image courtesy of the Department of Special Collections, Memorial Library, University of Wisconsin–Madison.

the viewer a sense of the location of the sites the author describes in his text. The next image is a bird's-eye view of the remains of the ancient palace (fig. 58). Packed with detail, this small view labels the four main compass directions but does not include a scale. Wheler did not attempt to give a precise name to any structure for which they found no evidence on site. For example, the "square temple" is not ascribed a dedication.

Eighty-three years later, Robert Adam visited Split (Spalatro), and subsequently published his *Rvins of the Palace of the Emperor Diocletian* (1764). A Scottish architect, Adam completed two tours of Italy to study ancient architecture, believing that ancient buildings should "serve as models which we should imitate, and as standards by which we ought to judge" contemporary architecture; direct observation was the only way to "catch from them those ideas of grandeur and beauty" necessary for inspiration (Adam 1764, 1). The first plate in the book, engraved by Edward Rooker in London, presents a large map fused with a *veduta* of the peninsula (fig. 59). This map depicts what was then modern-day Spalatro, with the surrounding mountains, fortifications, and settlements outside the walls. Modern structures are all shaded with hatched lines, while within the imperial precinct, dark lines show what remained of the palace. Planimetric cartography, vertical projection, and an aerial view are all combined in this map. The *veduta* above depicts ancient structures on the left and right, with the center occupied by the modern city. At the top of the map, three metal clamps appear, as if suggesting that it was inscribed on a marble tablet rather than printed on paper. This illusion of the map as a marble fragment is problematic given that the three shorn clamps hold nothing. Although a figure on the right "leans" on the edge of the map, peering down to examine it, and architectural fragments sit precariously on the uneven border, the outline of the map is neatly finished and does not resemble rough stone.

While Wheler's small volume and Adam's mammoth elephant folio both could have appealed to an antiquarian audience, they compiled their works for different kinds of readers. English nobles gobbled up Adam's costly volume, their names recorded in a seven-page subscription list at the front of the book. Because Wheler's and Spon and Wheler's small volumes recounted their voyage to Italy, Dalmatia, Greece, and the Levant, they appealed to a wider range of readers. (Wheler's work was translated into French and Dutch, Spon and Wheler into German, Dutch, and Italian.) While both Wheler and Adam professed a devotion to direct observation, the images they created are quite different from one another. Wheler's illustrations, which may seem simple, are made to appear as having come directly from a notebook used during his travels. Adam's map, by contrast, resulted from an elaborate but typical image-making process for illustrated folios. After returning to Venice from Dalmatia, Adam collected the drawings created by the team of draftsmen who accompanied him (Fleming 1958). Two sets of the sheets were made, and one was sent to London to be engraved while the other remained in Venice for the same purpose. This cumbersome process meant that the final images that illustrate the text, including the map, were undoubtedly elaborated and edited far from the luminous white limestone walls of Diocletian's residence. Wheler's views, on the other hand, while surely undergoing alterations, appear as if they are rough sketches made on site.

Because accuracy, measurement, and reconstruction were things that antiquarians loved to fight about, it is not surprising that maps could also be sharply polemical. Bertrand Capmartin de Chaupy offers insight into both antiquarian practices and the use of maps (1767–69). Antiquarians like Capmartin de Chaupy tried for centuries to match with modern places the names of geographical features mentioned by ancient authors. Around 1760, he located the site of Horace's villa in the Sabine Hills in Lazio, a place familiar to any learned reader of the poet's *Odes*. Although Horace described his villa often in his poems, none of the place-names he mentioned survived the centuries. Capmartin de Chaupy entered into an ugly dispute with another antiquarian over who discovered the villa first. Then, he prepared

FIG. 59. ROBERT ADAM, MAP AND *VEDUTA* OF SPLIT (SPALATRO) AND DIOCLETIAN'S PALACE, *GENERAL PLAN OF THE TOWN AND FORTIFICATIONS OF SPALATRO*. The remains of three metal clamps appear between the map and the *veduta*. From Adam 1764, pl. II. Size of the original: 67.0 × 50.8 cm. Image courtesy of the Department of Special Collections, Memorial Library, University of Wisconsin–Madison.

FIG. 60. BERTRAND CAPMARTIN DE CHAUPY, MAP OF HORACE'S VILLA, *CARTE TOPOGRAPHIQUE DE LA PARTIE DE LA SABINE ANTIQUE OU FUT LA MAISON DE CAMPAGNE D'HORACE*. From Capmartin de Chaupy 1767–69, vol. 3, at end. Size of the original: 40 × 38 cm. Image courtesy of the Bibliothèque nationale de France, Paris.

his material and wrote a book, managing to stretch his "discoveries" at the villa to a three-volume set. Making a discovery in the field, squabbling with another member of the antiquarian community, and then publishing a book was a familiar pattern in the eighteenth century.

Capmartin de Chaupy's work included only one illustration, a map of the site of the villa and the surrounding area (fig. 60). Rather than rely on modern surveys of the region or precise measurements taken by the author, the map shifts geographical features in order to meet Horace's descriptions of his villa and the surrounding terrain. In addition to a key and a scale in Roman miles, Capmartin de Chaupy presents two inscriptions, settled among the underbrush and broken columns that appear in the lower-right corner. He used these inscriptions and the ancient place-names they record to locate the villa. Presenting ancient objects found onsite around the edges of maps was a common practice in the 1700s. This map would have a role to play in another dispute. In Capmartin de Chaupy's introduction, he attacks an engraver in Rome "who makes the principal books on antiquity but he should limit himself to executing the plates [that accompany them], which would be well-intended and faithful if they were guided by true erudition" (1767, 1:xliii).

There can be no doubt about the identity of this engraver: he was Piranesi. To respond, Piranesi picked up his favorite weapon, the burin. The colophon to the text in his *Diverse maniere* is his response (fig. 61). It takes the form of a scatological map (Minor 2015). The print depicts three volumes stacked on top of each other. Representing Capmartin de Chaupy's work, one spine includes the author's name. On the back cover of the top book, a map appears. A piece of excrement with dung beetles scurrying about appears on the site of the villa. Piranesi uses his map to attack Capmartin de Chaupy's sloppy placement of geographical features. One example is Piranesi's location of Licenza, a hill town near the site of the villa, which he places in the same position that Capmartin de Chaupy does. Piranesi labels the town "Con Licenza" (with license) drawing the viewer's attention to the license Capmartin de Chaupy took in mistaking the location of the town.

In the 1700s, antiquarians combined observation and measurement, visual and literary evidence, and imagination to reconstruct lost sites. This medley of sources and procedures coexisted happily in the maps they created.

HEATHER HYDE MINOR

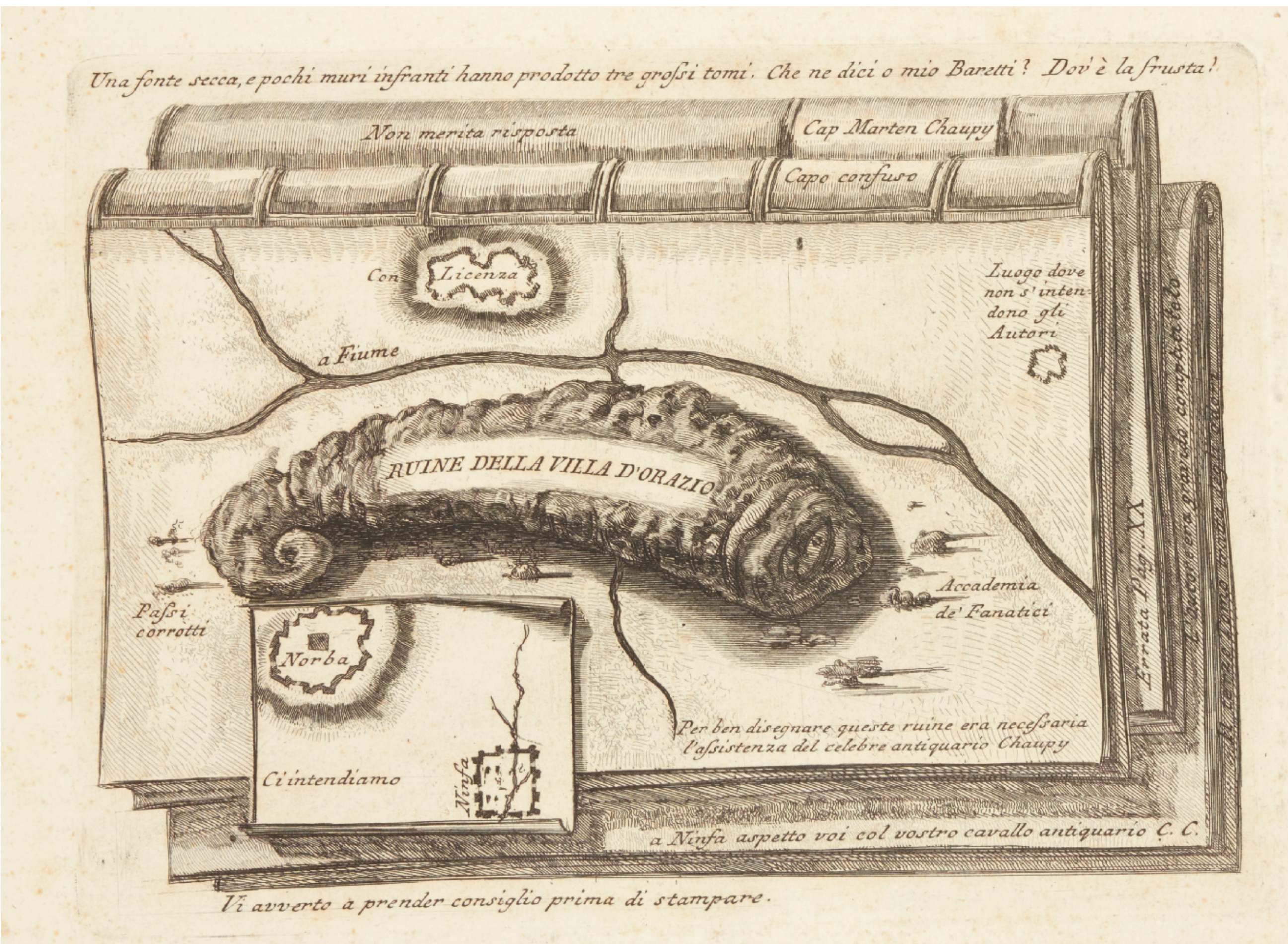

FIG. 61. GIOVANNI BATTISTA PIRANESI, MAP OF THE *RUINE DELLA VILLA D'ORAZIO*. From Piranesi 1769, 35. Size of the original: ca. 15 × 21 cm. © The British Library Board, London.

SEE ALSO: History and Cartography; Public Sphere, Cartography and the; Thematic Mapping; Travel and Cartography; Urban Mapping

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Anville, Jean-Baptiste Bourguignon d'. Jean-Baptiste Bourguignon d'Anville (Paris, 11 July 1697–Paris, 28 January 1782), the son of Hubert Bourguignon, a master-tailor, and Charlotte Vaugon, was baptized Charles Bourguignon. His predilection for geography may have been piqued at the Collège des Quatre-Nations (Collège Mazarin), where mapmaking was included in the lessons on mathematics. D'Anville's first map, of ancient Greece, created sometime around age fifteen, demonstrated his interest in the classical world (fig. 62). This precocity may have introduced him to the circle of abbé Louis Dufour de Longuerue, a specialist in classics and oriental languages, who invited the young d'Anville to create a series of historical maps for his *Description historique et géographique de la France ancienne et moderne* (1719). D'Anville's connection with the abbé doubtless led to his appointment as one of the geography tutors (along with Guillaume Delisle) to the young Louis XV. His map, *La France ancienne* brought him the title of *géographe du roi* in 1719, and in the same year, the Regent, Philippe II, duc d'Orléans, invited him to create the *Carte du Royaume d'Aragon*, which considered the recent theater of war with Spain and was based on survey work in the Pyrenees by Roussel.

While a nearly contemporary catalog of d'Anville's maps and writings (de Manne and Barbié Du Bocage 1802) shows no cartographic production between 1720 and 1727, he was employed by various authors to supply maps as illustrations for their books. In addition, Júnia Ferreira Furtado (2012) has revealed that d'Anville worked for the Portuguese government during this period. Guillaume Delisle's map of South America (many editions, earliest probably 1700), unfavorable to Portuguese interests, had stimulated the Portuguese am-

FIG. 62. *GRÆCIA VETVS*, 1712. Printed after d'Anville's death, the map was copied from the first map made by the geographer when he was about fifteen years old, as witness by the signature, "J. Babtiste Bourguignon" (having not yet taken the name d'Anville). Scale: ca. 1:91,500. From de Manne 1834, vol. 1, before i.
Image courtesy of the Bibliothèque nationale de France, Paris.

bassador to France to try to hire Delisle, who refused. They turned to d'Anville, who accepted. The role of d'Anville's patron, the duc d'Orléans, may be seen in his acceptance of the Portuguese proposal; the duke's failure to succeed to the throne of Spain caused him to look to Portugal for a new if fragile alliance, given Portugal's ongoing friendship with England, France's historical enemy. In fact, it was the English who remunerated d'Anville for his work for the Portuguese. Nonetheless, d'Anville's financial security derived from the pension awarded to him by Louis, duc d'Orléans, the son of the Regent, whom he served as personal secretary. He also enjoyed lodging in the Galeries du Louvre, where his presence is attested from 1746.

The work of d'Anville was firmly within the tradition of French *géographes de cabinet*, such as the Sanson family or Guillaume Delisle, during a period when field cartography was undergoing important advances. He never traveled through the territories that he represented nor did he use astronomical procedures for the determination of locations. Nevertheless, as compilations from a wide variety of sources, his maps possessed a remarkable level of precision. D'Anville maintained a vast correspondence and accumulated a very large archive of documentary material. His map collection comprised about 10,500 sheet maps (de Manne 1834), which he offered to Louis XVI in 1779 in return for a pension and with the right to use it until d'Anville's death in 1782. Since 1924, this enormous collection has been housed in Paris at the Bibliothèque nationale de France (BnF) (Département des cartes et plans, Ge DD 2987). D'Anville's working archive is spread among several places: 380 manuscript maps are kept in the BnF Cartes et plans (Ge D 10329–10708), some geographical notes are kept in the BnF Département des manuscrits (primarily NAF 6502–6503, 11715, 17381–17383), while the remainder is found in public and private archives around the world. Because of the size and scope of d'Anville's working archive, it is possible to understand his working methods, the contexts of his cartographic production, and his independence from the commercial pressures of the map trade (Projet d'Anville website).

D'Anville's *Considérations générales sur l'étude et les connoissances que demande la composition des ouvrages de géographie* (1777) laid out his working methods, reflected on the cartographic process, and admitted "the impossibility of producing a faithful image of regional topography, even while insisting on the necessity of enriching knowledge of a locale with pertinent information" (Safier 2008, 138). Published toward the end of his long career, this work summarized d'Anville's geographical ambitions of working towards perfection: "A focused dedication and sixty years of application to this study have allowed me to make several steps toward this perfection. The bringing together of nine to ten thousand map sheets, of which more than five hundred are manuscript, was able to contribute greater precision to geographic works, whether written or cartographic, and to spread greater wealth [of knowledge] if I may express myself thus, than has been known before" (de Manne 1834, 1:2). Bon-Joseph Dacier's eulogy of d'Anville emphasized his rigorous scientific spirit and his constant concern for perfection (Dacier 1793, 68). D'Anville constantly updated his work; for example his *Carte d'Asie* was first published in 1751 and corrected in 1753, 1755, 1758, and 1763.

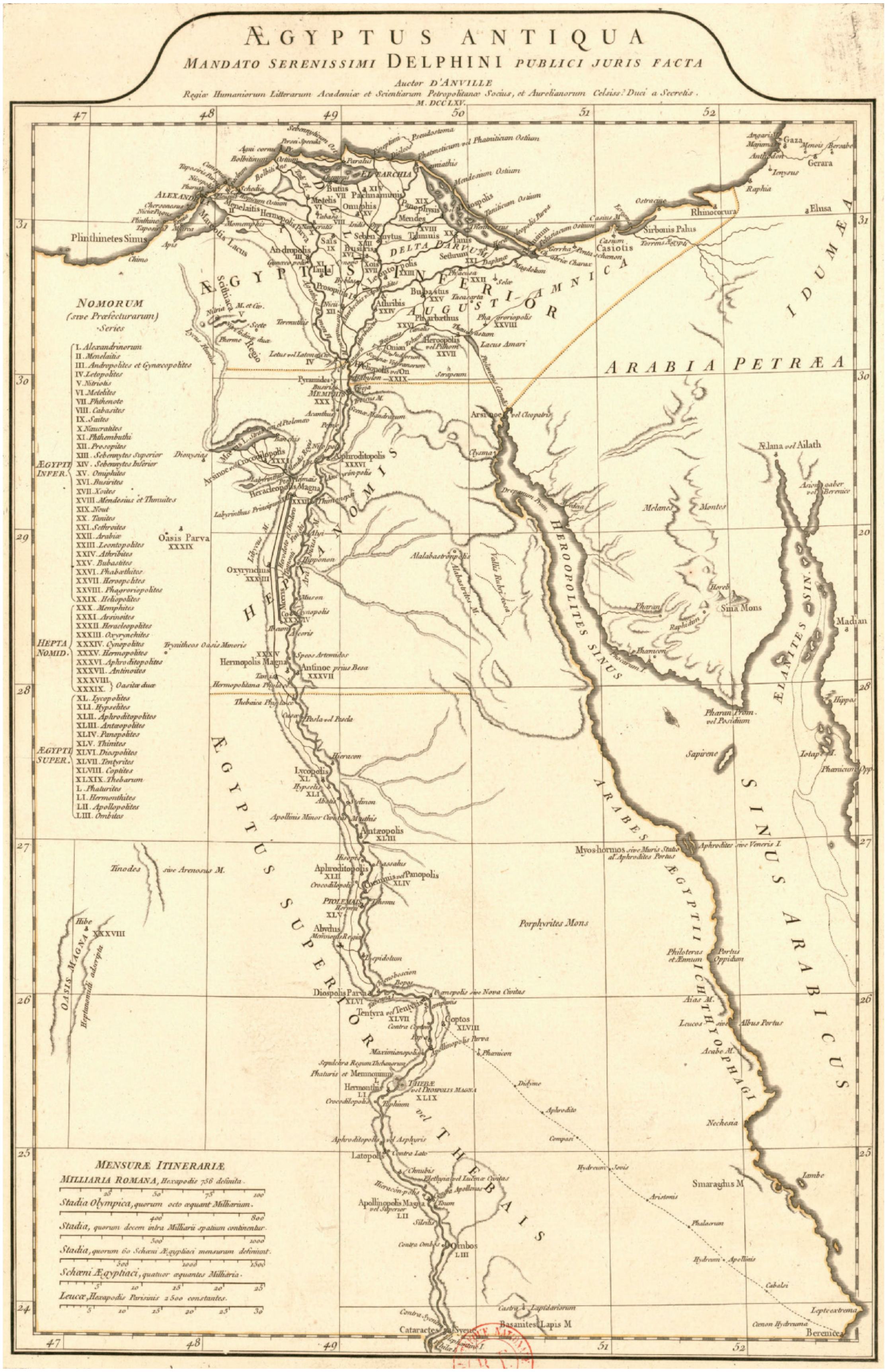
In addition to precision and exhaustive research, d'Anville eschewed the representation of uncertain regions or the use of decorative elements to fill in blank areas without connection to reality. The resulting maps displayed a very sober aesthetic, presenting information in the simplest way possible: "vast blank spaces marked what was not yet known, but they were a proof of the exactitude of all that was filled in" (Condorcet 1785, 71).

To prepare his maps, d'Anville first determined the position of places by studying ancient and medieval texts along with contemporary accounts in a variety of languages as well as interviewing travelers for their direct observations. From his collection of maps and books he made notes and sketches, drawing portions of maps and annotating them carefully before compiling a manuscript draft of the final map. He carefully checked the engraved proofs before publication and wrote long *mémoires*, many of which were published, to justify his cartographic choices. He also composed several theoretical treatises, such as *Considérations générales* (mentioned above) and *Traité des mesures itinéraires anciennes et modernes* (1769), which laid out his method for establishing the correspondence among measurements through the ages.

D'Anville was consistently productive throughout his career, though by comparison with contemporary commercial geographers in Paris, his total output was rather small. Louis-Charles-Joseph de Manne, the son of d'Anville's secretary Nicolas-Joseph de Manne, prepared the catalog of his published maps and written works (de Manne and Barbié Du Bocage 1802), which comprised 209 maps and plans and 78 written works including analyses of individual maps and theoretical memoirs. In his early career (1719–50), d'Anville mostly prepared maps for others on commission, but in his mature period (1750–80), his maps satisfied his own scholarly interests. He was supported by his patron and by the academies, which provided him with pensions and publication outlets. His most productive period was between 1730 and 1759, and his entire opus could be divided into two categories: ancient geography (107 maps) and modern geography (102 maps).

D'Anville's concentration on ancient geography brought him great renown from the beginning of his career. His early commissions included fifty-five maps for historical works. He produced seven general maps of the antique world, forty-four maps of ancient Europe, seven maps of ancient Africa (fig. 63), nineteen maps of Asia, six maps related to medieval geography, and five to sacred geography. In addition to illustrating the works of abbé de Longuerue, d'Anville's maps of Egypt and ancient Greece were found in the *Histoire ancienne* of Charles Rollin (1730–38), and his maps of the Roman Empire in the *Histoire romaine* (1738–48) of Rollin and Jean-Baptiste-Louis Crévier. He provided maps for the *Histoire des empereurs romains, depuis Auguste jusqu'à Constantin* (1750–56) by Crévier and illustrated the itineraries of the expeditions of the sainted King Louis IX for the reedition of the *Vie de saint Louis* (1757) by Jean de Joinville.

In modern geography he created two general world maps, twenty-seven maps related to Europe, thirty-three maps of Asia, seventeen maps of Africa, and twenty-three focused on the Americas. For each continent, d'Anville produced small-scale general maps and medium-scale regional maps, which could be assembled in a general atlas, but as an *atlas factice* rather than an atlas prepared by d'Anville himself. His world map in two hemispheres was first published in 1761 and reedited on numerous occasions (see fig. 290). His maps of Asia included those prepared for the *Description géographique, historique, chronologique, politique, et physique de l'empire de la Chine et de la Tartarie chinoise* (1735) by Jean-Baptiste Du Halde and reassembled and published as the *Nouvel atlas de la Chine, de la Tartarie Chinois et du Thibet* (1737).


ÆGYPTUS ANTIQUA
MANDATO SERENISSIMI DELPHINI PUBLICI JURIS FACTA
Auctor D'ANVILLE
Regiæ Humaniorum Litterarum Academiæ et Scientiarum Petropolitanæ Socius, et Aurelianorum Celsiss.i Duci a Secretis.
M. DCCLXV.
NOMORUM (sive Præfecturarum) Series
I. Alexandrinorum
II. Menelaitis
III. Andropolites et Gynæcopolites
IV. Letopolites
V. Nitriotis
VI. Metelites
VII. Phthenote
VIII. Cabasites
IX. Saites
X. Naucratites
XI. Phthembuthi
XII. Prosopites
XIII. Sebennytes Superior
XIV. Sebennytes Inferior
XV. Omiphites
XVI. Busirites
XVII. Xoites
XVIII. Mendesius et Thmuites
XIX. Nout
XX. Tanites
XXI. Sethroites
XXII. Arabiæ
XXIII. Leontopolites
XXIV. Athribites
XXV. Bubastites
XXVI. Phabæthites
XXVII. Heroopolites
XXVIII. Phagroriopolites
XXIX. Heliopolites
ÆGYPTI INFER.
XXX. Memphites
XXXI. Arsinoites
XXXII. Heracleopolites
XXXIII. Oxyrynchites
XXXIV. Cynopolites
XXXV. Hermopolites
XXXVI. Aphroditopolites
XXXVII. Antinoites
XXXVIII. XXXIX. Oasitæ duæ
HEPTA NOMID.
XL. Lycopolites
XLI. Hypselites
XLII. Aphroditopolites
XLIII. Antæopolites
XLIV. Panopolites
XLV. Thinites
XLVI. Diospolites
XLVII. Tentyrites
XLVIII. Coptites
XLIX. Thebarum
L. Phaturites
LI. Hermonthites
LII. Apollopolites
LIII. Ombites
ÆGYPTI SUPER.
MENSURÆ ITINERARIÆ
MILLIARIA ROMANA, Hexapodis 756 definita.
Stadia Olympica, quorum octo æquant Milliarium.
Stadia, quorum decem intra Milliarii spatium continentur.
Stadia, quorum 60 Schœni Ægyptiaci mensuram definiunt.
Schœni Ægyptiaci, quatuor æquantes Milliaria.
Leucæ, Hexapodis Parisinis 2500 constantes.
ÆGYPTUS INFERIOR
AUGUSTAMNICA
HEPTANOMIS
ÆGYPTUS SUPERIOR
THEBAIS
ARABIA PETRÆA
IDUMÆA
SINUS ARABICUS
HEROOPOLITES SINUS
ÆLANITES SIN.
ARABES ÆGYPTII ICHTHYOPHAGI
OASIS MAGNA
Oasis Parva
Plinthinetes Sinus
ALEXANDRIA
Memphis
Pyramides
Heliopolis
Arsinoe vel Crocodilopolis
Heracleopolis Magna
Oxyrynchus
Hermopolis Magna
Antinoe prius Besa
Lycopolis
Antæopolis
Aphroditopolis
Chemmis vel Panopolis
PTOLEMAIS
Abydus
Diospolis Parva
Tentyra vel Tentyris
Coptos
Thebæ vel Diospolis Magna
Hermonthis
Latopolis
Apollinopolis Magna
Ombos
Syene
Cataractes
Berenice
Myos-hormos sive Muris Statio
Porphyrites Mons
Smaragdus M.
Basanites Lapis M.
Sina Mons
Horeb
Pharan
Rhinocorura
Sirbonis Palus
Casiotis
Gaza
Raphia
Elusa
Ælana vel Ailath
Madian
Lacus Amari
Arsinoe vel Cleopatris
Tinodes sive Arenosus M.
47 48 49 50 51 52
31 30 29 28 27 26 25 24

D'Anville's oeuvre included private work for his patrons, the ducs d'Orléans (father and son) (fig. 64), and for public administration, such as the *Carte topographique du diocèse de Lizieux* (ca. 1730), the map of France for the *Almanach royal* (1755), or *La France divisée en provinces et en généralités* (1773–74) for Louis-Paul Abeille, secretary for the council-general of trade (de Manne and Barbié Du Bocage 1802, 73–74). Foreign commissions included his work for the Portuguese and the Spanish Crown, with the *Carta de la provincia de Quito y de sus adyacentes* (1750), compiled from data provided by Charles-Marie de La Condamine's mission to Peru (Safier 2008; de Manne and Barbié Du Bocage 1802, 100–101).

D'Anville's maps enjoyed great authority throughout Europe and were used by numerous explorers and travelers. During his voyage to the Moluccan archipelago, the navigator Louis-Antoine de Bougainville praised the quality of d'Anville's maps, especially that of Asia (1752) and its portrayal of the island of Alambai (de Manne and Barbié Du Bocage 1802, 9–10). Similarly, French officers on Napoleon's expedition to Egypt were astonished at the accuracy of his maps (Broc 1975, 34).

During his career, Jean-Baptiste Bourguignon d'Anville gained the esteem of other scholars, receiving titles and honors. He belonged to the Society of Antiquaries of London and the Akademiya nauk of Saint Petersburg. In 1754, he was received as a member by the Académie des inscriptions et belles-lettres. In 1773, after the death of Philippe Buache, he became *adjoint géographe* of the Académie des sciences and received the title of *premier géographe du roi*. Despite his fame, his succession was problematic. With his wife, Charlotte Testard, he had two daughters, one of whom became a nun (Order of the Visitation); the other married Jacques Augustin Hébert de Hauteclair, *trésorier de France, directeur des ponts et chaussées, et du pavé de Paris*. Without a son to succeed him, d'Anville tried to find students, but none satisfied him, as he recounted ruefully in his *Considérations générales*, deploring the fact that he was unable to find anyone as committed to the necessary and selfless research as he was (d'Anville 1777, 110). But in 1777 he took on Jean-Denis Barbié Du Bocage, who became a specialist in the maps of the ancient world, like his master. Unfortunately, only a few years remained for d'Anville to train the young man, for his eyesight had been deteriorating since 1772, and he succumbed to dementia in 1781.

When the geographer died in 1782, de Manne inherited the geographical papers and manuscript maps. As a tribute to d'Anville, de Manne published an annotated list of d'Anville's complete works in 1802 with the help of Barbié Du Bocage. The considerable archive of d'Anville's correspondence points to his close connections with engravers, publishers, scholars, travelers, diplomats, academicians, and of course his patron, Louis d'Orléans, further suggesting that he did not completely fulfill the lonely scholar image he presented to the public.

For more than a century after his death, d'Anville remained a reference point in cartography, as scholars and travelers referred to his works throughout the nineteenth century. His was a familiar name to a large public, both in France and abroad. Eighty-two years after his death a street was named after him in the fourteenth arrondissement of Paris, and in 1881 his statue was placed on the city's Hotel de Ville.

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SEE ALSO: Art and Design of Maps; Geographical Mapping: (1) Enlightenment, (2) France; History and Cartography; Indigenous Peoples and European Cartography; Map Trade: France; Memoirs, Cartographic; Society of Jesus (Rome)

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(*facing page*)
FIG. 63. *ÆGYPTUS ANTIQUA MANDATO SERENISSIMI DELPHINI PUBLICI JURIS FACTA,* PARIS, 1765 (REPRINTED 1769). D'Anville included multiple scales, based on ancient measure: Roman, Greek, and Egyptian, reflecting his interests and analysis of historical sources for the re-creation of ancient geography (de Manne and Barbié Du Bocage 1802, xi–xii). D'Anville drew upon the *Carte de l'Egypte ancienne, divisée en ses 58. nomes ou gouvernemens* (1722) prepared on site by Claude Sicard, a Jesuit from Cairo, a copy of which is in the Bibliothèque nationale, Collection Anville (Ge DD 2987 [7804, 1-2 B]).
Size of the original: 58 × 42 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [10186]).

FIG. 64. *L'ITALIE PUBLIÉE SOUS LES AUSPICES DE MONSEIGNEUR LE DUC D'ORLEANS PRÉMIER PRINCE DU SANG,* PARIS, 1743. One printed map in two sheets with outline color, cartouche design by Charles-Antoine Coypel, engraved by Antoine Aveline. This map is particularly mentioned in Dacier's *Eloge* of d'Anville as one of the maps that made his reputation (Dacier 1793, 160–74). D'Anville provides measurements to recreate the image of the peninsula well in advance of the measures taken by the Jesuits Christopher Maire and Ruggiero Giuseppe Boscovich along the meridian in midcentury. D'Anville explained the construction of the map in his *Analyse géographique de l'Italie* (1744).
Size of the original: 83 × 69 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [4966 B]).

1802. *Notice des ouvrages de M. d'Anville*. Paris: Chez Fuchs et Demanne, Imprimerie de Delance.
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Projet d'Anville website. "Jean-Baptiste d'Anville: Un cabinet savant à l'époque des Lumières." Website places d'Anville in the intellectual context of the Enlightenment; assembles monographs both about and by d'Anville; and provides links to his maps, his archives, and his manuscripts as they become digitized by the Bibliothèque nationale de France and other institutions.
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Apocryphal Voyages. See Imaginary Geographies and Apocryphal Voyages

Art and Design of Maps. In June 1738 the *Mercure de France* published a critique by Jean-Baptiste Bourguignon d'Anville of the Dutch edition published in The Hague of *Description . . . de la Chine* by Jean-Baptiste Du Halde (1736). D'Anville had prepared the large maps for the original French edition of 1735, which were copied for The Hague edition of the *Nouvel atlas de la Chine* (1737). The foreword to Du Halde's 1736 revised Dutch edition asserted that "without exaggeration, those [maps] in our edition offer as much as the maps engraved in *France*" (1:lxvi). Although the foreword claimed to have followed d'Anville's maps in detail, the original author expressed his reservations:

> The overall general map is drawn with a relatively good hand, and is the best presented of all: however, the rows of mountains are interrupted almost everywhere.
>
> The general map of China falls far short: the mountains on the Dutch map are in very bad taste: they are small hills, completely detached and placed haphazardly, and without any connection to convey the natural [setting]: the writing is thin, and of equally bad taste. . . .
>
> The general map of the Chinese Tartary [Mongolia] is in the same [style of] engraving as that of China, and in many places, where it is not clear that there are very high mountains that form long chains between them, such as at Mont *Chanyen* or *Chanpé*, which is almost always covered in snow: we do not see, or scarcely, the expression of these mountains in the Dutch copy. . . .
>
> Throughout, the taste of engraving is more akin to woodcut than copperplate engraving. Yet we must acknowledge that cartouches were added to all the individual sheets in the Dutch copies; but does the beauty of these cartouches justify the liberty taken to place them where they are; because it is absurd to place a cartouche on each separate sheet of a map composed of many sheets, like the [twelve] maps of Tartary and [the nine of] Tibet: so if you join the sheets together to make a general map, this map will be littered with cartouches and separate titles. (d'Anville 1738, 1091–93; see Cams 2014, 58, 63, 64, for illustrations)

D'Anville's reflections focus on the Dutch publisher's competence with regard to the engraving and layout of the maps, not his "Dutch" style. In other words, maps produced in different places in the eighteenth century were not described in terms of national styles but in terms of taste and effect.

Similar ideas suggested that there were no differences between types of maps. John Green (pseudonym of Bradock Mead) refused to differentiate between land maps and marine charts, criticizing those who imagined that "a MAP is to be drawn only by [copying from] a MAP, and a Chart from a Chart" (Green 1717, 137). *Le Nouveau Mercure de France* (March 1721, 178) translated this as "qu'une Carte terrestre doit être dessignée autrement qu'une Carte marine" using the word "design" (*dessigner*) and thus placing map composition as a graphic art (as done earlier by Cousin 1685). In fact, d'Anville's comparison of his own maps with the Dutch copies used a criterion that was as much aesthetic as technical, and his vocabulary indicated the practical and aesthetic challenges involved in the creation and reading of maps: the mountains on the Dutch map were "in very bad taste" (*sont d'un fort mauvais goût*); the writing was "thin, and of equally bad taste" (*d'un goût également mauvais*); while due to crude and unskilled engraving the entire work was more like woodcut than copper engraving; and finally the cartouches, though attractive, had been placed without any logic on the individual map sheets so that the assembled general map would be "littered with cartouches and separate titles." Thus d'Anville's harsh criticism that the Dutch copies lacked taste and the composition lacked simplicity highlighted two underlying principles in the design of maps in the eighteenth century that reflected judgments of both producers and users: *taste* and *composition*.

D'Anville was not alone in using the word *goût* (taste) in his critique of the Dutch maps. Edme de La Poix de Fréminville employed similar instructions regarding the production of property maps: "As to property maps fitted onto geometric maps, there will be a difference in that the seigneur, who has a geometric survey made of his land, does so only to keep these maps [for himself]; thus it will be necessary that the property maps be related to each other and arranged in the same taste" (1746, 1:119). Nicolas Buchotte made a similar assessment concerning relief representation: "With regards to the accompaniment of the entire map—I am referring to the landscape around it—there are few people who make tasteful maps showing plowed land and mountains and hills, these things not being as easy as they seem; because there is big difference between the landscape shown in plan and that shown in perspective. In the latter, if the objects are shown in profile as they are seen in nature, they continue to make an impression. It is not the same as the landscape on a map: if the mountains and hills are represented in bird's-eye view (meaning in a flattened manner) because of the frequent need to know the physical extent of their base, if they are not rendered with good taste, they have no effect, or are only disagreeable to view" (Buchotte 1754, viii–ix).

Thus taste appeared both as a criterion for evaluating the quality of maps but also as a general rule in their production, applicable to every cartographic mode. Therefore, the question of taste within the larger framework of the visual arts bears consideration.

The concept of taste was not restricted to fine art and poetry. In the eighteenth century, it took on a familiar connotation in the development of aesthetics, such as the science of sensibility (Baumgarten 1735). Taste was defined as a feeling of pleasure bound to the experience of all kinds of objects surrounding humans. As such, this feeling applied equally to things in nature, works of art, and scientific creations. Aesthetics comprised the set of rules to assess, by both intellect and appreciation, these various types of objects. In this way, maps, which are images presented as visual works, also provide an opportunity for an aesthetic experience. But the aesthetic assessment of cartographic images did not conflict with their cognitive significance. On the contrary, aesthetic assessment was carried out from a perspective of knowledge or geographic science, and on this basis the discernment of taste was implemented. Art and science were not in opposition but linked in a common purpose of the readability and efficacy (or "truth") of geographic images. Map producers joined in a broader visual culture that connected them with painters, architects, engravers, and anyone involved in the design and production of images, whether artistic, scientific, or religious.

Certain key elements defined a work as being tasteful or tasteless. *Essai sur le goût* (1757) by Charles-Louis de Secondat, baron de Montesquieu, as well as the *Livre d'architecture* (1745) by Germain Boffrand provided some specifics: taste was a feeling of pleasure or displeasure experienced by the soul when presented with something; the pleasantness or unpleasantness is the determinant. Buchotte's text asserted that anything drawn on the map was designed to have an effect on the viewer, and this effect could be considered pleasant or unpleasant, in other words, tasteful or tasteless, depending upon the choice of representation. According to Montesquieu, a map might be judged as tasteful, and thus pleasant to view when it brings together the following qualities: it conveys something to the soul; it shows it with order (avoiding confusion); it incorporates variety (avoiding uniformity); and this variety embodies symmetry, that is, an overall balance of the parts (Baxandall 1988, 135–37). Montesquieu's instructions have a clear goal: the creator of the image must assemble a complete visual whole that is rich, varied, and ordered, easy to grasp visually, and easy to read (Montesquieu 1993, 44). As Buchotte wrote: "If one is not born with a talent to draw, one should at least know how to draw tastefully in order to be understood by the connoisseurs and to recognize drawings [of others] that follow the rules" (Buchotte 1754, viii).

Indeed, Montesquieu and the *encyclopédistes*, along with d'Anville, confirmed the prerogatives of classical taste against the excessive ornamentation characteristic of earlier periods. This broad discussion revolved around the legitimacy and form of ornament in the art of design. Charles-Nicolas Cochin, who himself designed cartographic ornaments, agreed with Montesquieu: "The primary shape of something is produced for this purpose [i.e., use and convenience], and the rest is only added to enrich and embellish it: thus ornament is subject to laws of decorum. The general rules of taste, established in all the other areas of art, are no less important: variety, symmetry, calm next to business, irregularity in masses and their components; proportional relationships of large to small, which are discernible to the eye and which are recognized as one of the main causes of the pleasure created by beautiful things" (Cochin 1757, xiv).

A standard of taste applied in all the arts, whether mechanical or decorative. The goldsmith, engraver, cabinetmaker, and others such as painters, sculptors, and scientists tended to comply with this rule. Over the course of the century, such thinking led to the creation of schools for artisans, where geometry played an important role, and also technical schools like the École des Ponts et Chaussées, where cartographic production and geometric knowledge were equally valued (Picon and Yvon 1989). The curriculum of the art schools determined that geometry would allow the ornament to be standardized and subjected to rules of good taste by curtailing the whimsical and bizarre (Courajod 1874, 201).

"A well composed picture," wrote Denis Diderot, "is a whole, enclosed by a single point of view wherein the parts contribute to a common goal, and form a complete whole through their mutual correspondence, which is as real as that of the limbs of an animal's body; in such a way that a fragment of a painting has a large number of shapes cast randomly, without proportion, or understanding, or unity, no longer deserving to be called an *actual composition*, any more than scattered studies of legs, a nose, eyes on the same bit of paper are worthy of being called a *portrait* or even a *human figure*" (1753b, 3:772). In other words, a painting, and moreover a map, were well put together when they demonstrated unity of viewpoint, symmetry, and proportion in the arrangement of their whole and thus reflected their creator's good taste.

However, the issue of the unified point of view was debatable where maps were concerned. In 1722, Buchotte still considered it acceptable to see certain elements drawn in elevation, whether man-made constructions (cities, houses, castles) or landmarks (mills, posts, crosses, prominent trees) (104). Yet by 1801, Louis-Nicolas de Lespinasse rejected this style of graphic representation, criticizing maps that "allow and accept trees, boulders and other objects in elevation. . . . One wonders about these inconsistencies between convention and execution and why one [mapmaker] accepts the geometrical, while another discredits it, thus creating the impossible" (47).

In his *Cosmographie* (1551), Peter Apian had long since defined chorography and geography based on Ptolemy's *Geography*; Apian had illustrated their differences with diagrams of the ear (chorography) as opposed to the entire head (geography). Diderot's text on painting employed this same logic to the art of composition. Cartography, like painting, should be considered as an art that developed images that followed the general laws of visual composition established in contemporary visual culture. This hypothesis seems to be supported by Augustin Lubin's definition of the word *tabula*: "The word *Tabula* in Greek is πίναξ from which is derived the word *Pinacographia, the composition of maps*; geographers, who make their reputation from geographic tables, should not dismiss the quality of *Pinacographs*, which is *Tavola* in Italian, *Carta* or *Mapa* in Spanish, *ein Tafel* in German, and *a chart* in English" (Lubin 1678, 347–48). Diderot wrote that composing "is to put together several parts to make a body," and the act of composing, he added, applied "to the creation of the arts that suggest invention and genius, such as fine art, painting, sculpture, engineering, etc." (1753a, 3:768). Geography in the eighteenth century was a graphic art, an art of the image. Geography created maps and tables, that is, complex images intended for the visual communication of comprehensive information relative to a territory (its shape, history, contents, and qualities) and the different interests, intentions, and interpretations for which it was the object. When d'Anville criticized the useless proliferation of cartouches on the separate map sheets of the Dutch map of China, he was considering the complete composition of the set of plates as a general map, and more specifically, the visual coherence of this composition. Visual simplicity was the rule that he applied.

Maps have long been studied from the perspective of the history of discoveries and the development of measurements; however, they should also be considered as part of the history of graphic arts, as images to be read and deciphered. Maps generate questions about the demands placed on eighteenth-century mapmakers regarding the readability of maps as well as their accuracy. As a whole, the graphic resources employed in map production (legends, colors, fonts, drawing and engraving techniques, and layout), responded to the requirement of readability, which was expressed through *composition* and *good taste*.

Any research that studies maps within the context of graphic arts, an area that remains to be thoroughly developed, should consider the many issues that eighteenth-century cartographers resolved before organizing information on the map. Among these are four under-studied topics concerning the graphic organization of the cartographic page: (1) the relationship between image and text (map and memory); (2) the representation of cartographic practices and phenomena in different cartographic modes; (3) the relationship between the map and the frame (the edge of the map); and (4) the collaboration among the different agents in graphic production.

(1) Image and text. An example of the question of balance between image and text was considered by d'Anville in another critical letter in the *Mercure de France* (1751) leveled at Solomon Bolton, who had published a copy of d'Anville's map of North America (1745) in London in 1750 to accompany Malachy Postlethwayt's *Universal Dictionary of Trade and Commerce* (a translation of Jacques Savary des Brûlons's *Dictionnaire universel de commerce*, 1726–32). While d'Anville's overall critique explored whether Bolton's copy of the French original was "greatly improved," as the title claimed, and discussed the geopolitical nature of the two maps, d'Anville turned to the appearance of the Bolton copy in questioning the acceptable amount of text on the map. "The first of M. Bolton's legends does not say anything other than that according to the Treaty of Utrecht, the French have the right to frequent the northern coast of Newfoundland. This is certainly a fact about which I would agree with him; but I would have omitted it from my map on the grounds that I would have discussed it elsewhere, in notes of some kind" (d'Anville 1751, 153–54).

Bolton's copy had added too many words for d'Anville, who distinguished good and bad relationships between the map and text. The larger subject of the relationship of the map to the accompanying memoir is only fleetingly touched upon here; it is the visual effect of legend and text on the map itself that concerned the French geographer. The question of where text should be located had also elicited comment from Green, who confirmed the ineluctable connection between the map and its accompanying memoir, without which the map could not be understood. D'Anville considered Bolton's map overloaded, specifically because the author had not correctly allocated the necessary information between the map and an accompanying memoir, which in this case did not exist.

Maps created through different cartographic practices at different scales demanded different approaches to the text and map question. Geographical maps compiled at a medium to small scale called for explanatory memoirs because their production was based on multiple sources—graphic, textual, and oral—and their justification and value resided in the explanation of how these sources were evaluated and employed. For such maps, the memoir served as the extension of the map image, which allocated space for text in the form of title, dedication, scale, and explanatory legend. At large scales, property, topographic, or geodetic maps such as the Cassinis' *Carte de France*, based entirely on trigonometric ground survey, were not always intended to be accompanied by published texts, even though they were based on the compilation of on-site observations and texts and tables of information. The *Carte de France* was designed to stand alone as a graphic image without text, and any accompanying legends or memoirs were prepared by commercial publishers, not by the Cassinis.

(2) Representation of cartographic practices and phenomena. Most modes of cartography are concerned at a basic level with the naming of things or places and their location within a determined spatial framework. The distribution of people, places, objects, or institutions in space had long been considered the primary function of cartography. In the eighteenth century the concern for determining location with greater accuracy than ever before was accompanied by an increasing desire to identify and quantify physical phenomena and human practices. While not new in the eighteenth century, thematic maps of various sorts were made increasingly possible by the development of communication networks, by the increased gathering of statistical data, and by the observation and representation of natural phenomena.

Among the thematic maps that employed unusual graphic techniques in the representation of information were road maps, such as found in the strip maps of John Ogilby's *Britannia* (see figs. 614 and 866) or the route maps as found in the "Atlas de Trudaine" (see fig. 867). These maps employed line and scale, and, in the case of Ogilby, trompe l'oeil techniques to devalue the nature of the terrain in order to emphasize the route or road as a straight line. Similar methods were used in battle maps, which integrated lines representing the trajectories of cannon balls, and later, the movement of troops, culminating in very complex maps showing several movements of the same units (see fig. 579). Thematic maps that showed the distribution of natural or man-made phenomena required specialized symbols for the phenomena and explanatory legends to make them comprehensible, such as those for the mineralogical maps of Jean-Étienne Guettard (see fig. 345) or Belsazar Hacquet (see fig. 786). Graphic techniques using color and symbol were employed to show temporal events, such as the map of the 13 July 1788 storm drawn by Jean-Nicolas Buache for the *Mémoires de Académie des Sciences, année 1790* (1797, 308, pl. 2), and the eclipse map of 1762 by Nicole-Reine Étable de la Brière Lepaute, Marie-Françoise Lattré, and Elisabeth Claire Tardieu, discussed below.

(3) The relationship between the map and the edge of the composition. An aspect of map design rarely touched on in eighteenth-century or modern literature is the question of the edge (the border or the frame) of the map. Leaving a map without an edge might imply incompletion: the map was a draft, a sketch, an early attempt to render the image. The choice of frame or edge allowed the cartographer to create a visual marker for the whole of the composition and, in addition, to make a visual statement about the nature of the composition (its audience, its display, its intention). Most commonly, a map or plan, whether in manuscript or print, was finished with a neat line, a single line that encompassed the cartographic content of the map. Sometimes the line was doubled and the intervening place filled with important information marking the grid of longitude and latitude. For example, d'Anville's 1740 map of the ancient world (fig. 65) employs two distinctly different cartouches, one for the title and another for the scales, with text integrated into the latitude and longitude grid. The whole composition is surrounded by a double line frame that encloses the longitude and latitude numbers, yet by necessity the geography of the map breaks the frame in order to provide a complete composition. In some maps, outside the double line, there is a border of scenes, views, portraits, and peoples creating an encyclopedic effect of a catalog of information in addition to the map content (fig. 66). Similar pictorial elements might form the frame on maps the purpose of which was display and historical grandeur, such as that of Giovanni Battista Nolli's *Nuova pianta di Roma* (1748) (see fig. 609).

It should also be considered whether styles found in the decorative arts encouraged authors to create compositions resulting in different combinations of texts, cartouches, and maps on the same plate. For example, the map of Rome published around 1740 by Covens & Mortier employs different styles of cartouches and uses

FIG. 65. JEAN-BAPTISTE BOURGUIGNON D'ANVILLE, *LE MONDE CONNU DES ANCIENS* (PARIS, 1740). Size of the original: 40 × 49 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [9709]).

various frames and graphic insertions (fig. 67). Part of the complexity of eighteenth-century map design could be summed up by what appears to be a tension between the seemingly overloaded style of this map of Rome and the apparent simplicity of a plate of the *Carte de France* (see fig. 140). While the two maps represent different modes of cartography at different scales, they also represent the tension between the baroque style, or at least rococo, and the classical.

Sometimes, the map or plan was surrounded by a trompe l'oeil frame, emulating the wood or plaster frame that a map might be housed in on an owner's wall, as in *A Plan of the City of Bath* (1735) by the architect John Wood the Elder. Wood used a distinctive oval frame to set off the city plan, surrounding the oval frame with explanatory text set within the corners of the outer rectangular frame (see fig. 24) (Michel 1987). A cartographer might also frame several separate maps, each with its own neat line or edge, within a larger whole (fig. 68). Encompassed by the neat line that ties them together, they acquire completeness. The outer frame indicates both the edge of composition and the unity of the whole. Clearly there were many design choices open to the cartographer, and the varieties of frames used deserve a larger, more nuanced study within the context of the map's content, its perceived audience, and the meaning it adds to the image (Foucart 1987).

(4) The collaboration between different agents in the process of map production influenced the graphic choices and resulting compositions. Scholars have

FIG. 66. JEAN-BAPTISTE NOLIN THE YOUNGER, *L'AFRIQUE DRESSÉE SUR LES RELATIONS LES PLUS RECENTES ET RECTIFIÉES SUR LES DERNIERES OBSERVATIONS, DEDIÉE ET PRESENTÉE A SA MAJESTÉ TRES CHRESTIENNE LOUIS XVI* (PARIS: CREPY, 1775). Scale: ca. 1:10,787,000. Size of the original: 129 × 143 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge AA 3111).

shown the importance of the relationship between cartographers and engravers and its effect on different elements of maps and cartouches in France (Pastoureau 1982; Pedley 2005), yet no study has thoroughly explored the nature and consequences of this collaboration. Little archival evidence has emerged to elucidate this process. D'Anville relied on his brother, engraver Hubert-François Gravelot, for the design of many of his cartouches, and their close relationship must have been mutually beneficial. However, little is known of their collaboration, and the small number of d'Anville's maps (compared with growing production throughout Europe in the eighteenth century) means that there is not a clear picture of the role each of them played in the design process. That the cartographer-engraver relationship could be one of equals is supported by a map produced entirely by women. The *Passage de l'ombre de la lune au travers de l'Europe dans l'eclipse de soleil centrale et* *annulaire qui s'observera le 1er avril 1764* (1762) "is the work of three women, the astronomer [*calculatrice*] who calculated and compiled its contents [Lepaute], Mad. *Lattré*, who engraved it, & Mad. *Tardieu*, who was responsible for the ornamental details" (*Affiches annonces et avis divers* 1762, 99) (see fig. 950). Lepaute was a gifted mathematician who calculated pendulum oscillation tables for her husband Jean-André Lepaute, clockmaker to the king, and calculated the return of Halley's comet with Joseph-Jérôme Lefrançais de Lalande. Tardieu was the wife of Jacques-Nicolas Tardieu; both were reputable engravers, often of maps. Lattré was the wife of Jean Lattré, map and atlas publisher and engraver, and actively involved in her husband's workshop (Petto 2009, 71–72). The fact that the work is attributed to all three women without any ranking of one as the author and the others as employees or workers is to be noted. According to the *Encyclopédie*, a work (*ouvrage)* is "the creation of a man of letters," but the word is also an architectural fortification term referring to a construction resulting from the involvement of various specialists (Jaucourt 1765, 11:722, 724). The *Journal général de France* (1762, 99) attributed authorship of the map to all three women, showing the strength of relationships built at the junction of cartographic techniques: the map's projection and geographic design, its engraving, its ornamentation, and its printing in two colors (a striking example of this printing technique).

The *Mercure de France*, which mirrored the tastes of eighteenth-century salons, revealed the concern for bal-

FIG. 67. *RECENTIS ROMÆ ICHNOGRAPHIA ET HYPSOGRAPHIA* (AMSTERDAM: COVENS & MORTIER, CA. 1740). The Dutch plan of Rome, based on Giovanni Battista Falda's large *Nuova pianta et alzata della città di Roma* (1676), employs different styles of cartouches and works with frames and graphic insertions.
Size of the original: 67 × 86 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge C 1194).

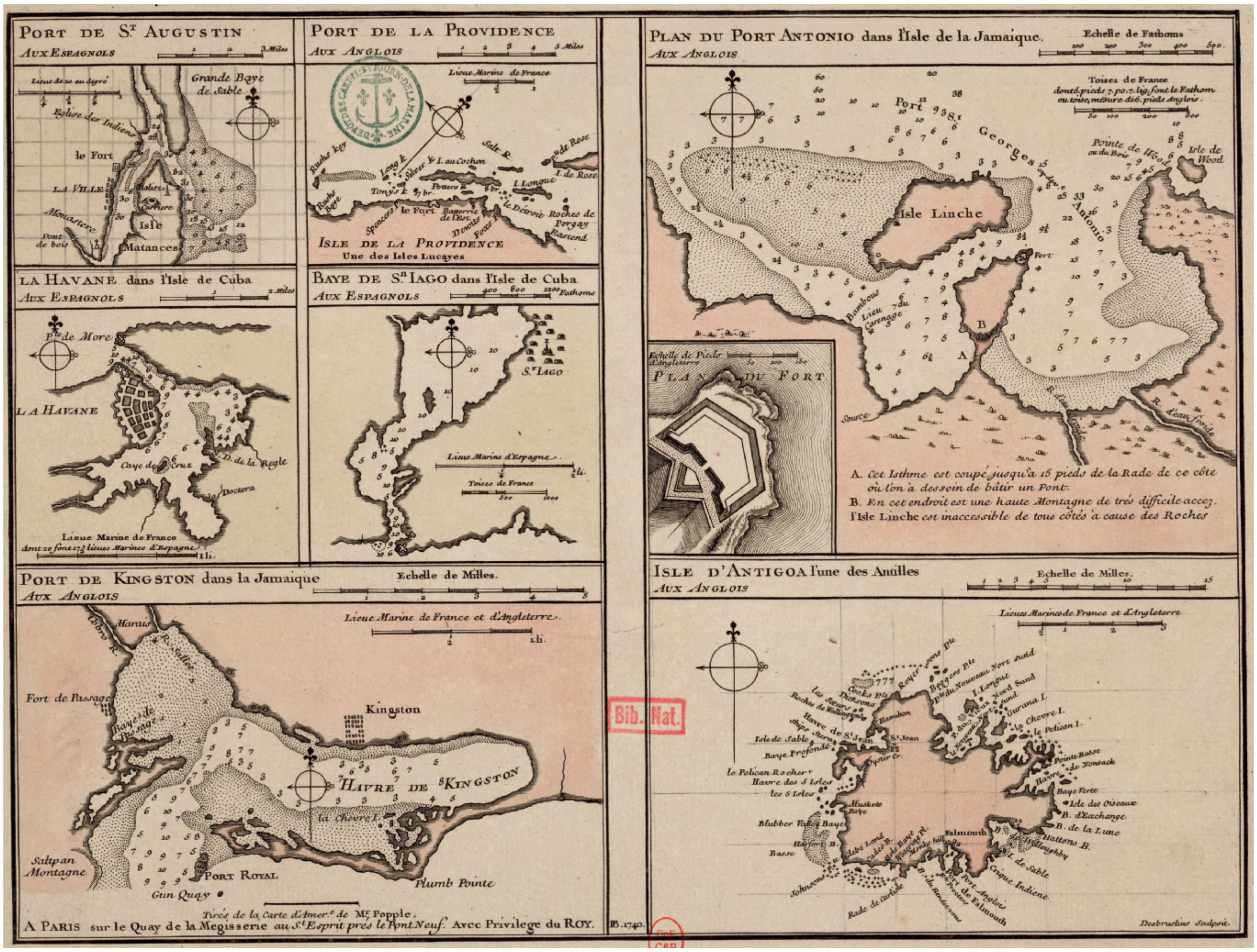

FIG. 68. PORTS OF THE ANTILLES (PARIS, 1740) BY HENRY POPPLE. The composition of multiple maps is brought into a single frame to create a whole of the seven maps of the Antilles.

Size of the original: 27 × 36 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge SH 18 pf 145 div 12 P 5 D).

ance between accuracy and quality of engraving that occupied many commentaries of the period. In 1702, Nicolas de Fer was hailed for the "exactitude and design" of a recently revised celestial planisphere (*Mercure Galant*, April 1702, 291). Two years later, de Fer's *L'Espagne triomphante sous le regne de Philippe V*^{em} was described as "more accurate and more detailed than what has been published before, a beautiful engraving that is pleasing to view" (*Mercure Galant*, March 1704, 297). Twenty-two years later, the *Carte de la France divisée par généralites* (1726) by d'Anville was recognized: "The accuracy of this edition, and the beauty of the paper and the style, will be no small advantage for such a useful work for the public" (*Mercure de France*, November 1726, 2527). In 1751, the *Carte generale de la Monarchie des Gots tant dans les Gaules qu'en Espagne* by Gilles Robert Vaugondy was described as "accurate and very elegant" (*Mercure de France*, July 1751, 116). Both neat drawing and neat engraving that was considered elegant were the fundamentals for rendering maps useful to the public and for acquisition by libraries belonging to men of taste. In a period in which libraries and the building of libraries constituted a step on the social ladder, the acquisition of maps and atlases that were both useful and beautiful created a demand for these commodities that geographers were eager to satisfy.

The definition of the word "art" in the *Encyclopédie* rendered its meanings, if not synonymous, at least similar to those of "science" and "discipline" by emphasizing "a system of rules or instruments, and guidelines aimed at the same goal" (Diderot 1751, 1:713). In the encyclopedic spirit of the eighteenth century, it was appropriate to consider the design and composition of maps not only by studying mapping techniques, now a standard approach, but also by studying maps in the context of the transformation of visual knowledge. The "rules and instructions" that defined visual knowledge were expressed in the design of maps, a meeting point of increasing exactitude, careful engraving, and the skills of ornamentation.

NICOLAS VERDIER AND JEAN-MARC BESSE

SEE ALSO: Cartouche; Color and Cartography; Constellations, Representation of; Iconography, Ornamentation, and Cartography; Landscape, Maps, and Aesthetics; Reproduction of Maps; Signs, Cartographic; Urban Map

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Artaria Family. The Artaria family originated in the Duchy of Milan (Italy), which became part of Austria after the end of the War of the Spanish Succession (1701–14). In 1768, cousins Carlo Artaria and Francesco Artaria moved to Vienna, where in 1770 they were granted the privilege of selling copperplate engravings. By 1775, their substantial profits enabled them to set up shop in the most elegant business quarter of Vienna, the Kohlmarkt. In 1789, the enterprise transferred to a bigger house in the same street, where the headquarters of the company Freytag-Berndt & Artaria KG are located to this day (Dörflinger 1983, 58; 1984, 271–72).

In early 1782, the Artaria firm was granted an imperial printing privilege by Joseph II, which protected its publications against reengraving for a period of ten years. Over time, a number of employees and other people, such as Pasquale Artaria, Ignazio Artaria, Tranquillo Mollo, and Giovanni Cappi, acquired shares in the company. When several of these shareholders attempted to withdraw their stake around 1796, a spate of litigations concerning the division, donation, and sale of shares ensured. These legal problems negatively affected publishing activities, since new contracts with artists and engravers could not be implemented while the ownership of the firm remained unclear (Dörflinger 1984, 274–77).

From its very beginnings, the firm focused on buying and selling copperplate engravings. By 1778, the company had extended its stock to sheet music, soon publishing works by leading composers, such as Wolfgang Amadeus Mozart, Joseph Haydn, and Ludwig van Beethoven. The sale of maps was likewise initiated in the 1770s. At first this was limited to reengraving maps and atlases that had most often been issued by publishing houses in Paris and southern Germany, e.g., Homann. But by 1786 the company began to publish maps to which it held the rights. The most important copperplate engravers working for Artaria included Johann Ernst Mansfeld, Franz Müller, Carl Schütz, and Jakob Adam (Dörflinger 1984, 272–74, 283).

Artaria won its greatest renown for maps covering military events made for public consumption (not for military purposes). Among the roughly thirty-nine maps issued by the company between 1786 and 1802, about half depict theaters of war or territorial changes. Thus a high point of the company's map publishing activities came in 1788, when Austria began publishing maps covering the war between Russia and the Ottoman Empire, begun in 1787. In that year alone, no fewer than six maps recording troop movements and military engagements were created (Dörflinger 1984, 279, 312). Map production likewise increased notably during the first two Coalition Wars against France between 1791 and 1802. Artaria also produced a map of Galicia, Lodomeria, and Poland, *Neueste Karte von Galizien und Lodomerien nebst dem oesterreichischen neuen Antheil von Polen* (1796), in connection with the Third Partition of Poland-Lithuania and Austria's related territorial gain (Dörflinger 1984, 288–96, 301–2).

Most of the Artaria maps created in the eighteenth century could be criticized from a cartographic viewpoint. Sometimes compiled using faulty information, their factual accuracy was not always on a par with other maps. However, exceptions to this included Müller's map of Hungary (*Mappa novissima Regnorum Hungariae, Croatiae, Sclavoniae, nec non Magni Principatus Transylvaniae*, 1792) and the two maps of the environs of Vienna engraved by Maximilian Grimm and Stephan Jakubicska. Grimm's work, *Grundriss der kk. Residenzstadt Wien mit allen Vorstädten und der umligenden Gegend* (1786), was probably the first original map published by Artaria (Dörflinger 1984, 277–78, 283, 294, 299–300). According to Johannes Dörflinger (1984, 284–86), Jakubicska's map represents a high point of cartographic production by Artaria in the eighteenth century (fig. 69). Emperor Joseph II had commissioned Jakubicska, a captain serving in the quartermaster general's staff, to produce a map of Vienna and its environs based on the hitherto-secret Josephinische Landesaufnahme in order to provide a more accurate map of this area and create a counterpoint to the *Carte de France*, a work of exceptional cartographic quality. Like most Artaria maps, Jakubicska's work, which was first published in 1789, was reissued several times (Dörflinger 2004, 121).

FIG. 69. DETAIL FROM STEPHAN JAKUBICSKA, *NEUESTER GRUNDRISS DER HAUPT UND RESIDENZSTADT WIEN UND DER UMLIEGENDEN GEGENDEN IM UMKREIS VON ZWEI DEUTSCHEN MEILEN* (VIENNA, 1791).
Size of the entire original: 62 × 97 cm; size of detail: ca. 25 × 16 cm. Image courtesy of the Woldan Collection, Österreichische Akademie der Wissenschaften, Vienna (Sammlung Woldan, K-III: OE/Vie 237).

In addition to the maps of the city and environs of Vienna and maps compiled in connection with wars and other political events, the publication list of the company included outline maps (partly post-route maps) of Germany and Central Europe. Analogous to other works of Enlightenment cartography, Artaria maps often feature decorative cartouches or allegorical scenes (for example, Grimm's map of Vienna).

PETRA SVATEK

SEE ALSO: Austrian Monarchy

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Astronomical Instruments. See Instruments, Astronomical

Astronomical Models. The shift in perspective, so central to the seventeenth-century Scientific Revolution, from the geocentric (Ptolemaic) to the heliocentric (Copernican) world model induced many novelties in the design of astronomical models. During the Enlightenment numerous models served to popularize the new astronomy based on the laws of gravity and of mechanics described in Isaac Newton’s *Philosophiæ naturalis principia mathematica* (1687). Generally, astronomical models were used for the simple demonstration of the new ideas as well as to illuminate arguments in religious disputes and to dispel superstition. The construction of such models attracted astronomers, globemakers, and mathematical instrumentmakers and also inspired many new inventions in clockmaking. Artful clockwork universes were produced to please kings and princes and other wealthy patrons. Beyond the universities and scientific societies, simpler systems turned many public lectures on astronomy and geography into sophisticated entertainment, as popularized by J. T. Desaguliers in Britain and Jean Antoine Nollet in France, among many others (Sutton 1995, 208–11, 238–39; Walters 1997). In England, the triumph of experimental philosophy created a boom in instrumentmaking. Mathematical instrumentmakers started to develop their own train of astronomical devices. The more widespread types of astronomical model are outlined here—armillary sphere, Copernican sphere, tellurian, orrery, grand orrery, and planetarium—together with some unique creations of the Enlightenment. Henry C. King (1978) remains the best source for the study of these astronomical models; John R. Millburn (1992) proposed a more consistent nomenclature that is followed here.

Armillary spheres were made to display the structure of the geocentric cosmos and became the most common astronomical model in the Renaissance. They continued to be made during the Enlightenment as instructional devices to explain both the main celestial circles, as seen from earth, and the phenomena caused by the apparent diurnal motion of the celestial sphere. Armillary spheres consist of an open sphere built from the main celestial circles: the equator, the tropics, the polar circles, the colures, and the zodiacal band (fig. 70). At the center of the sphere there usually is a small sphere representing earth. Armillary spheres in the Enlightenment were generally twenty to thirty centimeters in diameter, with a small terrestrial globe of about six centimeters diameter, although smaller and larger spheres were made. The celestial sphere is mounted on an axis fixed at its north and south poles to a meridian ring that in turn is placed in a stand supporting a horizon ring. There is often an hour circle at the north pole and the sphere can be ad-

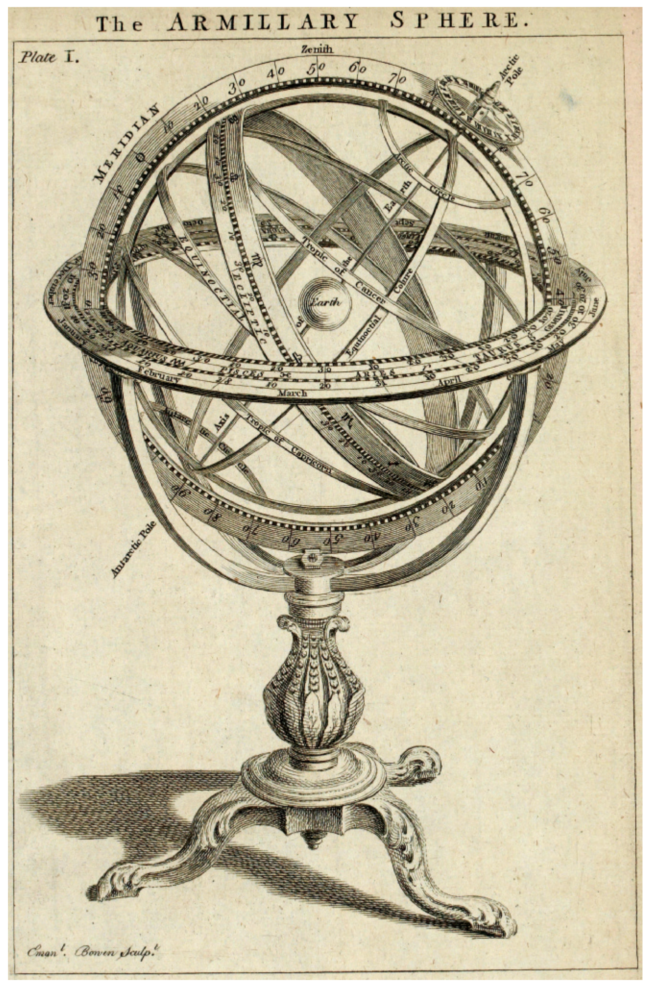

FIG. 70. DIAGRAM OF AN ARMILLARY SPHERE. From Benjamin Martin, *The Description and Use of Both the Globes, the Armillary Sphere, and Orrery* (London, 1758), pl. 1. Image courtesy of the National Library of Scotland, Edinburgh.

justed for the latitude of a place. Some geocentric armillary spheres also have planets attached to arcs fixed at the north or south ecliptic pole. Most armillary spheres are made of brass. Exceptions are devices made in the eighteenth century and later by French firms; these were made of wood with strips of paper printed with the details that were otherwise engraved on brass circles (Dekker 1999; 2004, 72–94).

In the eighteenth century a variant type of armillary sphere was developed to demonstrate the change from the Ptolemaic to the Copernican perspective. A geared device was added to the mounting such that in one mode the celestial sphere could be turned from east to west while keeping the terrestrial sphere fixed, in line with the Ptolemaic world system, and in another mode the celestial sphere was fixed and the earth could be turned from west to east, in agreement with the Copernican world system. This device seems first to have been applied to the glass celestial globe, invented in 1742 by Roger Long, first Lowndean professor of astronomy and geometry at Cambridge (Morton and Wess 1993, 222–23), and was probably first applied to armillary spheres by James Ferguson (Millburn 1988, 81, 119).

An important development of the conventional armillary sphere was its adaptation to the heliocentric worldview, thereby producing the Copernican sphere (fig. 71). The central axis of a Copernican sphere connects the north and south ecliptic poles instead of the equatorial poles, the horizontal band represents the zodiacal band instead of the horizon, and the planets are attached to circles that can move around the central axis. An early description of a Copernican sphere is found in the second part of Willem Jansz. Blaeu's globe manual, *Tweevovdigh onderwiis van de hemelsche en aerdsche globen* (1634). Blaeu's Copernican sphere was an elementary device of which only one copy (diameter 69 cm) seems to have survived (Mackensen 1991, 68–69). In England, the globemaker Joseph Moxon advertised at the end of the seventeenth century a Copernican sphere and a tellurian, both by Blaeu. Richard Glynne, a mathematical instrumentmaker who sold all kinds of spheres and globes, made a Copernican sphere that combined the characteristics of both the Blaeu-Moxon tellurian and the Copernican sphere (King 1978, 157–58).

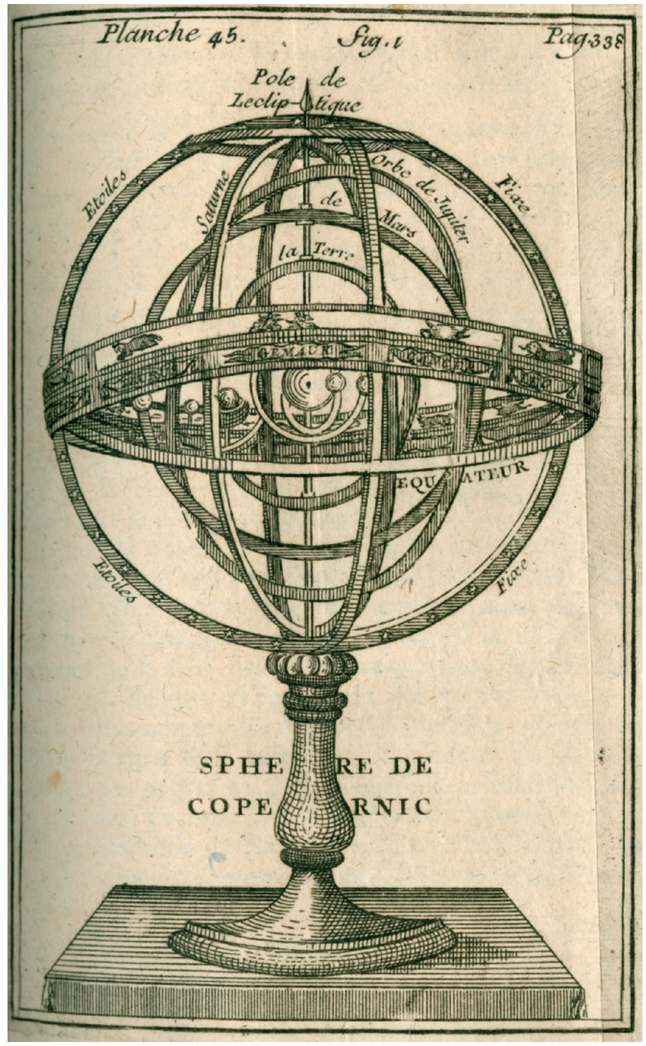

FIG. 71. DIAGRAM OF A COPERNICAN SPHERE. From Nicolas Bion, *L'usage des globes celestes et terrestres, et des spheres* (Paris: M. Brunet, E. Ganeau, C. Robustel, 1728), opp. 338. Size of the original: ca. 21 × 13 cm. Image courtesy of the Newberry Library, Chicago (Ayer 7 .B58 1728).

The French tradition of making Copernican spheres started with Nicolas Bion, who described a simple Copernican sphere in the various editions of his book *L'usage des globes celestes et terrestres, et des spheres* (1699). This design was taken over by several eighteenth-century French globemakers. Most of these simple Copernican spheres were made of wood, but copies made in brass are also known (Dekker 1999, 166–67, 173; 2004, 94–98).

A number of geared and clockwork-driven Copernican spheres were made, starting in the middle of the seventeenth century. These were all expensive models ordered by rich patrons as special, one-off items. The earliest extant clockwork-driven example is that at Gottorf (Gottorp) (diameter 134 cm) built in 1654–57 in conjunction with the joint celestial and terrestrial globe (diameter 311 cm; see fig. 163) to express in principle the twofold way of presenting the cosmos, as Blaeu had discussed; globe and Copernican sphere were part of a grand design conceived by Duke Frederik III of Holstein-Gottorp that included a *Kunstkammer* where the Copernican sphere was kept and, in the garden, a building to house the globe (Lühning 1997). Another interesting early example is the clockwork-driven Leiden sphere (diameter 155 cm). This 1672 sphere was designed with the help of the mathematician Nicolaas Stampioen as a showpiece in honor of, and at the expense of, the wealthy Rotterdam burgomaster Adriaen Vroesen. Donated at the turn of the seventeenth century to the Leiden University Library, hence its name, it is now in the Museum Boerhaave, Leiden (Dekker 1986). A third example is the geared Nuremberg sphere (diameter 60 cm) made after a design by Georg Christoph Eimmart, an astronomer who founded an observatory in Nuremberg and who also produced some globes there. In 1713 the Nuremberg sphere was acquired by the merchants Ingolstetter and Grassel for the University of Altdorf, where it served for the education of students (*Focus Behaim Globus* 1992, 2:540–41). Finally, a clockwork-driven copy of Bion's Copernican sphere was designed in 1706 for Louis XIV by Jean Pigeon in cooperation with Jean-Baptiste Delure. A description of this design was published in Paris in 1714 (Kugel 2002, 172–83; King 1978, 282). Pigeon stood at the start of an impressive French tradition in horology that saw the production of a variety of clockwork-driven spheres and astronomical clocks. Their construction reached its apex at the turn of the eighteenth century with the work of Antide Janvier (below).

Less complex models were made especially for the demonstration of the earth's threefold motion: its annual motion around the sun, its daily rotation around its own axis, and the constant orientation in space of its inclined axis of rotation. Such a heliocentric mode is called a "tellurian" (also "tellurium," sometimes "tellurion"). Blaeu gave an early description of a tellurian in his 1634 treatise, and an early example is illustrated in figure 72. In it the earth is presented by a small terrestrial globe of 10 centimeters diameter, mounted on a polar axis inclined 66.5° to the (horizontal) ecliptic plane. Around the earth itself is a set of rings that differ in structure from those of the common armillary sphere: the horizontal ring around the earth represents the ecliptic plane instead of the horizon; the horizon is attached to the earth and shifts its position when the earth rotates around its own axis.

The name tellurian has also been used for a device made in 1651 to show "the motions of the Earth/Moon system around the Sun in three dimensions, incorporating the inclination of the Moon's orbit" (Millburn 1992, 7; see also King 1978, 101–2); Millburn, however, noted that this model should more properly be called an "orrery." This term derives from the similar device—similar in that it also displayed the earth-moon system—made about 1713 by the London instrumentmaker John Rowley for Charles Boyle, fourth earl of Orrery. Rowley's "orrery" was in fact an imitation of a model made in 1704–9 by George Graham. To add to the confusion, "orrery" is also used for devices having additional components to show planets and satellites in addition to the earth-moon system. An example is the Venus orrery designed by Ferguson in 1746, which consists of a system of gears driving the motions of the sun, the inner planets Mercury and Venus, as well as the earth-moon system (Millburn 1988, 39–47).

A complete model of the solar system, intended to demonstrate the motions of all the planets and all their satellites, was in eighteenth-century England called a "grand orrery" (fig. 73). Such models were usually driven by complicated wheelwork set in motion by a handle or by a clock. Typically, the grand orrery also preserved half of an armillary sphere with the main celestial circles on top of the ecliptic plane. It is generally surmised that Thomas Wright was the first to build a grand orrery. Although expensive, the grand orrery was a very successful model and imitations were made throughout the eighteenth century by Wright's successors Benjamin Cole, Thomas Heath, Benjamin Martin, and George Adams Sr. An impressive early example is preserved in the George III Collection in the Science Museum in London (Morton and Wess 1993, 402–5), and a grand orrery is the centerpiece in the famous painting by Joseph Wright of Derby: *A Philosopher Giving a Lecture on the Orrery* (1766), with a lamp in place of the sun (see fig. 188).

Alongside Copernican spheres and orreries, other models of the solar system were developed, such as the planetarium. By this name we refer to devices representing the relative motions of the planets around the sun without details of, say, their axial inclination. Typical early examples are the models by the astronomers Ole Rømer and Christiaan Huygens. They were both especially interested in reproducing reliably the Keplerian orbital characteristics of planetary motion. Rømer's planetarium of 1680 was paid for by Jean-Baptiste Colbert and is now in the Bibliothèque nationale de France. Another copy, in the Rosenborg Castle in Copenhagen, was made for Christian V of Denmark. The planetarium designed by Huygens also had the approval of Colbert. The wheelwork driving the planets in this machine is kept in motion by a spring-driven clock movement and the ratios between the wheels, derived by the method of continued fractions, differ completely from those used by Rømer. Colbert's death prevented Huygens from showing his planetary machine to Louis XIV. It therefore remained in his family until 1809, when it was donated to the Leiden University Library; it was later moved to the Museum Boerhaave, Leiden.

Desaguliers, the pioneer in adult education in England, is known to have designed a planetarium and separate devices for demonstrating satellite systems of the earth, Jupiter, and Saturn. Similar groups of instruments were developed in the middle of the eighteenth century

FIG. 72. A TELLURIAN BY WILLEM JANSZ. BLAEU, CA. 1634. Image courtesy of the Nederlands Scheepvaartmuseum, Amsterdam (B.0054[01]).

by Martin. His models, simple in structure and easy to produce, comprised a planetarium and various subsystems for the demonstration of the motion of satellites around their mother planet. After Martin's death other makers, such as George Adams Jr., Dudley Adams, and William and Samuel Jones continued to produce them. The collection of the Teylers Museum in Haarlem has five models made by George Adams Jr.: a planetarium that shows all the planets, a tellurian, and three models of the satellite systems of the earth (Lunarium), Jupiter (Jovilabe), and Saturn (Saturnilabe) (Turner 1973, 202–5). Models showing the motion of the satellites of Jupiter and Saturn had already been developed by Rømer in 1677 and 1687, respectively. At that time, interest in the satellites of Jupiter was inspired by the problem of finding the longitude at sea, but in the eighteenth century the interest was solely to show the structure of the solar system. That motivation also was behind the Jovilabe and Saturnilabe designed by Janvier around 1790.

During the Enlightenment a number of outstanding

FIG. 73. BENJAMIN COLE'S TRADE CARD, CA. 1745, DEPICTING A GRAND ORRERY.

astronomical models were made that do not fit into the main stream of modelmaking. Three deserve to be singled out. In 1780 a well-to-do Dutch wool comber of Franeker, Eise Eisinga, who in his free time studied astronomy, finished the construction of the largest planetarium of the eighteenth century in the living room of his house. His motive for building it was to fight the superstition among the Frisian population triggered by the special conjunction in May 1774 of Mercury, Venus, Mars, Jupiter, and the moon in Aries. The planetarium had to be accurate enough to show that such planetary conjunctions had no supernatural significance but followed from the structure of the solar system. This planetarium can still be seen today in Franeker in full working order. In Germany, the most prestigious planetary model, the *Weltmachine*, was designed by Philipp Matthäus Hahn, a theologian by profession, who next to his pastoral duties had required a reputation in making clocks and other instruments. Together with his brothers Georg David and Gottfried, he worked for twenty years to finish his machine. After his death, the *Weltmachine* was exhibited in London and acquired by George III. From London, the machine went to China in 1793, where it remained until it was returned to Europe in 1806. In 1878 it, or rather what was left of it, was added to the collection of the Germanisches Nationalmuseum in Nuremberg. Finally, the geared Copernican spheres made by Janvier were among the most sophisticated devices made in the late eighteenth century. The great talents of the young Janvier were recognized when, at the age of fifteen, he constructed a clockwork-driven geocentric sphere that was presented to the Académie des sciences, belles-lettres et arts de Besançon and is now (with modifications) preserved in the Museum of the History of Science in Oxford. He started on his finest work, his "Chef-d'œuvre," after 1789 and finished it in 1801: it displays the moon and all the known planets, including that discovered in 1781 by William Herschel (Uranus), driven by complex wheelwork (Kugel 2002, 202–25). It is without exaggeration the ultimate presentation of a clockwork universe.

ELLY DEKKER

SEE ALSO: Celestial Mapping; Cosmographical Map; Globe: (1) Celestial Globe, (2) Pocket Globe, (3) Lunar Globe

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Atlantic Neptune, The. *The Atlantic Neptune* was a major maritime atlas published in London between 1774 and 1782. The four volumes contained more than a hundred charts at different scales as well as many views and profiles of the coasts of eastern North America. It was considered "one of the most remarkable products of human industry which has been given to the world through the arts of printing and engraving" (Webster 1933, 27) and "the most splendid collection of charts, plans, and views, ever published" (Rich 1835–44, 249).

The Atlantic Neptune emerged in the wake of Britain's victory over France and Spain in the Seven Years' War (1756–63). To make sense of Britain's newly enlarged empire, the government and the East India Company embarked on an extensive gathering of geographic, economic, and demographic information. In North America, the army, navy, and Board of Trade focused on surveying and mapping areas captured from the French and the Spanish. The army surveyed the Saint Lawrence, Ohio, and Mississippi Rivers; the navy concentrated on the coasts of Newfoundland, Nova Scotia, and the Gulf of Mexico; and the Board of Trade instituted surveys of the remaining coast from the Gulf of Saint Lawrence to Cape Florida. With no central mapping agency, the surveys served different departments of government and were frequently organized on an ad hoc basis. Nevertheless, by 1770, some order was being imposed on this enormous effort. Army officer Samuel Holland, who was responsible for the Board of Trade's General Survey of the Northern District (from the Gulf of Saint Lawrence to the Potomac River), and J. F. W. Des Barres, another army officer, who had been hired by the Admiralty to survey the coast of mainland Nova Scotia and Sable Island, met in Liverpool, Nova Scotia, and agreed to share their manuscript charts with a view to having them engraved and published. Des Barres took the lead in the project, hoping to make considerable profit.

After finishing the survey of Nova Scotia, Des Barres arrived in London in late 1773 and began lobbying the Admiralty for funds to publish the charts. With British authority breaking down in Massachusetts and other colonies in spring 1774 and the navy desperate for charts of the American eastern seaboard, Des Barres quickly won support. Between 1775 and 1780, the government funded publication of the *Neptune*. The charts themselves continued to be printed until 1802.

The charts were based on the most accurate surveys carried out in North America up to that time. Des Barres drew on his own survey (fig. 74) as well as those of James Cook, Michael Lane, William Gerard De Brahm, George Gauld, and navy captains. The bulk of the charts, however, were based on surveys undertaken by Holland and his deputies. These encompassed the intricate coast from Quebec to eastern Long Island and were based on trigonometrical surveying and astronomical observation. To the envy of Des Barres, Holland and his men were equipped with the latest telescopes, pendulum clocks, and quadrants and had a dedicated survey vessel at their disposal.

Des Barres may have drawn on the skills of James Newton, a renowned map- and globemaker, to engrave the charts. Certainly, the published charts were magnificently designed and far superior to those of Cook and Murdoch Mackenzie the Elder. At least some credit for the designs must go to Holland, whose manuscript charts closely match the engraved copies. As the charts accumulated, Des Barres organized them into four volumes: 1 and 2 covering Nova Scotia, 3 New England, and 4 the Gulf and River Saint Lawrence and New York south to the Gulf of Mexico. Sets of *The Atlantic Neptune* were quickly distributed to the Admiralty and naval vessels on the North American station. The charts were soon copied by commercial chart publishing houses and remained in use until a new round of coastal surveying by the British and U.S. governments in the mid-nineteenth century.

Although *The Atlantic Neptune* charts were of little assistance to the British military effort on land during the American Revolution, they were a great help to the navy patrolling the coast. Moreover, the original surveys developed a cadre of skilled men who later served as provincial surveyors in Quebec, New Brunswick, and Prince Edward Island, and also as marine surveyors for the navy. Overshadowed by Cook's explorations and mapping of the Pacific in the 1770s, *The Atlantic Neptune* nevertheless remains one of the great monuments of British imperial endeavor and Enlightenment science in the late eighteenth century.

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SEE ALSO: Atlas: Marine Atlas; De Brahm, William Gerard; Holland, Samuel (Johannes); Marine Charting: Great Britain; Topographical Surveying: British America

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FIG. 74. J. F. W. DES BARRES, SPRY HARBOUR TO FLEMING RIVER CHART (LONDON, 1776). First state; copper engraving on two sheets. This large-scale chart shows the detailed surveys, soundings, and coastal views along southern Nova Scotia undertaken by Des Barres himself in 1764–65, and the fine layout, typography, and engraving characteristic of charts in *The Atlantic Neptune*.
Size of the original: 63 × 90 cm. Map reproduction courtesy of the Norman B. Leventhal Map Center at the Boston Public Library (G1106.P5 D47 1777).

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Atlas.

ATLAS IN THE ENLIGHTENMENT
GEOGRAPHICAL ATLAS
MARINE ATLAS
COMPOSITE ATLAS
SCHOOL ATLAS
HISTORICAL ATLAS

Atlas in the Enlightenment. Although books of maps were produced by many cultures before 1500, the modern atlas dates from the last decades of the sixteenth century. Since then the core idea has been stable: an atlas is a book either composed entirely of maps or conceived primarily to present cartographic content; shaped by the guiding hand of an editor or editors; generally conforming to a standard size, design, and format; and arranged according to a consistent and meaningful plan (Akerman 1995a; Wolter and Grim 1997, ix–xi; Koeman et al. 2007; Carhart 2016). The term has been applied as well to compilations of manuscript maps and, mainly after 1800, to scientific reference books of spatial information presented in graphic formats, notably anatomical atlases. Until the nineteenth century, the uncertainties of the marketplace and the expense of copper engraving worked against the publication of truly uniform editions. Composite atlases assembled informally by mapsellers or consumers accounted for a significant portion of atlas production from the 1670s to the early 1800s.

The ideal of an edited, meaningfully designed and organized atlas—first articulated by Gerardus Mercator, Abraham Ortelius, and their contemporaries—was nevertheless also applied with increasing rigor across the spectrum of atlas production and to a diversity of atlas concepts far exceeding that of previous centuries. Many seventeenth-century atlas publishers aimed obsessively at comprehensiveness, producing bloated and expensive multivolume works or abortive projects that often failed to live up to their prospectuses. Eighteenth-century atlas publication mostly abandoned the pursuit of grandiosity, developing the atlas largely as we know it: a distillation, popularization, and interpretation of current geographical knowledge informed by divergent local, national, and imperial interests.

Mercator's term "atlas" was applied widely to books of maps by 1700, and its use was nearly universal by 1800. The most prominent genre was the geographical world atlas, a treatment of the entire earth employing mostly medium- and small-scale maps. Regional and national atlases, compilations of city maps and views, sea atlases, and historical atlases were also established genres by the mid-seventeenth century. The steady expansion of European map consumption during the eighteenth century encouraged mapmakers and publishers to experiment with new forms, most prominently road, war-related, and scholastic atlases. The geographical diffusion of the form throughout Europe and across the Atlantic accompanied this thematic diversification. Of the 1,173 printed atlases in the Library of Congress published before 1801 listed by Philip Lee Phillips and Clara Egli LeGear (1909–92, vols. 1–8), 72 percent were published between 1676 and 1800. Comparable numbers have been found among atlases held by the British Library (Woodfin 2007). The Netherlands remained the leading producer until the mid-eighteenth century. Thereafter, British, French, and German production matched or exceeded the Dutch (Akerman 1991, 303–5; Woodfin 2007, 66–67).

Thematic diversification and geographical diffusion were clearly correlated. Road atlases flourished among mobile Britons (Delano-Smith and Kain 1999, 168–78). Atlases of theaters of war and fortifications, such as Pierre Duval's *Les acquisitions de la France par la paix* (1660 and later) (fig. 75) and Nicolas de Fer's *Les forces de l'Europe* (1690–95), were popular on the Continent during the expansive wars of Louis XIV, and the endless dynastic and imperial struggles among European powers throughout the eighteenth century ensured their continuing popularity. National and local interests supported the emergence of new genres. In the Netherlands, composite polder atlases, composed of multi- and single-sheet maps of lands reclaimed from the sea, enjoyed some success. Wall-sized multisheet maps of the great eighteenth-century seats of empire, notably Louis Bretez's twenty-sheet *Plan de Paris* (1739; see fig. 174) and John Rocque's sixteen-sheet *An Exact Survey of the City's of London, Westminster* (1746), survive primarily in durable atlas formats, accompanied by title pages, summary regional or index maps, or indexes (fig. 76).

Established genres also evolved in ways reflective of shifting geopolitical interests. From the later seventeenth century, British, Dutch, and French sea atlases expanded the traditional European, Baltic, and Mediterranean navigation to include maps and sailing instructions embracing the worldwide scope of their imperial activities, with the east coast of North America, the West Indies, and the Indian Ocean receiving particular attention (Woodfin 2007, 187–214). Historical atlases, previously focused exclusively on classical and biblical geography, took on medieval and early modern subjects reflective of religious, dynastic, and national history (Black 1997, 21–26; Goffart 2003, 131–302).

The eighteenth-century wealth of British, French, and German geographical atlases likewise reflected the geographical orientations of their respective markets. The British were prolific publishers of county atlases during the eighteenth century (Hodson 1984–97). British editors produced geographically balanced and systematic works such as John Senex's *Modern Geography* (1708–25) and *A New General Atlas* (1721), the didactic *A New Sett of Maps Both of Antient and Present Geography* (1700) by Edward Wells, and *A New Atlas of the Mundane System*

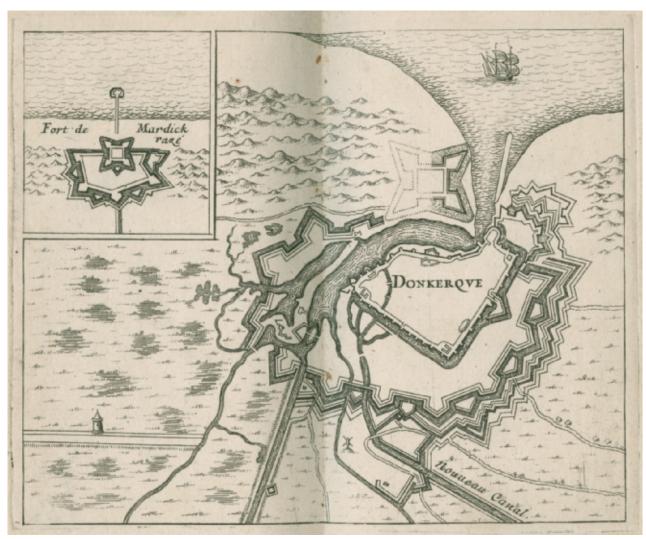

FIG. 75. PIERRE DUVAL, *DONKERQVE*. From Duval's *Les acquisitions de la France par la paix* (Paris: Chez l'Auteur, 1663). Size of the original: ca. 13.5 × 14.0 cm. Image courtesy of the Newberry Library, Chicago (F 3924 24).

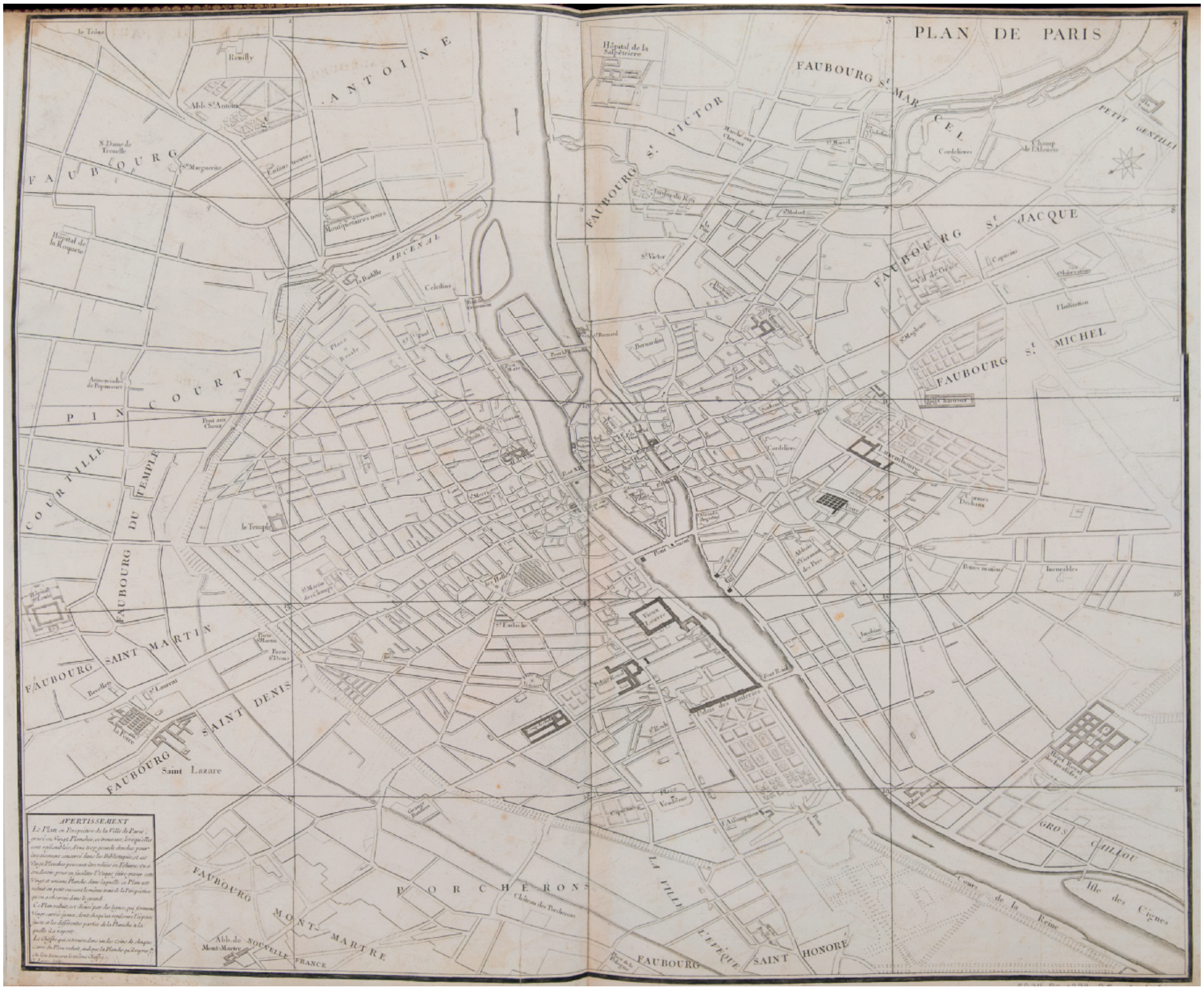

FIG. 76. INDEX SHEET TO LOUIS BRETEZ, *PLAN DE PARIS COMMENCÉ L'ANNÉE 1734* (PARIS?, 1739).
Size of the original: ca. 62.5 × 90.0 cm. Image courtesy of the Newberry Library, Chicago (Wing oversize ZP 739 B844).

(1774) by Samuel Dunn. But more politicized works cut a higher profile, including Herman Moll's sharply mercantilist *The World Described* (1708–20), the openly imperialist *General Atlas* of Thomas Kitchin (1773), and its successor, *A New and Elegant Imperial Sheet Atlas* published by Laurie and Whittle. In the 1760s to 1780s, Thomas Jefferys's *West-India Atlas* and *American Atlas*, Jeffreys's *General Topography*, and J. F. W. Des Barres's *Atlantic Neptune* provided a cartographic context to British power in North America and the Caribbean.

Germans, in contrast, favored volumes preoccupied with Continental affairs. Larger volumes by Johann Baptist Homann (and Homann Heirs), Tobias Conrad Lotter, and Matthäus Seutter typically included substantial complements of maps of the many states and provinces of Continental Europe but relatively few maps of the world beyond Europe. A copy of Seutter's *Atlas novus* (ca. 1740) in the Newberry Library, Chicago, comprising forty-nine sheets, for example, treats the world, Asia, Africa, and the Americas in the first five maps only, while the other forty-four mostly concern Central Europe.

The general expansion and diversification of atlas publication was also reflected by the number of distinct atlas projects associated with a single mapmaker, author, or publisher. The map compiler and engraver Emanuel Bowen, for example, was author or contributor to *Britannia depicta* (1720), a road atlas; *The English Pilot*, fourth book (1729); *A Complete System of Geography* (1747); *A Complete Atlas* (1752); Patrick Gordon's *Geography Anatomiz'd* (20th ed., 1754); John Gib-

FIG. 77. *ASIA ACCORDING TO THE SIEUR D'ANVILLE.* The northern two sheets of a four-sheet map joined, folded, and bound together in Thomas Kitchin's *A General Atlas Describing the Whole Universe* (London: Robert Sayer, 1773). Size of the original: 54.5 × 120.0 cm. Image courtesy of the Newberry Library, Chicago (oversize Ayer 135.K6 1773 A).

son's *Atlas Minimus* (1758); *The Maps and Charts to the Modern Part of the Universal History* (1766); and an atlas of English counties, *The Large English Atlas* (1749–60), and its reduced version, *The Royal English Atlas* (1762). The great Amsterdam publishing house of Covens & Mortier published thirty-six different atlas titles during the eighteenth and early nineteenth centuries (many in multiple editions and versions), mostly copied or derived from previous work (Van Egmond 2009).

If produced in greater variety, atlases were also narrower in ambition. Partly this was a matter of economics. London map publishers were in constant financial stress. During the last decades of the seventeenth century four ambitious atlas projects floated by Richard Blome, John Ogilby, Moses Pitt, and John Seller floundered. The use of prepublication or serial subscriptions to spread expenses among distributors and consumers was tried with limited success by both British and French publishers. Atlas map sheets were frequently also sold as separate items, offering a more flexible way to realize profits from costly engraving and printing. A Parisian composite atlas assembled circa 1786 features twelve two- and four-sheet maps by Jean-Baptiste Bourguignon d'Anville. It lacks a title page and index but includes an engraved price list for the maps in the atlas when sold singly (Chicago, Newberry Library, Baskes oversize G1019 A598 1786). Similarly, Kitchin's *General Atlas* is composed almost entirely of maps printed on either two or four large plates (many based on d'Anville). Most of the four-plate maps in the volume, including the world map, six continental maps, and a map of India, bear elaborate title cartouches that betray their marketability as separate wall maps (fig. 77). Finally, quarto, octavo, and even smaller formats were published for a growing market in economical and portable atlases (fig. 78).

The instability of editions and the cost and time involved in copper engraving worked against the achievement of a truly uniform design among the maps in a given atlas. Costly, larger-format works commonly incorporated maps from a variety of sources. As a result, the graticule may have appeared on some maps in an atlas but not on others, and that graticule might have been based on two or more prime meridians. Maps often were oriented haphazardly to the north, east, or south as dictated by their subjects. At times, projections differed without any apparent system. Inconsistencies in symbols for towns, natural features, and political boundaries, as well as standards for nomenclature, betrayed both multiple sources and the stylistic habits of individual engravers.

Even so, by the last half of the eighteenth century most atlas publishers clearly had enforced uniformity in their use of conventional signs. Each one of the maps in Gilles Robert Vaugondy and Didier Robert de Vaugondy's *Atlas universel* (1757) is aesthetically admirable on its own terms, from its elegantly framed cartouches to its pleasing calligraphy, but the Vaugondys also struggled to achieve uniformity in the use and placement of toponyms, topographic and political symbols, color schemes, and size and format of the maps (Pedley 1992, 51–68). Dunn's *New Atlas of the Mundane System*, Isaak Tirion's *Nieuwe en beknopte Hand-Atlas* (1744), Jacques-Nicolas Bellin's *Le Petit atlas maritime* (5 vols., 1764), and Antonio Zatta's *Atlante novissimo* (4 vols., 1779–85) are representative of smaller folio atlases (35–45 cm) designed uniformly. Their compilers only rarely incorporated foldout maps, preferring instead to break regions accorded more detailed treatment into constituent subregions. The style of borders and cartouches and the use of text and topographic symbols show little variation from plate to plate, except—as for the representation of cities and rivers—variations required by scale. Uniformity was nevertheless occasionally breached by expedience. Zatta, motivated by the American Revolution, inserted a twelve-sheet map of the United Colonies (*Le Colonie Unite dell'America Settentr*^{le} *di nouva pro-*

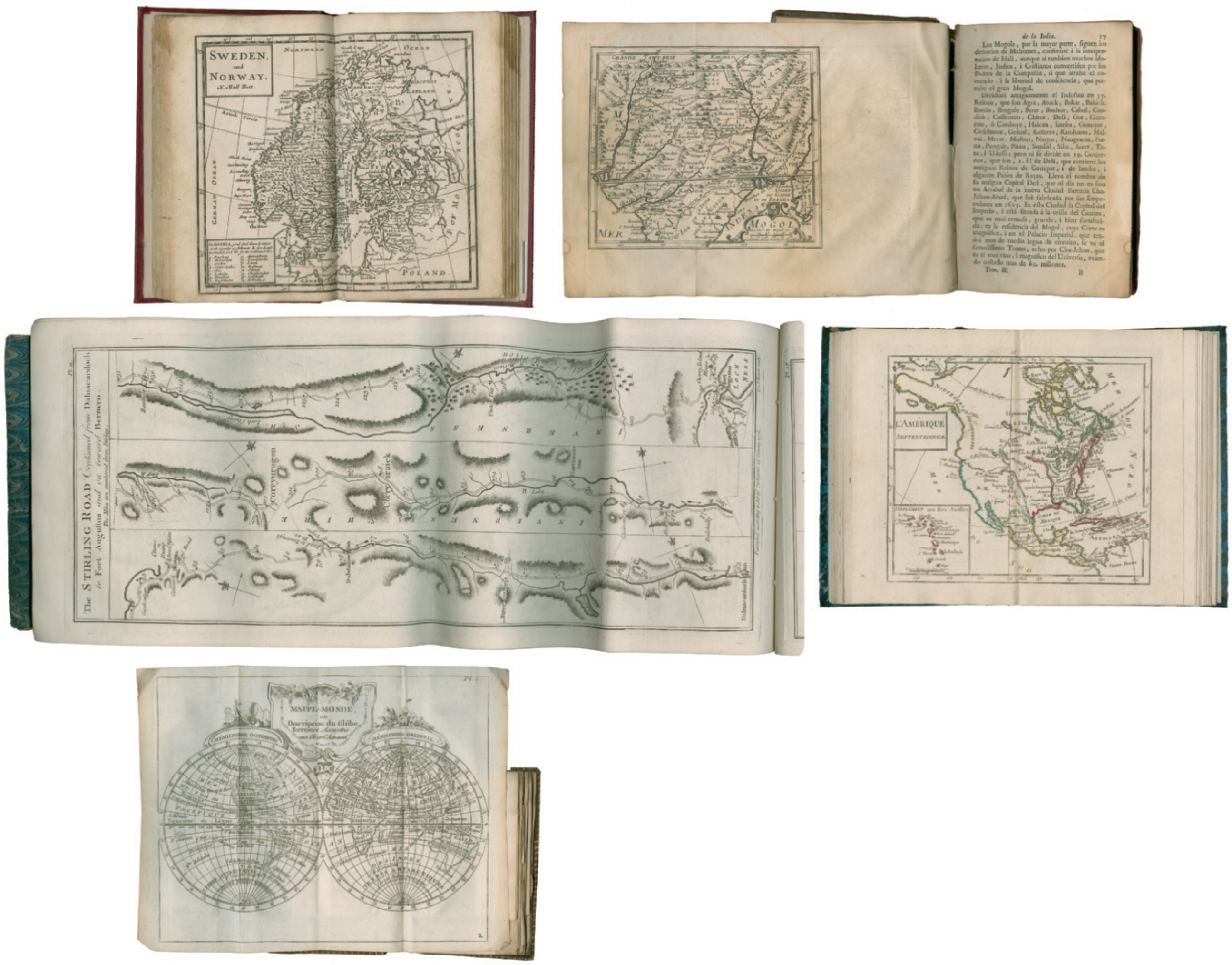

FIG. 78. A SELECTION OF SMALLER-FORMAT ATLASES. Left to right, top to bottom: Herman Moll, *Atlas manuale* (London: A. and J. Churchil and T. Child, 1709); Francisco Giustiniani, *El atlas abreviado* (Lyon: Jaime Certa, 1739); George Taylor and Andrew Skinner, *Survey and Maps of the Roads of North Britain or Scotland* (London, 1776?); Louis Brion de La Tour, *Atlas, et tables élémentaires de géographie, ancienne et moderne* (Paris: J. Barbou, 1777); and *Bibliothèque universelle des dames: Atlas portatif* (Paris, 1786).

All images courtesy of the Newberry Library, Chicago. Moll, 19.5 × 21.5 cm (Ayer 135.M7 1709); Giustiniani, 18.5 × 26.1 cm (Ayer 135.G53 1739); Taylor and Skinner, 22.0 × 58.8 cm (sc1002); Brion de La Tour, 19.0 × 22.4 cm (Baskes G1015.B769 1777), and *Atlas portatif*, 18.0 × 24.8 cm (Baskes G1015.B45 1786).

jezione) among his more characteristic self-contained single-sheet maps.

Underlying this greater formal consistency was a more systematic approach to geographical content, particularly geopolitical content. Before 1750, for example, the shared boundaries between France and the Holy Roman Empire in the region of modern Belgium were often delineated differently in the same atlas's maps of France, the Netherlands, the counties of Flanders and Artois, and the Empire. After that date these inconsistencies largely disappeared (Akerman 1991, 543–49; 1995b). Smaller-format atlases and atlases developed for scholastic use were particularly mindful of the need for consistency in the rendering of topography, hydrography, and political geography.

Atlases had been, since the time of Ortelius, microcosms of the world, flavored by the worldviews, impulses, and sentiments of both their makers and their consumers. Yet, as atlasmakers abandoned the goal of mapping the whole world in detail and settled into reaching specific markets, needs, and tastes, editors more consistently expressed geographical ideas through an orderly sequence of maps specifically designed for a given purpose. The differences between a late eighteenth-century and a mid-seventeenth-century atlas are often subtle. More often than not, later atlases betray an increasing sophistication and consistency in design. This greater devotion to the plan and organization of an atlas made it possible for atlases not merely to catalog and systematize the representation of geographical features, but also, through the thoughtful selection and edition of constituent atlas maps, to elucidate local, national, and imperial narratives.

JAMES R. AKERMAN

SEE ALSO: Celestial Mapping; Geographical Mapping; Map Trade

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Geographical Atlas. Though all atlases that have the earth as their subject are in the broadest sense geographical, works providing a general overview of global or regional geography, consisting primarily of medium-scale general reference maps are here defined as "geographical atlases." Despite the proliferation of new genres, geographical atlases remained the dominant type, accounting for roughly 50 percent of editions produced during the eighteenth century (Akerman 1991, 320). Basic and unspecialized, they were intelligible to wide audiences and often explicitly didactic.

Eighteenth-century geographical atlases could be grand or voluminous, but competition and economics encouraged most atlas editors and publishers to embrace selectivity and system over exhaustiveness. The concise reference atlas published in-folio or small folio, ranging from twenty to a hundred mapsheets, developed in the later seventeenth century (Carhart 2016). Their modest size allowed compilers to enforce uniform symbolic templates, scales and projections, orientations, textual styles, ornament, and color. Comparatively simple designs emphasized clarity over density of information. A preference for uniformity and clarity was at work as early as 1658, in the design of Nicolas Sanson's *Cartes générales de toutes les parties du monde*. The layout, symbolization, and color schemes of its component sheets were unusually uniform. Notably, country or regional boundaries and labels conformed very closely to a set of hierarchical geographical tables of the regions and physical features of the world published by Sanson fourteen years earlier as geographical aide-mémoires.

Many geographical atlases of the eighteenth century had similar didactic orientations. The title page of Edward Wells's *A New Sett of Maps Both of Antient and Present Geography* (1700) instructed the binder to assemble the atlas with ancient and modern maps of the same country side-by-side so that "the most remarkable Differences of Antient and Present Geography may be quickly discern'd by a bare Inspection or Comparing of Correspondent Maps; which seems to be the most natural and easy Method to lead Young Students . . . unto

FIG. 79. TYPICAL EXAMPLE OF MAP DESIGN FOR AN EIGHTEENTH-CENTURY GEOGRAPHICAL ATLAS. *A Map of Independent Tartary, Containing the Countries of the Kalmuks and Uzbeks, with the Tibet*, from Samuel Dunn, *A New Atlas of the Mundane System* (London: For R. Sayer and J. Bennett, 1778), 26.
Size of the original: 31 × 44 cm. Image courtesy of the Newberry Library, Chicago (Ayer 135 D85 1778).

a competent Knowledge of the Geographical Science." Johann Baptist Homann's *Kleiner Atlas scholasticus* (1710) was conceived and carefully illuminated to accord with Johann Hübner's highly popular didactic work, *Kurtze Fragen aus der neuen und alten Geographie* (1693). The uniformly designed maps in "Mathematician" Samuel Dunn's *A New Atlas of the Mundane System* carefully attend to the subdivisions of each country or region (fig. 79). The simple design of Didier Robert de Vaugondy's *Nouvel atlas portatif* (1762) is striking especially when compared to the same publisher's ornate *Atlas universel* (1757). Though more expensive and beautiful, the *Atlas universel* was nevertheless a standard atlas with prescribed content and arrangement and engraved according to uniform specifications under the watchful eye of the editors (Pedley 1992).

The history of geographical atlas production over the course of the eighteenth century was largely one of gradual triumph of the systematic atlas over more informally designed and compiled atlases—but not entirely. Leading German publishers, such as Homann, Matthäus Seutter, and Tobias Conrad Lotter, produced both standard and composite atlases, as did the French heirs of Sanson. The practice of offering constituent atlas maps for separate sale was clearly widespread. And large regional maps, such as Henry Popple's *A Map of the British Empire in America* (1733), were often bound as atlases, and so might be combined with other maps independently conceived and designed. These practices invited customization by or for individual customers.

Whether in standard or irregular editions, the content, structure, and design of eighteenth-century geographical atlases are almost all marked by increased sensitivity to political territory and geopolitics. British world atlases of the eighteenth century were more likely to include maps of British territories in America and Asia than French or Spanish territories; French atlases were similarly biased toward their colonies. The larger works of Seutter and Homann are crowded with maps of German principalities ignored by publications from Britain or France (Akerman 1995). County atlases of the British Isles enjoyed enduring popularity (Hodson 1984–97), while Dutch atlases of their homeland clung to the politically anachronistic concept of the Seventeen Provinces of a united Low Countries. Not surprisingly, Philadelphia publishers issued distinctly American atlases, dominated by American states and territories, within two decades of the Declaration of Independence.

While composite atlases assembled to the order of individual buyers remained popular, over the course of the eighteenth century the standard geographical atlas asserted its dominance, in part because it allowed editors to assert that geographical science was the basis of their work. Geographical atlases, however, also appealed to geopolitical sentiment. While not all were explicitly didactic, eighteenth-century geographical atlases provided a foundation for what was already by 1800 becoming a sharply territorial and imperialistic geography of nation-states.

JAMES R. AKERMAN

SEE ALSO: Geographical Mapping; Map Trade

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Marine Atlas. From the close of the sixteenth century and especially through the first half of the seventeenth century, European cartographic production, including marine charts, benefited from progress made in engraving. The term "atlas," which prevailed only after 1630, was applied to many collections of printed marine charts that were heterogeneous works of compilation without a coherent purpose. "Atlas" was also used to describe combinations of maps and texts when the former outnumbered the latter. A need existed to gather charts into volumes that could be handled more easily than individual large-format sheets. Yet these voluminous atlases remained expensive, and works of nautical instruction experienced greater success (Chapuis 1999, 145, 150, 152). Nautical books actually favored coastal views over maps, the geometric perspective of which was still difficult for many coastal navigators to understand (Chapuis 1999, 150). Their lower cost and more manageable size also played a role in their popularity (Chapuis 1999, 144–45). Even well into the eighteenth century, the imperatives of cost and size encouraged the production of small atlases such as *Le Petit atlas maritime* (1764) of Jacques-Nicolas Bellin, although such atlases were impractical for plotting while navigating (Chapuis 1999, 314).

Atlases of printed charts acquired a particular distinction for their rich illumination, paid for by wealthy clients who appreciated the application of color to the maps; such addition was one of the trademarks of engraved charts from Holland up to the eighteenth century. Thus the *Spieghel der zeevaerdt* by Lucas Jansz. Waghenaer, published from 1584 to 1585, became the standard maritime atlas, lending the name of its author to any atlas of this type, the *waggoner* (Schilder and Van Egmond 2007, 1385).

Waghenaer's *Spieghel* influenced the production of marine atlases in other European countries. In France, *Le Neptune françois* (1693) adopted the *Spieghel*'s innovative principle of uniform scale by providing detailed maps of the French coasts at ca. 1:100,000, a rather large scale for the period (Chapuis 1999, 104). These maps overlapped one another at their edges, initiating a clever practice still employed today for ease of use (Chapuis 2007, 134). The *Neptune* also offered quite complete legends and adopted a uniform set of standardized conventional signs, a distinguishing feature of marine atlases. Finally, the *Neptune* systematized features not invented by its authors, such as a proposed reference point for tides of the lowest seas of the equinox (Chapuis 2007, 135).

Just as the *waggoner* had assumed its place in European vocabulary, in French, the word *neptune* (without the initial capital) has been becoming the standard term since that time for a maritime atlas (Chapuis 2007, 109). A *neptune* was either an atlas of marine charts organized according to an order established at publication or, more often, a diverse collection of navigational charts assembled for binding as needed, containing maps of diverse provenance—even an artificial collection (recomposed after the fact with neither practical or editorial logic), of which the best example was the *Hydrographie françoise* in eighteenth-century France.

Le Neptune françois was not the first French effort at a marine atlas. Sixty years earlier, Christophe Tassin, royal engineer and *géographe du roi*, prepared the

FIG. 80. MURDOCH MACKENZIE THE ELDER, *THE SOUTH ISLES OF ORKNEY, WITH THE ROCKS, TIDES, SOUNDINGS &C.*, 1750. One of the seven detailed charts from the first edition of *Orcades: Or a Geographic and Hydrographic Survey of the Orkney and Lewis Islands in Eight Maps* (London: Murdoch Mackenzie, 1750), map engraved on one sheet, ca. 1:65,000.
Size of the original: 59 × 65 cm. © The British Library Board, London (General Reference Collection N.Tab.2017/16, chart 2, fols. 17–18).

Cartes generale et particulieres de toutes les costes de France tant de la mer oceane que mediterranée (1634) (Pelletier 2007, 1496; Chapuis 2007, 52). This atlas presented a map of France as an assembled picture (although *Le Neptune françois* did not contain such an assembled map), prefiguring the practices of numerous subsequent maritime atlases and of modern-day hydrographic departments.

In Great Britain, the competitive influence of the great maritime atlases engraved in Holland could be seen in the second half of the seventeenth century, notably with the publication of *The English Pilot* by John Seller beginning in 1671 and continued by his successors through the eighteenth century. This atlas combined nautical instructions and charts, some of which were reengraved or copied from Dutch plates, and its six volumes covered most of the coasts of the known world. For home coastal waters, both France and England decided to launch new surveys in the field, under the authority and with the financial support of the state. With official assistance but little monetary backing, Greenvile Collins published *Great Britain's Coasting-Pilot* in 1693, the same year as *Le Neptune françois*. Collins's work was regularly reissued, sometimes with revisions, for nearly one hundred years. State-supported marine mapping also encouraged the survey of the coasts of Spain under the direction of Vicente Tofiño de San Miguel y Vandewalle, resulting in the *Atlas maritímo de España* (1789).

The eighteenth century saw the continued production of large, prestigious atlases, including those of exploratory voyages in the Pacific. In France, *Le Neptune oriental* (1745), a volume covering the waters of the Indian Ocean, Southeast Asia, and the East Indies, included nautical instructions as well as charts, which were published facing the texts relating to the areas represented. The *Neptune du Cattegat et de la mer Baltique*, designed in three parts and not completely published until 1810 (dated 1809), held particular importance, especially for engraving—much greater than its confidential diffusion would suggest (Chapuis 1999, 286). In Great Britain, Murdoch Mackenzie the Elder's *Orcades* (1750) included a general map and seven more detailed maps of the Orkney Islands and surrounding waters at ca. 1:65,000, very large for the period; it was unquestionably the finest work of marine cartography at midcentury (fig. 80). The general outline of the Orkneys as delineated by Mackenzie conformed more closely to the actual coastline than that of Collins in 1693 (Robinson 1962, 66). Finally, *The Atlantic Neptune* (1774–82), edited by J. F. W. Des Barres, which covered the coasts of North America, was a monumental atlas of charts on standardized scales that provided an initial page of conventional symbols to be inserted at the front of each volume, though the volumes themselves varied in contents. No two exemplars were alike among the several editions (Evans 1969, 20).

OLIVIER CHAPUIS

SEE ALSO: *Atlantic Neptune, The; English Pilot, The;* Map Trade; Marine Chart; Marine Charting; *Neptune du Cattegat et de la mer Baltique; Neptune françois* and *Hydrographie françoise; Neptune oriental, Le*

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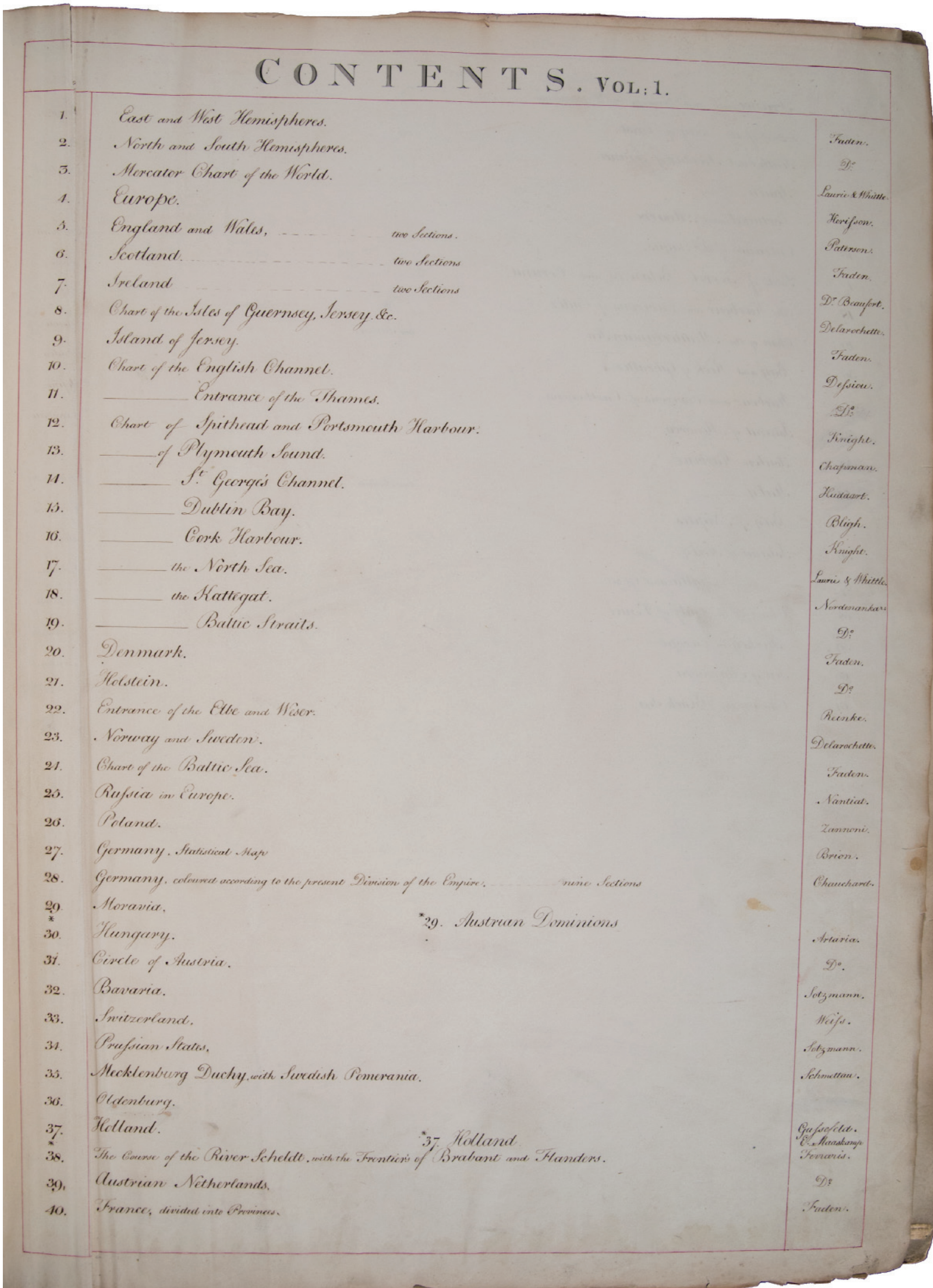
Composite Atlas. A composite atlas (*atlas factice* or *Sammelatlas*) is a book, or books, of printed maps assembled according to the specifications of individual consumers, often from the works of multiple publishers (Carhart 2016, 44). First developed by Italian mapsellers in the 1560s–70s, the practice persisted until the nineteenth century. The distinction between composite atlases and standard editions (i.e., those that conform to a predetermined plan) was an important but complicated one during this period. Since books of all types were commonly sold unbound, sellers and consumers could easily improvise on the plans of atlas compilers before binding them. Printed title pages, frontispieces, tables of contents, and introductory text might indicate that a work was conceived as a standard edition but did not guarantee that every or even most copies of that edition would be identical. Copies of Herman Moll's *The World Described* included a table of contents that doubled as a sales catalog for individual sale of the maps contained therein. This common practice invited seller and consumer alike to elaborate on the apparent plan. The manifest of a copy of Moll's atlas issued around 1760 by John Bowles (in Chicago, Newberry Library [NL], Case oversize G1007.58) lists thirty maps, all of which are present in their specified order, but the volume includes seven additional maps relating to the French and Indian War, five of which were made by Thomas Jefferys.

Several differences exist between the collector's composite atlas and the mapseller's composite atlas. The former was assembled by the consumer, perhaps over time from a variety of commercial sources; while the latter was assembled at a specific time apparently from a single seller's stock, but still has indeterminate content and may include maps from a variety of sources (Carhart 2016, 46). The gigantic "Atlas of the Great Elector" composed of Dutch wall maps presented to Friedrich Wilhelm, elector of Brandenburg, by Johan Morits van Nassau and the similarly proportioned "Klencke Atlas" given by Dutch merchants to Britain's Charles II are famous



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5.	England and Wales, ... two Sections.	Paterson.
6.	Scotland .... two Sections	Faden.
7.	Ireland .... two Sections	Dr. Beaufort.
8.	Chart of the Isles of Guernsey, Jersey &c.	Delarochette.
9.	Island of Jersey.	Faden.
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39.	Austrian Netherlands.	Do.
40.	France, divided into Provinces.	Faden.

FIG. 81. MANUSCRIPT TABLE OF CONTENTS FROM A COMPOSITE ATLAS. From volume 1, "General Atlas of Modern Geography," composite atlas perhaps assembled by William Faden in London, ca. 1816. Image courtesy of the Newberry Library, Chicago (Ayer 135 G32 1775).

examples of collectors' atlases. The circumstances of the assembly of most surviving composite atlases, however, are usually more difficult to document. One example, in two volumes titled on their spines "General Atlas of Modern Geography," consists of 145 map sheets dated from 1775 to 1816 (NL, Ayer 135 G32 1775). Perhaps half of the maps were published by William Faden, but the volumes include maps from several other London houses, as well as French, Dutch, Prussian, Swiss, and Austrian publishers (fig. 81). It is plausible that Faden assembled the atlas, but no direct evidence in the atlas supports this conjecture. One edition of the *Atlas minor* assembled by the Amsterdam-based publisher Carel Allard, perhaps in 1682 (NL, Ayer 135 A4 A), bears Allard's imprint on its frontispiece but includes maps from nine different publishers. The manuscript map register at the back of the volume lists only 70 of a total of 106 sheets. It conforms roughly to other examples of Allard atlases (described by Koeman 1967–85, 1:31–48), but it remains difficult in such cases to know whether the consumer or the seller held greater responsibility for determining the content of the volume. Still more highly varied were the composite atlases assembled by Reinier Ottens and Josua Ottens of Amsterdam in the middle decades of the eighteenth century. These atlases ranged in size from one to fifteen volumes and included "nearly every map of Dutch origin, available at the time" (Koeman 1967–85, 3:86). One example is in five volumes, with 247 map sheets of the Netherlands, primarily magnificent polder maps and provincial and city plans, dating from 1665–1734 (NL, Case oversize G1860 .O88 A84 1750).

The persistence of composite atlases would seem at odds with the Enlightenment's taste for systematic compilation and presentation of knowledge. Highly systematic atlases issued in uniform editions were indeed becoming the norm by the end of eighteenth century, but making atlases remained an expensive proposition requiring a high level of capitalization. Grand atlas projects, like those proposed by Moses Pitt and John Ogilby, fell under their own weight. Many English publishers relied on advance subscriptions and serial publication of atlas components to finance their projects, while in France guild loyalties and restrictions could militate against the collaboration of cartographers and book publishers (Pedley 2005, 84–93). In these circumstances, composite atlases offered a flexible form of atlas publication that limited mapsellers' up-front investment while satisfying buyers' desire for collections suited to their personal tastes and interests. Only the nineteenth-century development of printing technologies suited to industrial production and mass marketing gave publishers of fully standard atlases the upper hand.

JAMES R. AKERMAN

SEE ALSO: Map Collecting; Map Trade

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School Atlas. While almost any atlas can be construed as educational in nature, school atlases developed in the later seventeenth and eighteenth centuries as inexpensive works of small or medium size that were conceived and executed on a pedagogical plan (Pastoureau 1997, 110). They were often prepared in Latin or French, the languages of knowledge and teaching. One long-lasting cartographic didactic device was developed early, by the Hanoverian schoolmaster Johann Strube and published posthumously in his *Orbis terrarum veteribus cogniti typus in binis tabulis* (1664). It offered two maps of each region, one with place-names filled in and one in outline only, awaiting the student to fill in the names; this technique was used in many later school atlases, such as that published by Michał Gröll in Warsaw in 1770 (see fig. 490). The development of school atlases followed a common pattern in those countries in Europe where the map trade had developed substantially, such as the German states, France, and the Italian states.

Education flourished in the German states after the Thirty Years' War as the ideological struggle continued in the classroom. On the Catholic side, teachers associated with religious orders (especially the Jesuits and Piarists), and on the Protestant side, educators such as Johann Amos Comenius (who had been expelled from recatholicized Bohemia), labored to strengthen the study of geography, a process that continued into the eighteenth century. The school atlas developed in conjunction within the proliferation of geography schoolbooks. The educator Johann Hübner, whose textbook *Kurtze Fragen aus der alten und neuen Geographie* (1693) had become a European bestseller, joined the Homann publishing firm to create the first German world atlas that identified an educational goal in its title: *Kleiner Atlas scholasticus . . . durch eine accurate Illumination zu seinen geographischen Fragen accomodiret durch Johann Hübnern, Rectorn zu Merseburg* (1710?). In it Hübner described his unique system of coloring political divisions. In 1719, the Homann firm published the *Atlas methodicus = Methodischer Atlas*, whose maps were designed specifically for educational purposes.

In Prussia, the Berlin Akademie der Wissenschaften

FIG. 82. DETAILS OF *I^{E} CARTE DE L'EUROPE. 1754* AND *III^{E} CARTE DE L'EUROPE. 1754*. Both in Jean Palairet, *Atlas méthodique* (London, 1755). The first map (left), in a series of three, shows the simple outlines of Europe and its constituent regions in colors with only political boundaries and a few major cities depicted, the third has added more features such as rivers, bodies of water, and important physical features. Size of the originals: 49 × 57 cm; size of details: ca. 18 × 27 cm. Images courtesy of the David Rumsey Map Collection.

employed its privilege for reviewing and taxing imported maps. In the face of the increasing number of school atlases produced in Nuremberg, Leipzig, Augsburg, and outside the German states, the academy decided to produce its own, the *Atlas geographicus omnes orbis terrarum regiones . . . ad usum potissimum scholarum et institutionem juventutis editus* (1753) compiled by one of its members, Leonhard Euler. Reflecting the concerns of Enlightenment science and adding text written in Latin and French, Euler included world maps with magnetic declination for 1744 (see fig. 6), winds and monsoons, and measurements of gravity with a pendulum according to Isaac Newton, James Bradley, and Pierre Louis Moreau de Maupertuis.

In France, the Jesuits dominated the late seventeenth-century educational market, exemplified by *Parallela geographiæ veteris et novæ* (1648–49) by Philippe Briet, SJ, with 144 maps illustrating ancient and modern geography plus text to match. Other works competed with Briet's to attract clientele in the specialized market for supplying local academies and schools with products such as Pierre Duval's pocket atlases, copied and reduced from other authors, in pocket form and priced within reach of even a poor student (Pastoureau 1997, 119–22).

In all these works, the maps and the *cartes muettes* method (blank geographical maps or longitude and latitude grids to be filled in) emphasized memorization of nomenclature by students. By the second half of the eighteenth century, new concepts in pedagogy, under the influence of Jean-Jacques Rousseau, moved away from teaching by rote and embraced physical activity and a more child-centered, developmentally incremental approach to learning. Following these trends, the Italian map trade met an increased demand for school atlases in the last quarter of the eighteenth century, particularly in Venice. In France, the introductions and texts accompanying the school atlases of Didier Robert de Vaugondy (*Nouvel atlas portatif*, 1762; see fig. 233) and Louis Brion de La Tour (*Atlas, et tables élémentaires de géographie, ancienne et moderne*, 1774) incorporated new educational ideas (Pedley 1992, 97–104). *L'enfant géographe, ou nouvelle méthode d'enseigner la géographie* (1769) by Jacques-Nicolas Bellin employed simplified maps for very young students and included the traditional blank maps for filling in. The *Atlas méthodique* (1755) by the educator Jean Palairet employed two or three maps for each region, each one with progressively more information, allowing students to gradually increase and recapitulate their knowledge (fig. 82), as discussed in his "Préface." Edme Mentelle's *Atlas nouveau* (1779) included maps of physical geography and other themes, which he continued in greater detail in later editions. Yet the old tropes of memorization and linking geography with history persevered. The *Atlas méthodique et elémentaire* (1756) by the professor of geography Claude Buy de Mornas offered each map framed by columns of text that provide a historical overview and lists of old localities with their current names.

In the pedagogical debate in France on the eve of the Revolution—sharpened by the expulsion of the Jesuits between 1762 and 1764 and the end of their governance of more than one hundred colleges, nearly one-third of the secondary education institutions in France—there was scope for reform that looked toward standardization of programs and school textbooks, including atlases (Pastoureau 1997, 129–30). In 1791, the same committee that published the *Atlas national* produced the first official French school atlas, prepared by Pierre-Grégoire Chanlaire: the *Atlas national portatif de la France, destiné à l'instruction publique*. By the early years of the nineteenth century, educational reformers such as Mentelle had eliminated historical geography and introduced in his atlases essays on understanding and using maps, preparing children to understand large-scale maps as well as the more general small-scale standard fare of atlases (Heffernan 2005, 293).

JOACHIM NEUMANN

SEE ALSO: Education and Cartography; Euler, Leonhard; Geographical Mapping; Map Trade

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Historical Atlas. The *Parergon* of Abraham Ortelius (1579) often ranks as the original historical atlas, but 150 years after its appearance authors were still unsure of what a historical atlas might be. The first books titled "historical atlas" were a seven-volume *Atlas historique* probably by Zacharias Châtelain (1705–20) and a slim *Atlas historicus* by Johann Georg Hagelgans (1718). The former was no more historical than the Dutch atlases of the 1600s; the latter was a world chronicle in little pictures (Goffart 2003, 23–24, 132–33). Only in 1750 was the term first used for a collection of maps to illustrate and teach all or a part of history.

Ortelius's goal was ancient geography, not "historical cartography." Strictly biblical maps prolonged a medieval tradition of Holy Land illustration; for the classical repertory, Ortelius rejuvenated Ptolemy's maps of the ancient world and initiated the atlases of ancient geography, "classical and sacred," that continue to this day, in which timeless maps of ancient lands compete with scenes of historical moments. Ancient geography collections in the Enlightenment included independent anthologies (Janssonius Heirs, Jean Le Clerc, Johann David Köhler), supplements to geographical atlases (Guillaume Sanson, Giovanni Maria Cassini), scholarly improvements (Christophorus Cellarius, Adriaan Reelant), and schoolbooks. Comparisons of ancient and modern geography were held in great honor (Goffart 2003, 21). Nursed by a master like Jean-Baptiste Bourguignon d'Anville, ancient geography held its own as a discipline only in part concerned with history. Its atlases had a devoted, steady, and widening clientele.

The historical atlas as we know it developed on a track of its own. An atlas attentive to time was first assembled, from Holy Land maps, by Philippe de La Rue (1651), and described by Augustin Lubin in 1678 as worthy of a wider effort (Goffart 2003, 105–7). The actual execution of such collections did not occur until Menso Alting's *Descriptio secundum antiquos, agri Batavi & Frisii* (1697–1701) and Nicolas de La Mare's eight plans of Paris (1705), both of them isolated endeavors (Goffart 2003, 100–104, 110, 205–8). Guillaume Delisle planned historical collections covering broader geographical and chronological ranges, but died before carrying them out. Johann Matthias Hase first compiled an atlas spanning all history, in twenty-eight small maps of the "greatest empires" (fig. 83). These maps along with Hase's seven successive maps for German history were gathered by Homann Heirs into an *Atlas historicus* (1750). Applied to Hase's works, "historical atlas" inaugurated the sense it still has (Goffart 2003, 147–49, 256–62; 1995, 54–56).

Hase's epoch-making collection was imitated only in its universal scope. Its successors eschewed "empires" and focused on sequentiality. A commentator spoke in 1804 as though a normal form had jelled: "A historical atlas must . . . supply many maps and they must follow each other in chronological order, so as to present to the eye the gradual changes in the setting of events" (Goffart 1995, 58). This active atlas design, advancing almost cinematically frame by frame, continues to be used to illustrate change. It first appears as an unpublished sixty-six-map atlas, uncertainly dated 1747 (at the Bibliothèque nationale de France, Paris) and was realized in the anonymous sixty-map *Révolutions de l'univers* (1763); both included map-by-map explanations (Goffart 2003, 152–60). The same design, without associated text, guided Giovanni Antonio Rizzi Zannoni's

FIG. 83. JOHANN MATTHIAS HASE, *IMPERIVM ROMANVM SUB JVSTINIANO I.* From Hase's *Historiae universalis politicae qvantvm ad eivs partem I ac II.* (Nuremberg, 1743), pl. XI.

sixty-map *Atlas historique et géographique de la France ancienne et moderne* (1764) and Johann Christoph Gatterer's twenty-four-map *Charten zur Geschichte der Völkerwanderung* (1776), now almost wholly lost (Goffart 2003, 161–73). János Tomka Szászky's eighteen-map *Parvus atlas Hungariae* (1750–51) was also sequential but more clearly topical (Goffart 2003, 274–77). Only the idiosyncratic (and unfinished) *Historical Atlas of England* (maps dated 1790–97) by John Andrews was untouched by the sequential design (Goffart 2003, 278–80).

Ancient geography aside, these five publications were the total output of historical atlases between mid-century and 1800. Such works were not in demand; classics-weighted school curricula dispensed with atlases of the rest of history. Gatterer, professor of history at Göttingen, compiled the *Charten* to accompany his lectures, and Tomka Szászky's Hungarian collection had local interest; but the historical atlas, while becoming a recognized type of map book, found only a scattered public. The Rizzi Zannoni atlas, foreshadowing myriad nineteenth-century historical atlases of France, was the only example of its kind for sixty uninterested years.

Maps of ancient geography in anthologies were generously proportioned, those in schoolbooks usually very small. Small size also characterized the maps of historical collections, in part because atlases of universal history, though on folio sheets, extended from the British Isles to Japan. For all concerned, territorial boundaries, sometimes shifting from map to map, were the main historical information conveyed. Tracks signifying movement occurred almost only on select maps of ancient geography.

WALTER GOFFART

SEE ALSO: Geographical Mapping; Hase, Johann Matthias; Historical Map; History and Cartography; Homann Family; Map Trade; Public Sphere, Cartography and the

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Austrian Monarchy. The mapping activities of the Austrian monarchy in the late seventeenth and eighteenth centuries were characterized by an enormous increase in military and administrative cartography due to numerous wars and related territorial expansions of the Habsburg Empire in that period. In the eighteenth century, Austria—in addition to its hereditary lands—comprised the Bohemian lands, of which Silesia was largely lost in 1742; Hungary; nearly all of northern Italy; and, toward the end of that century, Galicia, Lodomeria, and Bukovina after the partitions of Poland-Lithuania (Vocelka 2001, 21–23).

The expansion began after the successful repulsion of the second Turkish siege of Vienna in 1683 and the subsequent Habsburg-Ottoman War, ended by the Treaty of Karlowitz (1699) by which Austria acquired Hungary, Transylvania, and parts of Slovenia and Croatia. Credit for these acquisitions went to Prince Eugene of Savoy, who from 1697 played an increasingly important role in the Austrian army (Sachslehner 2003, 8–9, 20–25).

Prince Eugene, a connoisseur of already renowned French cartography, promoted military mapping in the Habsburg Empire. A growing number of mostly secret maps and plans of fortresses, battles, and sieges were drawn starting in the late 1690s. By the early eighteenth century, leading mapmakers in the field included Leander Anguissola and Luigi Ferdinando Marsigli from Italy and Johann Christoph Müller from Germany (Dörflinger 2004, 75–76). During the 1690s, Marsigli and Müller had mapped the Danube from Vienna to the mouth of the Yantra River and published a map in eighteen sheets of unprecedented accuracy in 1726. Between 1699 and 1701, they surveyed the border area between Austria and the Ottoman Empire as defined by the Treaty of Karlowitz with a corresponding map drawn in 1706 (see fig. 101). In addition, Müller also surveyed Moravia and Bohemia, resulting in several manuscript and printed maps (e.g., *Mappa geographica regni Bohemiae*, 1722, 1:132,000) (Dörflinger 1989, 70–75; Wawrik and Zeilinger 1989, 318–20).

The War of the Spanish Succession (1701–14) led to the transfer of the Spanish Netherlands, the Duchies of Milan and Mantua, and parts of the Kingdom of Naples and Sardinia (swapped with Sicily in 1720) to the Austrian monarchy, with cartographic results. Notable examples are several maps of theaters of war on the Upper Rhine and in southern Germany drawn by the engineer-corps officer Cyriak Blödner as well as manuscript maps of Sicily by the quartermaster general's lieutenant Samuel von Schmettau ("Nova et accurata Siciliae Regionum, Urbium, Castellorum, Pagorum, Montium, Sylvarum, Planitierum, Viarum, Situum, ac singularium quorum. locorum et rerum ad geographiam pertinentium," 1722, 1:80,000; see fig. 305) (Dörflinger 1989, 66–68, 70).

In 1717, Prince Eugene and Anguissola promoted the establishment of an academy of military engineering, Militär-Ingenieurakademie, in Vienna, where engineer-corps officers were trained in map drawing and cartographic surveying. The first rectors of the academy were Anguissola and Johann Jakob Marinoni; together they had produced a plan of Vienna (*Accuratissima Viennæ Austriæ ichnographica delineatio*, 1706, ca. 1:5,400). This map was the first to provide an accurate picture of the Vienna suburbs so heavily affected by the Turkish incursion of 1683 as well as of the Linienwall, erected in 1704 as a second fortification line (Wawrik and Zeilinger 1989, 343). Marinoni's reputation rests chiefly on his development of a new plane table technique that he used for the cadastral survey of the Duchy of Milan, which had become part of Austria in 1714, and explained in his book on surveying, *De re ichnographica* (1751) (Dörflinger 1986, 565) (see fig. 2).

The War of the Austrian Succession (1740–48) and the Seven Years' War (1756–63) again required numerous maps and plans. Outstanding contributions were made by Johann Lambert Kolleffel (e.g., "Militärische Special-Charte der Reichs-Gefürsteten Marggrafschafft Burgau," 1:21,600) and Constantin Johann Walter ("Mappa Derienigen Gränzen Linie, welche zwischen dem Koenigreich Hungarn und dem Erzherzogthum Oesterreich unter der Enns von Marggrafthum Maehren bis an das Herzogthum Steytermark bestehet," 1756, 1:28,800) (Dörflinger 2004, 158–59; 1989, 78).

It became particularly clear after the Seven Years' War that the Austrian defeat resulted, in part, from a lack of accurate maps of the Habsburg Empire. In 1764, Empress Maria Theresa ordered the engineers of the quartermaster general's staff, established a few years before, to begin a comprehensive survey of the empire, known as the Josephinische Landesaufnahme. Rendered in over 3,500 sheets at a scale of 1:28,800, this survey, largely completed in 1787 under Emperor Joseph II, was certainly modeled on the *Carte de France*. However, the Habsburg monarchy lacked standardized triangulation techniques, and the surveying methods varied from province to province. For example, in Bohemia and Moravia, the map by Müller was used as a base map, enlarged to a surveying scale of 1:28,800, on which topographical details were integrated without extensive surveys. In most other provinces, however, the plane table was used to survey features that were represented by hatching. Thus were over 570,000 square kilometers of the empire surveyed. The mapping of the Tyrol, Vorarlberg, and the outer Austrian territories was not required, as excellent maps (by inter alia Peter Anich, Blasius Hueber, and Anton Kirchebner) already existed of these provinces; the same was true of the empire's territorial holdings in Italy. The Austrian Netherlands were not surveyed by the quartermaster general's staff but by the Artillerie Corps stationed there under the command of Joseph Jean François de Ferraris (Dörflinger 1986, 566; 2004, 77–78).

Contrary to the French model, the Josephinische Landesaufnahme remained in manuscript and top secret. Yet it served as a base for a map of the Austrian Netherlands (*Carte chorographique des Pays-Bas autrichiens*, 1777–78, 1:86,400, see fig. 238), for a map of the environs of Vienna by Stephan Jakubicska (*Neuester Grundriss der Haupt und Residenzstadt Wien*, 1789, 1:28,800, see fig. 69), and for the Estates map of Upper Austria (*Mappa von dem Land ob der Enns*, 1787). The map of the Austrian Netherlands used the same scale as the *Carte de France* and paralleled the French sheet format and topographical renderings. The map of Upper Austria was compiled at the request of the Upper Austrian Estates (political representatives of the different classes). To make sure that the secret maps of the Josephinische Landesaufnahme would not fall into the wrong hands, the Estates had to promise Emperor Joseph II that the map would be accessible only to select persons. Terrain was represented in perspective style and hence less suited for military purposes. The scale was reduced from 1:28,800 to 1:86,400 (Dörflinger 2004, 99, 112–13, 120–21). Topographical surveys in the two decades after the Josephinische Landesaufnahme on the one hand involved newly acquired territories, such as western Galicia and the Veneto, which had become Austrian in 1795 and 1797, respectively, and on the other hand concerned territories occupied as a result of military conflicts with the Ottoman Empire and France (e.g., Western Moldavia, Walachia) (Dörflinger 1986, 566).

Among the products of civil cartography, the work of Joseph Liesganig, Anich, and Hueber certainly deserves mention. Liesganig, a Jesuit who from 1756 was also prefect of the Vienna Observatory, introduced triangulation to Austria. After triangulating the environs of Vienna together with César-François Cassini (III) de Thury, he was commissioned by Empress Maria Theresa in 1762 with surveying the Vienna meridian across three degrees of latitude. After determining two baselines between Neunkirchen and Wiener Neustadt as well as in the Marchfeld plain, he established a triangulation network from Sobietschitz near Brünn (Brno in the Czech Republic) to Varaždin in Croatia. This was followed by astronomical-trigonometrical surveys in the newly acquired province of Galicia and Lodomeria (Kretschmer 1986, 448).

Anich, a farmer's son from Oberperfuss near Innsbruck, authored an exceptionally detailed map of Tyrol, one of Austria's most important eighteenth-century maps. The survey for this map began in 1759; from 1765, Anich cooperated with Hueber. After Anich's death, Hueber completed the work and published it in 1774 (fig. 84; see also fig. 57). Hueber also surveyed Vorarlberg, published as *Provincia Arlbergica* (1783, ca. 1:104,800) (Dörflinger 2004, 80–81, 106–7).

The late eighteenth century saw significant developments in the private enterprise of Austrian cartography. The establishment of the Vienna copperplate engraving school, Wiener Kupferstecherschule, in 1766 and the resulting enlarged pool of well-trained copperplate engravers (including Johann Ernst Mansfeld) helped the growth of the map trade. The improved level of general education during the reign of Empress Maria Theresa; the ascent of the bourgeoisie; the promotion of crafts, industry, and trade; Emperor Joseph II's liberal Censorship Decree; and the decline of the southern German publishing houses also contributed to Austrian commercial cartography. From 1780, the number of printed maps increased dramatically. At least 227 maps were produced in Austria during that decade, compared to a mere 240 maps published between 1700 and 1779. Most map publishers lived in Vienna, where Franz Anton Schrämbl, Franz Johann Joseph von Reilly, and Carlo and Francesco Artaria accounted for the majority of cartographic products. In addition to the supraregional atlases by Schrämbl and Reilly, the overwhelming share of published maps concerned regions and provinces of the Austrian monarchy and theaters of war. Commercial cartography exemplified the close ties between map production and political events. For example, the year 1788, when Austria entered the war between Russia and

FIG. 84. DETAIL FROM PETER ANICH AND BLASIUS HUEBER, *TYROLIS SUB FELICI REGIMINE MARIÆ THERESIÆ ROM. IMPER. AVG. CHOROGRAPHICE DELINEATA* (VIENNA, 1774), SHEET 16. Copper engraving on twenty sheets; 1:104,000. The special value of this map lies above all in its wealth of thematic and topographic particulars, revealed in its legend. See also figure 57.
Size of each sheet: 65.0 × 49.5 cm; size of detail: ca. 32 × 14 cm. Image courtesy of the Woldan Collection, Österreichische Akademie der Wissenschaften, Vienna (Sammlung Wolden, K-III: OE/Tyr 159).

the Ottoman Empire begun in 1787, saw a quantitative highpoint in the cartographic output of the Artaria company. During the First and Second Coalition Wars against France and in the wake of the Third Partition of Poland-Lithuania, map production increased noticeably (Dörflinger 1984, 74–78, 104–5, 108–9, 279, 288–96, 301–2, 312).

In addition, the number of thematic maps grew. Apart from maps depicting theaters of war, the increasingly dense post-route network demanded more post-route maps in the late eighteenth century. The most important examples of these include the *Post Charte der Kaiserl. Königl. Erblanden* (fig. 85) by Georg Ignaz von Metzburg and the *Atlas universae rei veredariae bilinguis . . . Allgemeiner Post Atlas von der ganzen Welt* (1799) by Reilly. The Court Chamber requested that Metzburg, who taught mathematics at the University of Vienna, design a post map of the entire Habsburg Empire, with an overview of post stations and trading posts (Dörflinger 2004, 90–91, 132–33).

Due to the growing number of new factories and rising interest in the economy, the volume of economic map production increased as well (e.g., *Comitatus Soproniensis ungarice Soprony varmegye et germ: Oedenburger Gespanschaft* by Joseph Marx von Liechtenstern, 1793, ca. 1:250,000; *Natur und Kunst Producten Karte von Kærnten* by Heinrich Wilhelm von Blum von Kempen, ca. 1795, ca. 1:1,000,000). In addition, thematic maps of the Austrian multinational state of the late eighteenth century began to gradually take into account languages, nations, and religions (*Novissima Regni Hungariæ potamographica et telluris productorum tabula* by Johann Matthias Korabinsky, 1791, ca. 1:1,000,000) (Dörflinger 2004, 91–92, 138–41, 166–67).

PETRA SVATEK

SEE ALSO: Anich, Peter; Boundary Surveying; Geodetic Surveying; Karlowitz, Treaty of (1699); Map Collecting; Military and Topographical Surveys; Military Cartography; Netherlands, Southern; Poland-Lithuania, Partitions of; Property Mapping; Reilly, Franz Johann Joseph von; Thematic Mapping; Urban Mapping

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FIG. 85. DETAIL FROM GEORG IGNAZ VON METZBURG, *POST CHARTE DER KAISERL. KÖNIGL. ERBLANDEN* (VIENNA, 1782). Copper engraving on four sheets; 1:1,300,000. As in most printed maps of the eighteenth century, the decorations surrounding the title cartouche are particularly rich and intricate. The title is depicted on a large monument crowned by the Austrian coat of arms and an eagle with a post-horn. A landscape with scenes from postal traffic is represented below and to the right of the title.
Size of the entire original: 100.5 × 150.5 cm; size of detail: ca. 51 × 76 cm. Image courtesy of the Woldan Collection, Österreichische Akademie der Wissenschaften, Vienna (Sammlung Wolden, K-III: OE 185).

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