P

Pacific Voyages. As late as the mid-eighteenth century, Europe's knowledge of the Pacific basin, covering almost one-third of the earth's surface, was sketchy and incomplete. The situation was transformed in the last forty years of the century, when expeditions from Europe led to the discovery and charting of previously unknown areas of the great ocean. Left unqualified, this statement could give a misleading impression of the nature of that "discovery." Long before Ferdinand Magellan's ships crossed the Pacific in 1520, its approximately 25,000 islands had been subject to a steady process of voyaging, exploration, migration, and settlement as shown by Tupaia's remarkable chart of Polynesia, copied by James Cook in 1769 (Finney 1998, 446–51, figs. 13.1–13.4). On an early eighteenth-century European map of the Pacific, the uncertainties far outnumber the certainties. The immensity of the ocean, problems of establishing longitude in the prechronometer era, and the twin threats of scurvy and mutiny posed formidable obstacles for Magellan's successors. Constraints of wind and current forced navigators to follow narrow tracks across an otherwise uncharted ocean. In the North Pacific, little was known away from the route of the Spanish galleons sailing between the Philippines and Mexico, shown on a chart seized from one of the galleons in 1743 by the Anson expedition (fig. 618). In the South Pacific, there had been sightings of some island groups near the diagonal sailing route between the tip of South America and the equator, but their exact location was uncertain. As John Green complained, "There are in the *South-Sea* many Islands, which may be called Wandering-Islands" (Green 1753, 43). Of the larger landmasses, the coasts of the western half of New Holland, New Guinea, and New Britain, together with short stretches of the shoreline of Van Diemen's Land and New Zealand, had been roughly charted, but their relationship with each other and with the hoped-for southern continent was unknown.

The heightening of overseas rivalry between Britain, France, and Spain in the first half of the eighteenth century was followed by an increase in European interest in the Pacific. Charles de Brosses published the first collection of accounts of voyages devoted exclusively to the Pacific, *Histoire des navigations aux Terres Australes* (1756), a work then plagiarized by John Callander in his *Terra Australis Cognita* (1766–68). After the end of the Seven Years' War (1756–63)—the first European conflict of truly global dimensions—attention turned to the Pacific as a vast area whose discovery and control might tip the balance of power in Europe. In both Britain and France, a new kind of naval hero emerged in the shape of the explorer whose ships left for the unknown and returned years later laden with specimens from the South Seas and with crews eager to publish accounts, maps, and views of the exotic places they had visited. The first voyage in the new era of Pacific exploration was made in 1764–66 by John Byron, who sailed with objectives ranging from the annexation of the Falklands to the discovery of the Pacific entrance of the Northwest Passage. It was an unconvincing start, for Byron followed the customary sailing route from the tip of South America northwest across the Pacific and made few discoveries of note. In 1766, the Admiralty sent out two more ships, commanded by Samuel Wallis and Philip Carteret, with orders to sail into high latitudes in search of the southern continent. After becoming separated from Wallis, the enterprising Carteret crossed the Pacific farther south than any of his predecessors and in doing so removed part of the supposed southern continent from the map. Wallis took a more cautious route, but his voyage was marked by the chance discovery in 1767 of Tahiti, a Polynesian island that for later generations was to conjure in the European imagination images of an earthly paradise (Salmond 2009). A few months after Wallis and Carteret sailed, ships of the French navy commanded by Louis-Antoine de Bougainville left European waters, also bound for the Pacific in the hope of finding unknown islands and continents. Unlike the British expeditions, Bougainville's ships included a

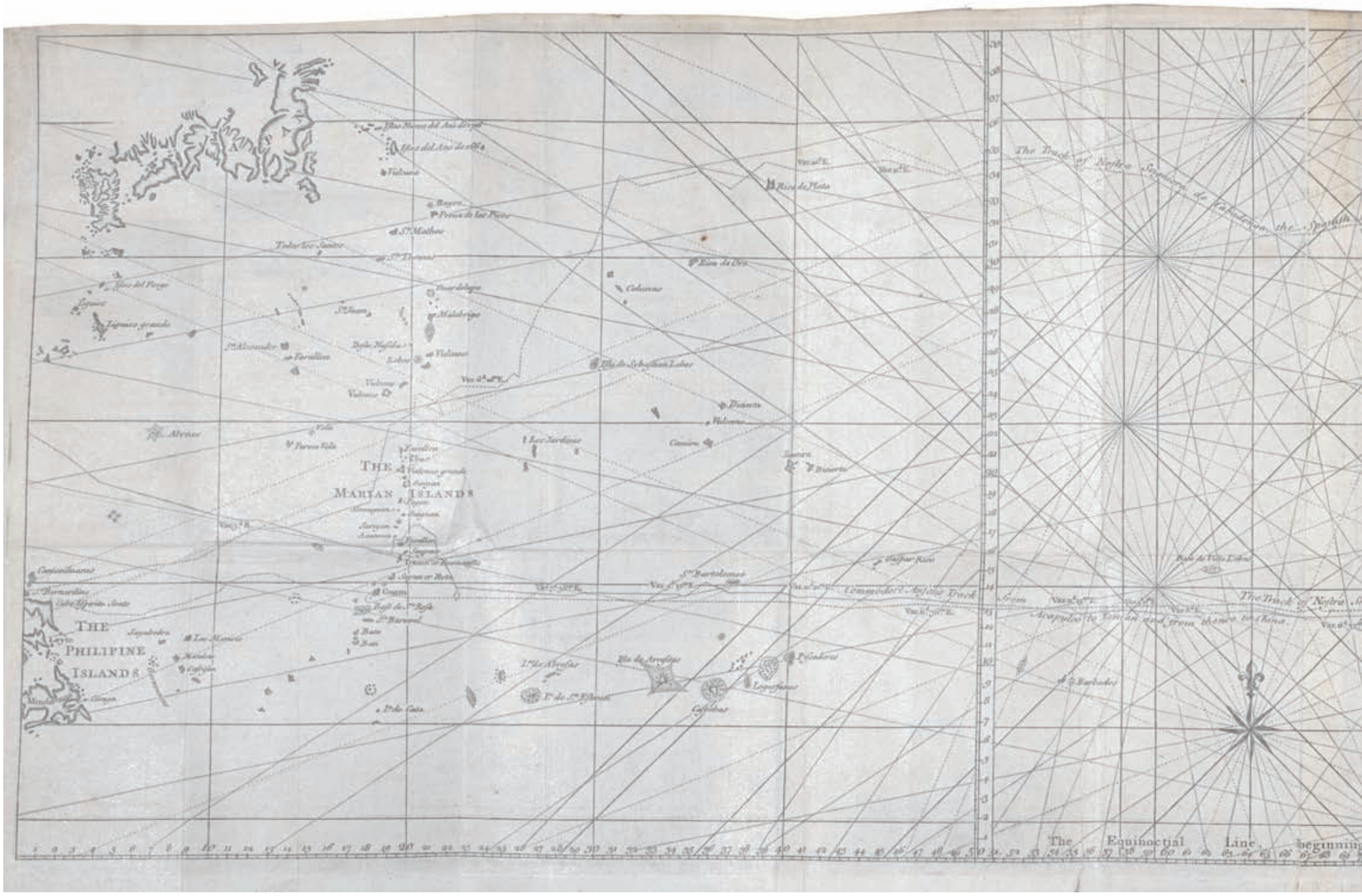
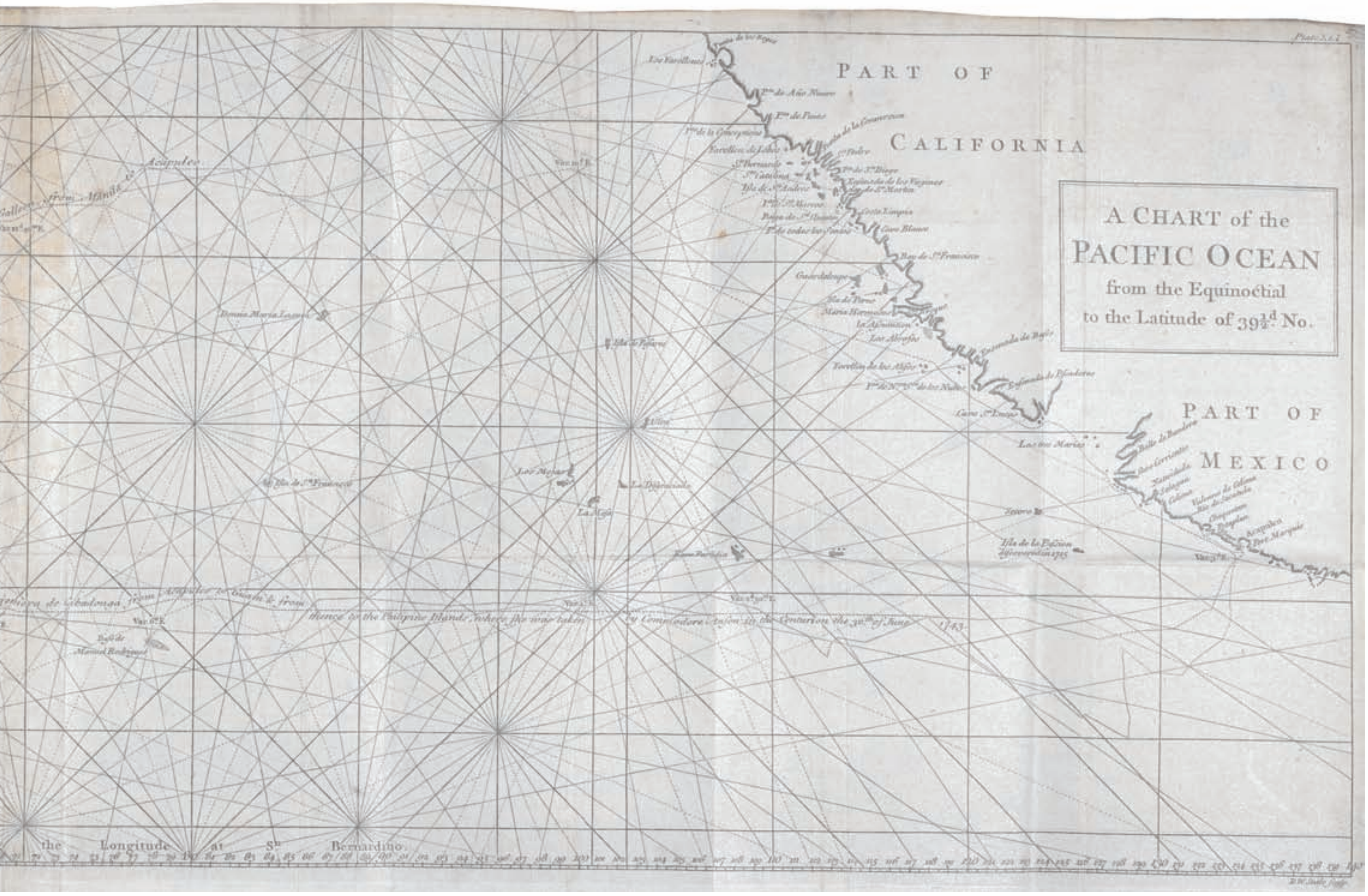


FIG. 618. *A CHART OF THE PACIFIC OCEAN FROM THE EQUINOCTIAL TO THE LATITUDE OF 39½D. NO.* From George Anson, *A Voyage Round the World, in the Years MDCCXL, I, II, III, IV* (London: John and Paul Knapton, 1748), pl. 41. A revised version of one of the Spanish charts seized by Anson's men. It shows for the first time the great circle route followed by the annual galleons on their eastbound voyage from Manila to Acapulco and the more southerly track, taking advantage of the trade winds, of the westbound return voyage.

naturalist and an astronomer; the inclusion of scientific supernumeraries would characterize most naval discovery expeditions from this time on for the French, British, and Spanish. Bougainville reached Tahiti in 1768 before sailing west through the Samoan group toward Espiritu Santo, discovered by Pedro Fernández de Quirós in 1606. This he found to be insular, not continental as the Spanish navigator had assumed. The French ships continued westward in search of the unknown east coast of New Holland before the outliers of the Great Barrier Reef forced them north (Bougainville 2002).

For all this flurry of activity, the central issues of Pacific geography were no nearer to a solution. The fabulous southern continent had simply receded a little farther south; New Holland was still the western part of a land of unknown extent; islands discovered and undiscovered remained to be properly identified and located. In the North Pacific, Vitus Bering, a Danish navigator in command of a Russian expedition sent by Csar Peter I to investigate the eastern fringes of his empire, made a tentative discovery in 1728 of a strait separating Asia and America. On a second expedition in 1741, Bering and the captain of a consort vessel, Aleksey Il'ich Chirikov, found a few pinpricks of land that they thought might be part of the American continent, but the reluctance of the Russian government to publish accounts and maps of Bering's explorations added to the air of mystery that surrounded the geography of much of the Pacific Ocean. Yet within a decade, the outlines of the Pacific took shape on maps in much the same form as they are found today. The man responsible for this leap in knowledge was James Cook.

Cook's first voyage (1768–71) was a joint venture by the Admiralty and the Royal Society, in which Cook was



to report on all aspects of new lands discovered and (in words that had become standard since Byron's voyage) was "to employ youself diligently in exploring as great an Extent of the Coast as you can; . . . surveying and making Charts, and taking Views of such Bays, Harbours and Parts of the Coast as may be useful to Navigation" (instructions to Cook in Cook 1955–74, 1:cclxxxii). On board Cook's ship were scientists and artists, including the botanist Joseph Banks, who carried with him an advance copy of Alexander Dalrymple's *An Account of the Discoveries Made in the South Pacifick Ocean Previous to 1764* (1769). Cook sailed first to Tahiti to carry out observations of the transit of Venus on behalf of the Royal Society. He then made the first detailed charts of the island, and then bore away south where he found no continental mass but instead mapped the coasts of New Zealand in a little over six months by means of a superb running survey (fig. 619). The French navigator Julien-Marie Crozet, who sailed under Marc-Joseph-Marion Dufresne off the New Zealand coast four years later, said of Cook's chart that it was "of an exactitude and of a thoroughness of detail which astonished me beyond all powers of expression" (David 1988–97, 1:xxxiv). On all three of Cook's voyages the surveying—from initial observations to the production of finished charts and views—was a collaborative business, with a half-dozen or more officers and supernumeraries working under their captain's supervision. From New Zealand, Cook turned northwest to the unexplored eastern shores of Australia that he coasted from just north of Tasmania to Cape York before sailing through Torres Strait to settle the issue of whether Australia and New Guinea were separated.

Cook's hydrographic surveys were carried out along largely unknown and often hazardous shores. With only


A CHART
OF
NEW ZELAND
OR THE ISLANDS OF
AEHEINOMOUWE AND TOVYPOENAMMU
LYING IN THE
SOUTH SEA
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CIRCUMNAVIGATED
BAY OF PLENTY

one ship, and without the loss of a single man from scurvy, he had put more than eight thousand kilometers of coastline on the map. The twin islands of New Zealand, the east coast of Australia, and Torres Strait had at last emerged from the mists of cartographic uncertainty. Three hundred twenty charts and coastal views survive, of which only a small number were published in the account of the voyage by John Hawkesworth in his three-volume compilation, *An Account of the Voyages Undertaken . . . for Making Discoveries in the Southern Hemisphere* (1773), which printed the journals of Byron and Wallis in the first volume and an amalgam of the journals of Cook and Banks in the second and third volumes. Hawkesworth's volumes had been preceded by Bougainville's account of his voyage, *Voyage autour du monde* (1771). Although it was elegantly written, and translated into English in 1772, it contained few nautical details or astronomical observations, and the twenty charts it included were "somewhat bare, reflecting the paucity of new information that Bougainville actually gained" (Robson 2004, 151).

Cook's second Pacific expedition (1772–75) was arguably the most comprehensive of all seaborne voyages of discovery. In his three years away, Cook disposed of the southern continent, reached closer to the South Pole than any man before him, and touched on a multitude of lands—New Zealand and Tahiti again, and for the first time Easter Island, the Marquesas, Tonga, New Caledonia, the New Hebrides, and South Georgia. Equipped for the first time with chronometers, he confirmed, located, and connected many of the uncertain discoveries of earlier explorers that had brought such confusion to maps of the Pacific, and in high latitudes he crossed and recrossed the Antarctic Circle in long methodical sweeps. Farther south, Cook wrote, lay the only southern continent, a land "doomed by nature to everlasting frigidness" (Cook 1955–74, 2:646). Cook's published account of 1777 contained many detailed surveys, while the frontispiece *A Chart of the Southern Hemisphere* showed the tracks of all the most important Spanish, Dutch, French, and British discovery voyages in the Pacific and was widely reproduced in pirated and foreign editions (fig. 620).

On his first two voyages, Cook had established the framework of the modern map of the South Pacific, and he was to add to this on his third voyage (1776–80) when he discovered the Hawaiian Islands and carried out a partial survey of the northwest coast of America in an unsuccessful search for the Pacific entrance of the Northwest Passage. Again, many hands were involved in both the original surveys and the preparation of charts for the authorized edition. Prominent among the helpers was William Bligh, master of Cook's ship the *Resolution*, who was awarded one-eighth of the profits of the posthumously published *A Voyage to the Pacific Ocean* (1784). This included a fourth volume folio atlas of the charts and the coastal views not included in the three volumes of text.

On his three voyages, Cook had established the salient features of the Pacific. Much remained to be done but mainly in the way of defining detail rather than in solving major geographical problems. There were further voyages of exploration to the Pacific before the end of the century, two of which were on a scale that signified their intention to rival Cook's voyages. The French expedition of Jean-Francois de Lapérouse (1785–88) included three hundred pages of guidance elaborating Louis XV's instructions to "have accurate charts drawn of all the coasts and islands he visits; and if they have already been explored he will check the accuracy of descriptions and charts provided by other navigators" (Dunmore 1994, cxliii). The voyage was marked by a series of misfortunes that overshadowed the careful charting in the North Pacific of the seas between Formosa, Japan, and Kamchatka. Off the Alaskan coast in 1786, two boats and twenty-one men disappeared in Lituya Bay, and the next year the second captain of the expedition and eleven men were attacked and killed in the Samoan Islands. After calling at the new British settlement at Botany Bay in early 1788, the ships vanished. For the French authorities the only consolation was that at each port of call, Lapérouse had sent back to France a journal and charts, and in 1797 a four-volume *Voyage de la Pérouse autour du monde* was published, which was translated into eight languages and helped to establish the Frenchman's status as one of Europe's foremost, if unluckiest, explorers of the Pacific. Bad luck also obscured the discoveries of the expedition of Joseph-Antoine-Raymond Bruny d'Entrecasteaux (1791–93), sent to search for the lost ships. The expedition's surveys were important, especially those of the south coast of Australia, but both d'Entrecasteaux and his successor died before the voyage's end, and in the years of wartime internment in the Dutch East Indies, the expedition disintegrated.

(*facing page*)
FIG. 619. JAMES COOK, "A CHART OF NEW ZELAND," 1769–70. Manuscript. In his journal entry of 31 March 1770, Cook pointed out that "this country, which before now was thought to be a part of the imaginary southern continent, co[n]sists of Two large Islands divided from each other by a strait or passage of 4 or 5 Leagues broad" (Cook 1955–74, 1:274). He added that after his survey (based on hundreds of observations made by the expedition's astronomer, Charles Green) "the situation of few parts of the world are better determined than these Islands."
Size of the original: 183 × 128 cm. © The British Library Board, London (Cartographic Items Add. MS. 7085.16).

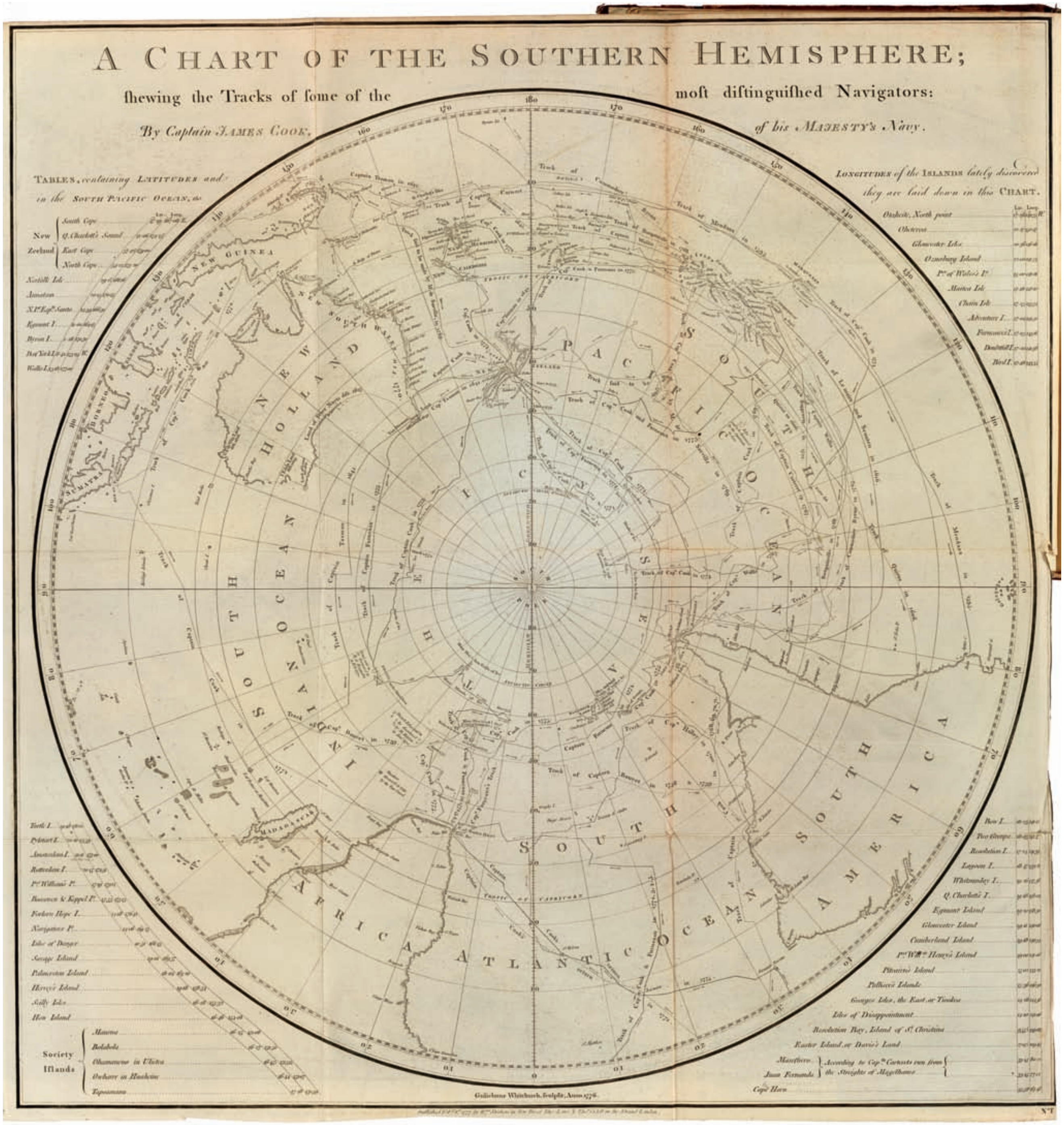


FIG. 620. *A CHART OF THE SOUTHERN HEMISPHERE; SHEWING THE TRACKS OF SOME OF THE MOST DISTINGUISHED NAVIGATORS*, BY JAMES COOK. From Cook's *A Voyage towards the South Pole, and Round the World*, 2 vols. (London: W. Strahan; and T. Cadell, 1777), pl. I. This magnificent polar projection chart shows the main Pacific voyages up to and including those of Cook and Tobias Furneaux on Cook's second voyage. It includes the tracks of Álvaro de Mendaña, Pedro Fernández de Quirós, François Le Maire, Jean-Baptiste Charles Bouvet de Lozier, and Louis-Antoine de Bougainville.

Size of the original: 56 × 54 cm. Image courtesy of the David Rumsey Map Collection, David Rumsey Map Center, Stanford Libraries.

FIG. 621. JUAN RAVENET, "EXPERIENCIA DE LA GRAVEDAD EN PUERTO EGMONT," 1794. This drawing by Ravenet, one of the artists on the Malaspina expedition, made at Port Egmont, West Falkland, in January 1794, shows the portable observatory set up on shore by the expedition's astronomers, while in the tent Malaspina (figure on the right) and others are carrying out gravity experiments with the aid of a pendulum.
Size of the original: 30.0 × 48.2 cm. Image courtesy of the Museo Naval de Madrid (MS 1726 [36]).

The Spanish expedition of Alejandro Malaspina was not intended to be a voyage of discovery in the traditional sense but a "Scientific and Political Voyage Around the World" (Malaspina 2001–4, 1:311–15), and it carried all the latest navigational and astronomical equipment (fig. 621). The expedition was away more than five years, during which time its hydrographers made meticulous surveys of the Pacific coasts of Spanish America, Alaska, and the Philippines before heading for the South Pacific, where it called at Botany Bay and the Tongan Islands. Because the expedition was on coasts controlled by Spain for much of the time, it followed a different cycle of activity from its British and French predecessors in the Pacific, at sea for only about 40 percent of its time away (compared with the 70 percent of Cook's second expedition). The ships arrived home safely, but soon after his return Malaspina was found guilty of political intrigue and imprisoned. His ambitious plans for a multivolume account of the expedition, including an atlas of seventy charts together with coastal views and harbor plans, were dropped, and he was long the forgotten man among Pacific explorers.

Many of Cook's men sailed to the Pacific again, notably Bligh and George Vancouver. Bligh's epic open-boat voyage (1789) after the mutiny on the *Bounty* says much for his hydrographer's visual memory, for he had no chart in the boat to guide him on his voyage of five thousand kilometers (Bligh 1792, 165–238; Kennedy 1989, 147–66). On a very different scale was Vancouver's painstaking survey (1792–94) of the northwest coast of America that filled in the detail Cook had been unable to supply during his dash north in 1778. Vancouver's charts were of such quality that they were used for a century after his voyage, and many of his place-names superseded those of his Spanish predecessors whose work suffered from the lack of official publication. At the end, in words that could have been written by Cook, Vancouver noted that he had carried out his survey "with a degree of minuteness far exceeding the letter of my commission or instructions" (Vancouver 1984, 4:1390).

GLYNDWR WILLIAMS

SEE ALSO: Bering Expeditions to Northeast Asia; Cook, James; Geographical Mapping; Imaginary Geographies and Apocryphal Voyages; Southern Continent

BIBLIOGRAPHY

Bligh, William. 1792. *A Voyage to the South Sea*. London: Printed for George Nicol.

Bougainville, Louis-Antoine de. 2002. *The Pacific Journal of Louis-Antoine de Bougainville, 1767–1768*. Trans. and ed. John Dunmore. London: Hakluyt Society.
Cook, James. 1955–74. *The Journals of Captain James Cook on His Voyages of Discovery*, 4 vols. in 5 plus atlas, ed. J. C. Beaglehole. Cambridge: For the Hakluyt Society at the University Press.
David, Andrew, ed. 1988–97. *The Charts & Coastal Views of Captain Cook's Voyages*. 3 vols. London: Hakluyt Society.
Dunmore, John. 1994. "Introduction." In *The Journal of Jean-François de Galaup de la Pérouse, 1785–1788*, trans. and ed. John Dunmore, vol. 1, xvii–ccxl. London: Hakluyt Society.
Finney, Ben. 1998. "Nautical Cartography and Traditional Navigation in Oceania." In *HC* 2.3:443–92.
Frost, O. W. 2003. *Bering: The Russian Discovery of America*. New Haven: Yale University Press.
Green, John. 1753. *Remarks, in Support of the New Chart of North and South America*. London: Printed for Thomas Jefferys.
Kennedy, Gavin. 1989. *Captain Bligh: The Man and His Mutinies*. London: Duckworth.
Malaspina, Alejandro. 2001–4, *The Malaspina Expedition, 1789–1794: Journal of the Voyage by Alejandro Malaspina*. 3 vols. Ed. Andrew David et al. London: Hakluyt Society, London, in association with the Museo Naval, Madrid.
Robson, John. 2004. "A Comparison of the Charts Produced during the Pacific Voyages of Louis-Antoine de Bougainville and James Cook." In *Captain Cook: Explorations and Reassessments*, ed. Glyndwr Williams, 137–60. Woodbridge: Boydell Press.
Salmond, Anne. 2009. *Aphrodite's Island: The European Discovery of Tahiti*. Berkeley: University of California Press.
Vancouver, George. 1984. *A Voyage of Discovery to the North Pacific Ocean and Roud the World, 1791–1795*. 4 vols. Ed. W. Kaye Lamb. London: Hakluyt Society.

Packe, Christopher. The claim to cartographic fame of Christopher Packe (1686–1749) lies in his creation of *A New Philosophico-Chorographical Chart of East-Kent*, which he published in Canterbury and London in 1743 (fig. 622). It is drawn at ca. 1.5 inches to a mile. Packe's *Chart* was the world's first reasonably accurate geomorphological map, employing a system of shading and the use of spot heights for elevation, the heights above sea level having been measured with a barometer (see fig. 350).

Some lengthy inscriptions on the *Chart* are descriptive of its subject; others refer to what Packe thinks are archaeological traces of Julius Caesar's invasion in 54 B.C. and two quote the Bible and Lucretius. The publication of this extraordinary image was accompanied a 110-page book in which Packe explained how he set about making the chart, what his aspirations were, and how some things that he could see would, he states, "for ever elude the Description of my Pencil or Pen" (Packe 1743, 100). Packe demonstrates how the *Chart* provides for a comprehensive topographical description of the region organized by its watersheds. Packe was a physician, and his classically influenced style employs the dialect of eighteenth-century medical practice, discussing "the *curvus Anfractus* . . . the common Sinuses or Ducts of the Vallies; . . . *Divarications* on each side of their Ducts into the greater and lesser Sections of their Ramifications" (Packe 1743, 100). Packe's use of language helps to release a whole series of questions and problems about the relation between land, seeing, and the body that have only been explored once (Charlesworth 1999). Previous commentators have concerned themselves with such things as the geomorphology and treated Packe in isolation (e.g., Campbell 1949). Yet it is possible to place Packe within a line of descent of geophysiology that leads to James Hutton and John Playfair.

Packe mapped East Kent because he lived in the city of Canterbury, but he regarded his map as a specimen of a new type of cartography that could be applied anywhere. He first wanted to print the map in color but could not prevent the colors from bleeding into each other, so he had to settle for shading: dark for the low-lying areas, paling to the white of the paper for the heights. The land is filled with delicate frond-like patterns of ramifying lines: these mark the streams and dry valleys of the area, as Packe was interested in the hydrological cycle, the circulation of the air, the pattern of valleys, and their possible connection with disease. Churches and landowners' houses are marked on the *Chart*, which pays attention to the social world but does not mark roads; a necessary omission but one criticized by some acquaintances of Packe.

Packe's instruments were barometers equipped with a sliding Nonius scale and microscope, which enabled him to read off by the hundredth of an inch, and a large azimuth compass fitted with "a theodolite" (i.e., a telescopic alidade) (Packe 1743, 9). This he carried up to a scaffolding platform he built on the tallest tower of Canterbury Cathedral and with it surveyed up to sixteen miles around the city. He exulted in this circle of sight, which is inscribed on the *Chart* as a series of concentric circles. Some of the places hidden by high ground were visited and mapped by conventional survey methods together with some reference to the maps of Kent by Philip Symonson (1596) and John Seller (1675) (Campbell 1949, 80). Packe's work, however, was unprecedented: nobody before him had tried for such a comprehensive accurate grasp of the land's rises and hollows.

For at least seven years before publishing the *Chart*, Packe had been in contact with members of the Royal Society. He had given a paper at the Society in 1736, outlining some of his ideas, and he sent them a specimen of the map printed in brown. From 1736 to 1741 he corresponded with the society president, Sir Hans Sloane. Packe contributed to the discourse of the hydrologic cycle in 1737. His 1737 essay is associated by Yi-Fu Tuan with another drawing by Packe showing the Kentish River Stour fitted into the body of a giant (the mouth of the river is a literal mouth here) (Tuan 1968, 29–30, fig. 3). This emblematic giant Stour may have been an aide-mémoire for the physiological understand-

FIG. 622. CHRISTOPHER PACKE, *A NEW PHILOSOPHICO-CHOROGRAPHICAL CHART OF EAST-KENT*, 1743. Engraved by J. Mynde, Canterbury, in four sheets. For a detail, see fig. 350. Size of each sheet: 60 × 65 cm. Image courtesy of the National Library of Scotland, Edinburgh (EME.s. 130).

ing Packe pioneered and an immediate explanatory device for his listeners, but it can hardly be counted as a scientific image. It was superseded by the much more advanced work achieved in the *Chart*.

MICHAEL CHARLESWORTH

SEE ALSO: Height Measurement: Altimetry; Topographical Surveying: Great Britain

BIBLIOGRAPHY

Campbell, Eila M. J. 1949. "An English Philosophico-Chorographical Chart." *Imago Mundi* 6:79–84.

Charlesworth, Michael. 1999. "Mapping, the Body and Desire: Christopher Packe's Chorography of Kent." In *Mappings*, ed. Denis E. Cosgrove, 109–24. London: Reaktion Books.

Packe, Christopher. 1736–41. Letters to Sir Hans Sloane. British Library, Sloane MSS. 4055 ff. 96, 169; 4057 ff. 1, 103; 4076 f. 220; 4078 f. 235.

———. 1737. *A Dissertation upon the Surface of the Earth, as Delineated in a Specimen of a Philosophico-Chorographical Chart of East-Kent*. London: Printed for J. Roberts.

———. 1743. *Αγκογραφια, sive Convallium Descriptio . . . (as an Explanation of a New Philosophico-Chorographical Chart) of East-Kent*. Canterbury: Printed and sold by J. Abree.

Tuan, Yi-Fu. 1968. *The Hydrologic Cycle and the Wisdom of God: A Theme in Geoteleology*. Toronto: University of Toronto Press.

Pallas, Peter Simon. A German zoologist, botanist, and geographer who spent most of his professional career in Russia, Peter Simon Pallas was born in Berlin in 1741, the son of a surgery professor. He studied at the University of Halle, the University of Göttingen, and the University of Leiden, where he earned a doctor's medical degree at the age of nineteen. After receiving a medical and surgical education in the Netherlands and London, he settled in The Hague, where he created his new system of animal classification. His *Miscellanea zoologica* (1766) included the descriptions of several new vertebrates he had discovered in Dutch museum collections.

His findings drew wide acclaim, and he was quickly elected to the Akademiya nauk, where he became a professor in 1767 at the invitation of Catherine II. Between 1768 and 1774, he led an academy expedition to Siberia, collecting natural history specimens on the upper Amur, around the Caspian Sea, and in the Ural and Altai mountains as far east as Lake Baikal. In 1793–94 and 1796, he led expeditions to southern Russia, where he explored Crimea and the Black Sea.

Pallas's lesser known but outstanding achievement in cartography is his article "Erläuterungen über die im östlichen Ocean" (1781), published in his major geographical work (1781–96). In the "Erläuterungen," he argued for an ancient linkage between Asia and America that had ceased to exist. Although the work was published after Captain James Cook's third voyage, Pallas intentionally left its contents (dated 1772) unchanged with regard to explorations in the north Pacific in order to stress the significance of the progress made by the Russians in the exploration of that region long before the voyages of the English mariner.

In his "Erläuterungen," Pallas hypothesized that mountain spurs at Kamchatka formed a natural arc with the Aleutian Islands via the islands of Bering and Medny. In a series of ingenious arguments, Pallas rejected the claims of Georges-Louis Leclerc, comte de Buffon, Philippe Buache, and others that Asia and America were physically connected (Pallas 1781). The thick distribution of volcanoes along the chain, he suggested, provided evidence for a geological cataclysm in the region. Pallas drew further on the findings of Vitus Bering and the Siberian Cossacks, especially Semën Ivanovich Dezhnëv's 1648 voyage, to argue that Asia and America were two separate continents. Finally, geographical observation—the absence of trees, the presence of ocean currents, severe temperatures, strong north winds, and even walruses—provided evidence against a contemporary land bridge to the east. Based on these conclusions, Pallas confidently proposed that a strait existed between Asia and America, and that it should be named for Bering (Postnikov and Falk 2015, 112–14).

Pallas compiled a map of the northern Pacific (fig. 623), which was attached to his "Erläuterungen" and published in several separate editions in German and Russian be-

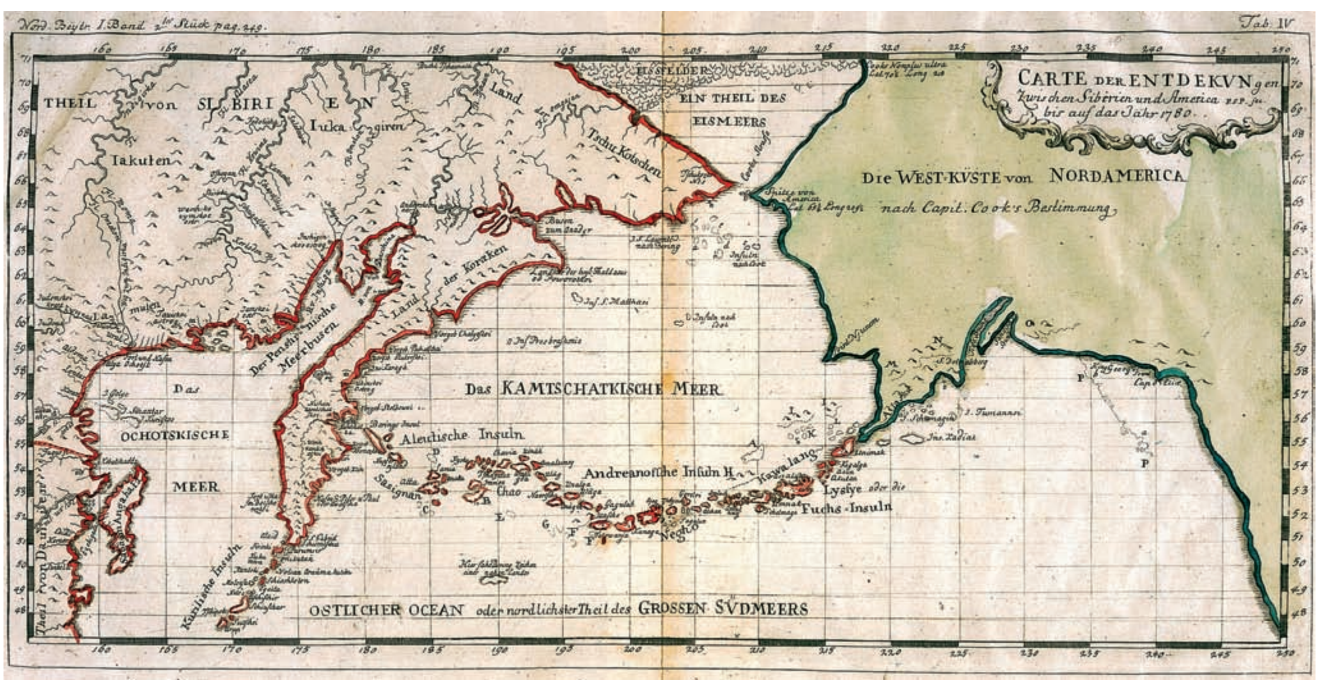


FIG. 623. PETER SIMON PALLAS, *CARTE DER ENTDEKVNGEN ZWISCHEN SIBIRIEN UND AMERICA BIS AUF DAS JAHR 1780*. From Pallas 1781–96, vol. 1 (1781), 249, Tab. 4.

Size of the original: 18 × 40 cm. Image courtesy of the Universität Bern, Zentralbibliothek, Sammlung Ryhiner (Ryh 1302:48).

tween 1781 and 1796, citing his sources and explaining their use. He located Alaska and the Aleutian Islands far more accurately than on previous charts and was perhaps the first to represent the Alaskan peninsula as part of the American mainland, thus confirming the considerable achievements of the Russian-led exploring expeditions of the late seventeenth and early eighteenth centuries.

In 1810 Pallas retired. He returned to Berlin, where he died in 1811.

ALEXEY V. POSTNIKOV

SEE ALSO: Bering Expeditions to Northeast Asia; Geographical Mapping: Russia

BIBLIOGRAPHY

Masterson, James R., and Helen Brower. 1948. *Bering's Successors, 1745–1780: Contributions of Peter Simon Pallas to the History of Russian Exploration toward Alaska*. Seattle: University of Washington Press.

Pallas, Peter Simon. 1781–96. "Erläuterungen über die im östlichen Ocean zwischen Sibirien und America geschehenen Entdeckungen." In *Neue nordische Beyträge zur physikalischen und geographischen Erd- und Völkerbeschreibung, Naturgeschichte und Oekonomie*, by Peter Simon Pallas, 7 vols., 1:273–313. St. Petersburg: Johann Zacharias Logan.

Postnikov, Alexey V., and Marvin Falk. 2015. *Exploring and Mapping Alaska: The Russian America Era, 1741–1867*. Trans. Lydia Black. Fairbanks: University of Alaska Press.

Pardies, Ignace-Gaston. The short life of Ignace-Gaston Pardies struck a balance between clerical and scientific interests. Born in Pau, France, on 5 September 1636, he was educated in a Jesuit secondary school and officially entered the Society of Jesus as a novice in 1652. In 1654, he entered the university at Toulouse, where he studied mathematics and natural philosophy. After graduating in 1656, he taught in Bordeaux before taking leave in 1660 to study theology. Ordained as a priest in 1663 and admitted to the Jesuit order in 1665, Pardies continued his ministry while recommencing his academic career at various schools in France from 1666 until his death in Paris on 21 April 1673. His early demise resulted from a fatal illness contracted while ministering at Bicêtre hospital during Easter season of 1673.

Pardies wrote on a variety of subjects including astronomy, physics, and mathematics and corresponded with many scholars such as Athanasius Kircher, Christiaan Huygens, and Isaac Newton. His *Globi coelestis*, published posthumously in 1674, appears to be the first work to depict the heavens in six sheets based on a gnomonic (or cube-shaped) projection (see fig. 157). Several republications of the atlas featured updates including revised star positions and the paths of the comets of 1680–82. This gnomonic format proved influential to such disparate cartographers as Johann Gabriel Doppelmayr and Johann Baptist Homann and to the Society for the Diffusion of Useful Knowledge. Many Jesuit astronomers utilized Pardies's maps for star-finding and other astronomical research, including Philippe-Marie Grimaldi, who used them to map Chinese constellations.

ANNA FELICITY FRIEDMAN

SEE ALSO: Celestial Mapping: Enlightenment; Society of Jesus (Rome)

BIBLIOGRAPHY

Costabel, Pierre. 1974. "Pardies, Ignace Gaston." In *Dictionary of Scientific Biography*, ed. Charles Coulston Gillispie, 10:314–15. New York: Charles Scribner's Sons.

Warner, Deborah Jean. 1979. *The Sky Explored: Celestial Cartography 1500–1800*. New York: Alan R. Liss.

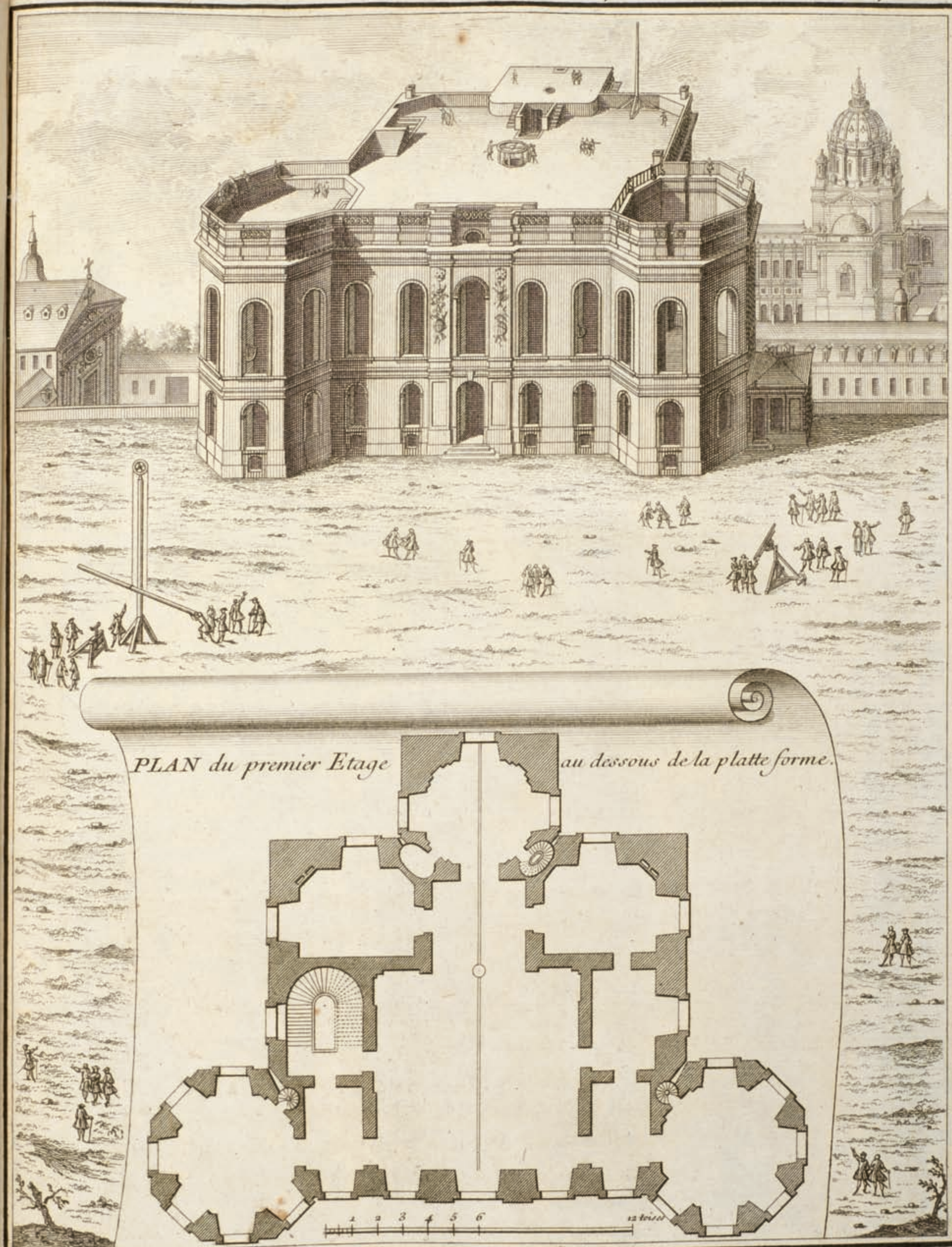
Ziggelaar, August. 1971. *Le physicien Ignace Gaston Pardies S.J. (1636–1673)*. Odense: Odense University Press.

Paris Observatory (France). The creation of the Paris Observatory—Observatoire—was closely linked to the foundation of the Académie des sciences in Paris in 1666. The Académie's core group of members included two astronomers: the abbé Jean Picard and Adrien Auzout, whose *L'ephemeride dv comete* (1665) had sought the creation of the Académie des sciences. In his dedicatory epistle to Louis XIV, Auzout insisted that there "was not a realm in Europe whose geographic maps were so inaccurate or where the position of locations was so uncertain." He asked the king to establish "some place where all types of celestial observations might be made in the future" (Wolf 1902, 3). With the support of his minister Jean-Baptiste Colbert, the king acceded to the request.

After the establishment of the Académie, the king entrusted its members to choose a site for the royal observatory. They rejected Montmartre because Paris chimney smoke was "a constant obstacle to all sorts of observation" (quoted in appendix 1 of Perrault 1993, 242). Instead, in March 1667 they purchased land south of the city on the Montagne Sainte Geneviève. From competing architectural proposals, Colbert selected that of Claude Perrault, who had just built the colonnade of the Louvre.

At the summer solstice (21 June) of 1667, five scientists carefully determined the exact position of the building. Its austerely classical plan was highly symbolic: not only did its north-south axis align with the new reference meridian for the future triangulation of France, but Perrault's observatory was avowedly "built in such a manner as to supply on its own all the principal instruments of astronomy used for observations" (quoted in appendix 1 of Perrault 1993, 243). The austere north façade incorporated three upper floors and, originally, an octagonal tower. On the south side, the building rested against a hillock and thus appeared to have just two stories (fig. 624). The building was flanked symmetrically on east and west by two octagonal towers, the faces of which were intended to align with the direction of sunrise and sunset, especially at the summer and winter solstices and equinoxes. Thus, the architecture celebrated the motto of Louis XIV—*nec pluribus impar*—and his emblem, the sun.

L'OBSERVATOIRE ROYAL COMMENCÉ EN 1667. ET ACHEVÉ EN 1672.



Dheulland Sculp

Martin Dumont Delineavit 1740.

In order to facilitate observations in different azimuths and at the zenith, the eastern tower initially had no windows and was not roofed. The south façade was decorated on the upper story with two bas-reliefs by Francesco Temporiti, symmetrically framing the central window overlooking what is today called as the *terrasse sud*. The western bas-relief shows a celestial globe and a clock with pendulum and weights as well as other astronomical instruments of precision. The eastern relief contains a terrestrial globe and a surveyor's chain grouped with other instruments for mapmaking. These representations closely linked astrometry and geodesy, the indispensable partners for preparing rigorous and precise maps.

When the Italian astronomer Jean-Dominique Cassini (I) arrived at the French court in 1669, the observatory had only its foundation. Barely presented to the king, Cassini I began criticizing Perrault's plan, in particular the absence of any room that allowed observation of the sky from all sides. Thanks to him, the north tower was made square; on the floor of level 2 he planned a huge (ca. 16 × 16 m) sundial, requiring Perrault to raise the ceiling and pivot the staircase 90 degrees (Cassini I abandoned the idea of the sundial, but eventually a 32-m *méridienne* was completed by Jacques Cassini [II]; see the plan at the bottom of fig. 624). Despite these alterations, the main construction was completed in 1672, although the interior was not finished until ten years later. Nonetheless, Cassini I lived in the observatory from September 1671.

For Colbert, the Paris Observatory was meant to be a forum for multidisciplinary academic research, but, in fact, it served only astronomers. Led by Picard, astronomers carried out the first measurements to determine the length of a degree of latitude along the meridian of the observatory. Philippe de La Hire and Picard fixed the longitude of the west coasts of France in relation to this meridian and designed the first map of France established astronomically on the meridian (see fig. 625).

Astronomers from the Paris Observatory supervised geodetic and cartographic work throughout the eighteenth century. The Cassini family, supported by their Maraldi cousins, directed the institution until 1793. Cassini I continued Picard's triangulation of the Paris meridian south to Canigou in 1683 and 1700–1701. The first complete drawing of the Paris meridian, north to south across the kingdom, was completed by Cassini II in 1718. César-François Cassini (III) de Thury and Nicolas-Louis de La Caille carried out new triangulation to verify the meridian in 1739–40. Cassini III supervised the geodetic determination of the perpendicular to the meridian of Paris, running from Alsace to Brittany, which provided the latitudinal reference point for the future *Carte de France*, completed by Jean-Dominique Cassini (IV), who also oversaw the geodetic connection of the Paris and Greenwich meridians in 1787. The Paris meridian was chosen by the revolutionary government (Assemblée Constituante) for determining the length of the meter, foundation of the decimal metric system, definitively adopted in 1799. Jean-Baptiste-Joseph Delambre and Pierre-François-André Méchain, observatory astronomers as well as members of the Académie des sciences and of the Bureau des longitudes, accomplished the survey for the meter along the meridian between Dunkirk and Barcelona.

SUZANNE DÉBARBAT

SEE ALSO: Academies of Science: Académie des sciences (Academy of Sciences; France); Cassini Family; Celestial Mapping: France; Geodetic Surveying: France; Instruments, Astronomical; Picard, Jean

BIBLIOGRAPHY

Cassini (IV), Jean-Dominique. 1810. *Mémoires pour servir à l'histoire des sciences et à celle de l'Observatoire royal de Paris*. Paris: Bleuet.

Perrault, Charles. 1993. *Mémoires de ma vie*. Introductory essay by Antoine Picon. Reedition of 1909, ed. Paul Bonnefon. Paris: Macula.

Petzet, Michael. 2000. *Claude Perrault und die Architektur des Sonnenkönigs: Der Louvre König Ludwigs XIV. und das Werk Claude Perraults*, esp. 355–97. Munich: Deutscher Kunstverlag.

Picon, Antoine. 1988. *Claude Perrault, 1613–1688, ou La curiosité d'un classique*. Paris: Picard.

Wolf, Charles. 1902. *Histoire de l'Observatoire de Paris de sa fondation à 1793*. Paris: Gauthier-Villars.

Peru Expedition. See Lapland and Peru, Expeditions to

Picard, Jean. Born in La Flèche in July 1620, Jean Picard was possibly the son of a bookseller who operated near the city's Jesuit college, where the future

(*facing page*)

FIG. 624. SOUTHERN FAÇADE OF THE PARIS OBSERVATORY. The image shows the two levels (the north façade has three levels), and all the window panes (windows that can be closed) had been installed except for those of the upper story of the east tower (on the right), which is not roofed, as is clearly visible. This gave easy access for the instruments, such as the portable quadrants, to make observations in the zenith; the tower was not roofed until much later, receiving its cupola in the nineteenth century. At the top of the east tower is a slit in the south balustrade and another slit, less visible and longer, in the north balustrade. Cassini would place his long-focus objective lens in the south slit and, eyepiece in hand, sit or stand on the floor of this room to observe, or, for longer focus, he would observe (with the objective lens still placed in the south slit) through the north slit from the north court of the observatory. From Pierre-Charles Le Monnier, *Histoire céleste, ou Recueil de toutes les observations astronomiques faites par ordre du roy* (Paris: Briasson, 1741), after xcii; designed by Martin Dumont and engraved by Guillaume Dheulland.

Size of the original: ca. 23 × 17 cm. Courtesy of the Adler Planetarium & Astronomy Museum, Chicago.

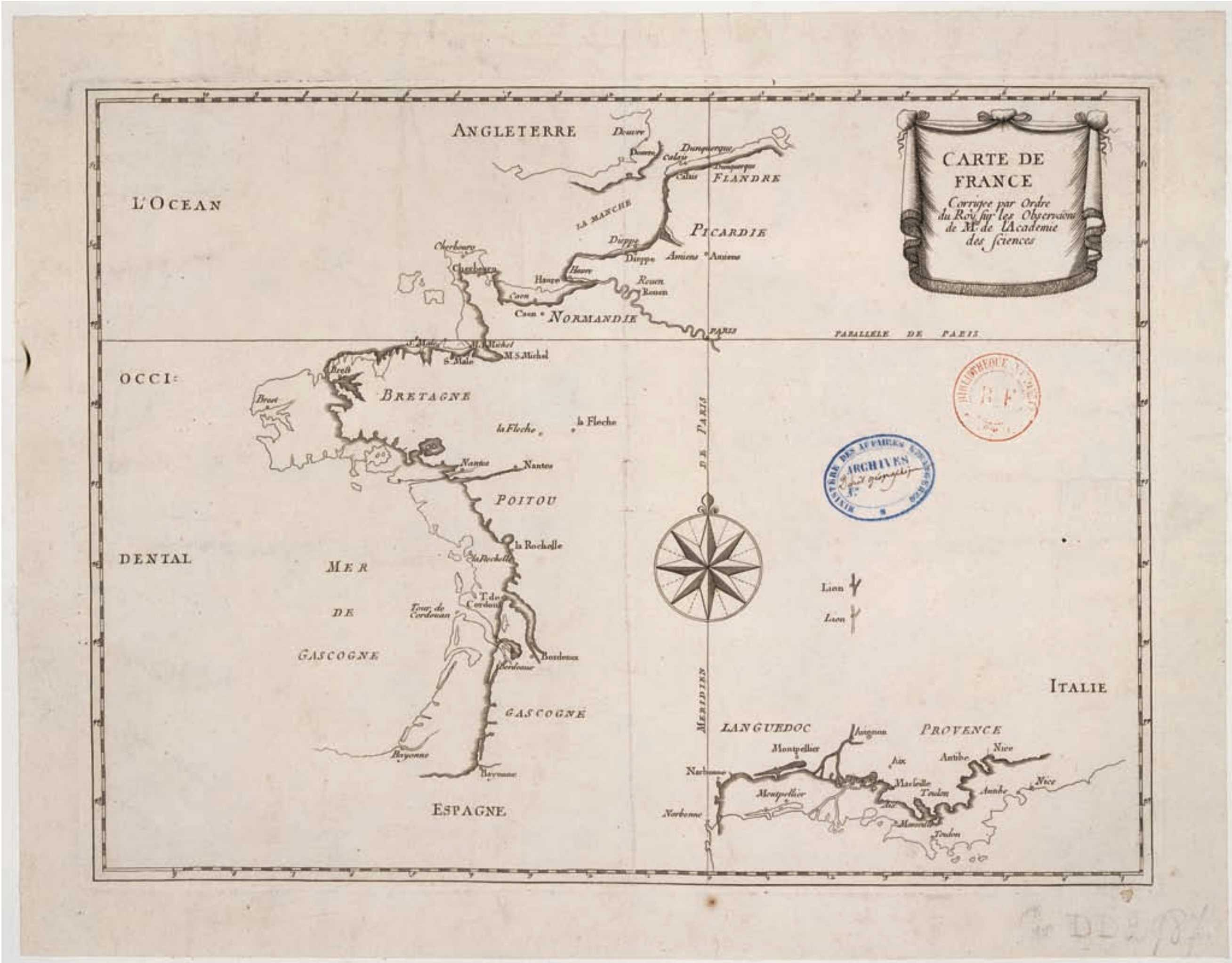


FIG. 625. JEAN PICARD AND PHILIPPE DE LA HIRE, *CARTE DE FRANCE CORRIGEE PAR ORDRE DU ROY SUR LES OBSERVATIONS DE MRS. DE L'ACADEMIE DES SCIENCES* (PARIS, 1693). The map, originally prepared in 1684, clearly shows the outline of France from the 1679 map of Guillaume Sanson (thin lines) and the corrected outline (heavy, shaded lines) based on Picard and La Hire's determinations of longitude by observations of Jupiter's satellites.
Size of the original: 26.5 × 36.0 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [777]).

scholar certainly pursued his studies. Before entering the Académie des sciences around 1666 or 1667, probably with the support of Adrien Auzout, Picard had already made a number of astronomical observations in Paris. From 1645 to 1647, he assisted Pierre Gassendi, then continued alone from 1661. He became a Master of Arts and a priest in 1650. The income from ecclesiastical beneficences allowed him to pursue astronomical research. He traveled in the provinces and abroad, spending time in Uraniborg—then in ruins—in 1671–72 to establish the difference in longitude between the observatory of Tycho Brahe and the Paris Observatory. He died in Paris on 12 October 1682.

In addition to numerous astronomical observations, Picard is known for his geodetic work, published for the first time in 1671 as *Mesure de la Terre*, bound with *Mémoires pour servir à l'histoire naturelle des animaux* by Claude Perrault. The two works, examples of the activities of the Académie des sciences, constitute a superb folio volume designed more for royal propaganda than for the dissemination of knowledge. In 1668–70, Picard measured a degree of the Paris meridian between Malvoisine, south of Paris, and Sourdon, south of Amiens, using a series of triangles (see fig. 257). He was able thereby to establish that the degree of the meridian was equal to 57,060 toises (111.090 km) at this latitude. This first modern measurement of an arc of meridian had a dual purpose: geodetic and geographical. From 1668

Picard supervised the surveying of the *Carte particuliere des environs de Paris* by David Vivier at the request of the Académie des sciences. With other members of the Académie, he checked the measurements of the angles and found them satisfactory despite the small size of the circle used. The map was published in 1678 at a scale of one ligne to one hundred toises (1:86,400) and reedited from 1684 to 1706 by François Vivier, the son of David (see fig. 4). It served as a model for the *Carte générale et particulière de la France*, known as the Cassini map or the *Carte de France*, created in the second half of the eighteenth century (Gallois 1909, 197–204).

Picard was directly involved in creating the *Carte de France corrigee*, presented to the Académie des sciences in 1684 before its publication in 1693 (fig. 625). With Philippe de La Hire, he traveled around France to measure latitudes and longitudes (Konvitz 1987, 5–6). The new outline of France that resulted was contrasted with the coastline from *Le royaume de France distingué suivant l'estendüe de toutes ses provinces et ses acquisitions*, which Guillaume Sanson had presented to the Dauphin in 1679. In his eulogy of La Hire, Bernard Le Bouyer de Fontenelle says of these two *académiciens*: "They made a very important correction to the Gascony coast by straightening out the curve it had been before and bending it backwards into the land, in such a way that the king was prone to say, jokingly, that their travels had caused him nothing but loss. It was a loss that enriched geography and ensured navigation" (1994, 430). Picard's most innovative project was contained in his memoir on the "carte du Royaume," presented to the Académie des sciences on 8 February 1681. Picard did not believe in rapid production of maps of provinces. He proposed establishing a "general framework" of chains of triangles that would be based on the Dunkerque-Perpignan traverse, corresponding with the Paris meridian and covering eight degrees of latitude, and would follow the territorial borders and the coasts. The goal was still twofold, geodetic and cartographic (Gallois 1909, 292–93). The Cassinis and their colleagues carried it through to the complete measurement of the meridian of the Paris Observatory in 1718 and the triangulation of France in 1744.

MONIQUE PELLETIER

SEE ALSO: Academies of Science: Académie des sciences (Academy of Sciences; France); Geodetic Surveying: (1) Enlightenment, (2) France; Longitude and Latitude; Paris Observatory (France)

BIBLIOGRAPHY

Fontenelle, Bernard Le Bouyer de. 1994. *Œuvres complète*. Ed. Alain Niderst. Vol. 6, *Histoire de l'Académie des sciences*. Paris: Fayard.

Gallois, Lucien. 1909. "L'Académie des sciences et les origines de la carte de Cassini." *Annales de Géographie* 18:194–204, 289–310.

Konvitz, Josef W. 1987. *Cartography in France, 1660–1848: Science, Engineering, and Statecraft*. Chicago: University of Chicago Press.

Picolet, Guy, ed. 1987. *Jean Picard et les débuts de l'astronomie de précision au XVII^e siècle*. Paris: Éditions du Centre National de la Recherche Scientifique.

Pilot Book. "Pilot book" is just one of many words and phrases that described the texts containing nautical instructions or sailing directions throughout the seventeenth and eighteenth centuries in Europe. Accompanying and completing marine charts, these texts compiled all the practical knowledge that the best nautical pilots were thought to possess and drew upon ships' logs as their most essential source. These logs had become standardized, and in France and elsewhere during the eighteenth century, numerous regulations obliged the officers in both the state and merchant marines to submit them for examination (Chapuis 1999, 183). For any given region, the size and scale of charting and informational coverage was dependent on how frequently it was visited by sailors. Nautical instructions described the ocean routes, the climatic data (especially dominant winds) and oceanographic data (currents and tides), the landfalls, coastlines, approaches and dangers, safe channels, the quality of the sea bottom (used both for the positioning of the ship as well as for anchoring), and the shelters, anchorages, and ports (Chapuis 1999, 638–39). In the eighteenth century, in the Dutch tradition of the *Spieghel der zeevaerdt* (1584–85), the texts continued to be illustrated with maps and plans, sometimes in great number, and accompanied by coastal views, as many of the practitioners at coastal sailing continued to prefer the coast profile to the zenithal view of a map (Restif 2005, 134; Chapuis 1999, 145, 150; 2007, 39–45).

In fact, although texts of nautical instructions existed from antiquity, such as the *periplus* in the Mediterranean, the structured writing down of information conveyed by an oral culture of marine practices only developed slowly in the face of local terminology and customs. By the end of the eighteenth century, efforts to reedit the instructions into the simplest language possible began in order to make them accessible to the greatest number of people. Such texts unlocked information about the coasts (in the same way that cartography did) since navigators who came from elsewhere could more easily dispense with the local human pilot thanks to the written pilot, now printed and no longer just in manuscript. In France, especially, multiple private copies or official examples from the Compagnie des Indes and the Marine, copied from the Dutch, circulated freely (Restif 2005, 136–37; Chapuis 1999, 146–50, 153-53, 637–39, 670–76).

Consequently, beginning in the seventeenth century, the word "pilot" designated, in various languages, both the person in charge of navigation and the book containing the necessary information to navigate. In French and

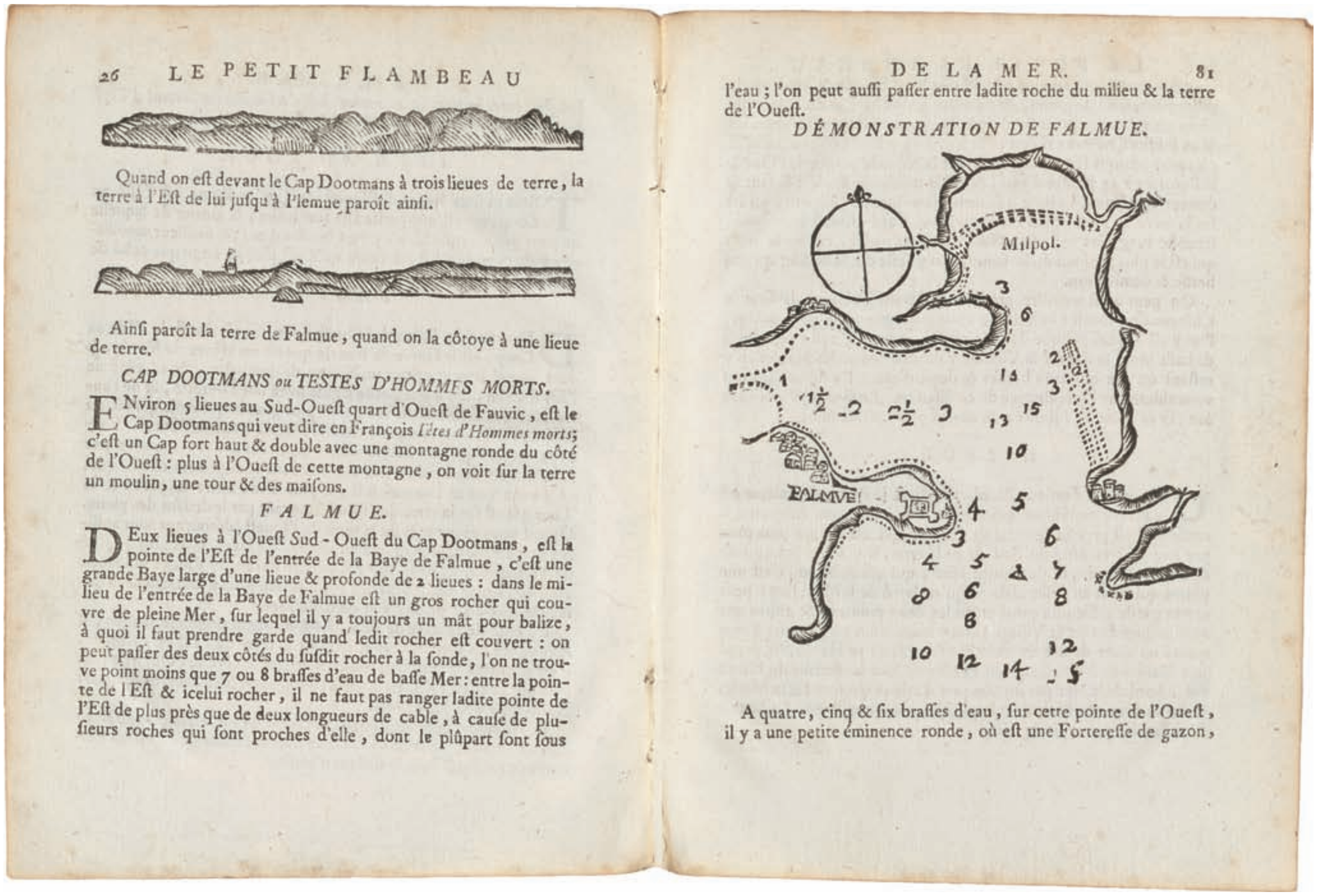
English, an adjective often qualified the type of work. Thus, the expression "coastal pilot" was applied both to the man charged with piloting ships in their approach to a coast and to the nautical instructions pertaining to the same coasts. In most of the European languages, the term *routier* or something similar was frequently used as a synonym for "pilot" in the sense of the written work. In practice, from the middle of the seventeenth century until the end of the eighteenth, the words *portolano* (Italian), *roteiro* (Portuguese), *derrotero* (Spanish), *zeeboek* (Dutch), *pilot book* or *rutter* (English), *pilote* or *routier* (French), and *Seebuch* (German) all had substantially the same meaning. This did not stop specific styles and contents from being linked to European cultural contexts (Jonkers 2007, 457), particularly those related to the two great modes of navigation, Eastern (Mediterranean) or Western (oceanic), essentially dependent on the absence or presence of a tide and its currents. In French, even if the word *pilot* increasingly came to replace *portulan* (as a text and not a map), the latter continued to be used until the mid-nineteenth century. Meanwhile, from the beginning of the nineteenth century, the word *routier* designated a small-scale map, at least in French (thus the *routier oceanique*). Finally, in French and in English, the phrase "nautical instructions" or "sailing directions" (*instructions nautiques* in French) would gain ground progressively from the end of the eighteenth century and especially in the nineteenth century.

This concentration of information, often in a single volume in a practical, usable format, explained the success of certain titles, such as the *Arte pratica de navegar* by the Portuguese Luís Serrão Pimentel (many editions from 1673 to 1762); *The English Pilot* of John Seller (1671 to 1803); *Great Britain's Coasting-Pilot* by Greenvile Collins (1693, with at least fourteen editions until 1792), the first edition of which was really a neptune, with a preponderance of maps (forty-nine) in relation to text (twenty-six pages); or *Le Petit flambeau de la mer* of René Bougard (fourteen editions from 1684 to 1817, in both French and English) (Restif 2005, 134; Chapuis 1999, 111–12, 153, 835, 836, 839). In spite of the criticism of the Académie de marine, which preferred the use of maps from *Le Neptune françois*, *Le Petit flambeau* was particularly prized for its coastal views. Bougard's work featured the familiar silhouettes of the coast memorized by sailors as an aide-mémoire for determining the ship's position (fig. 626) The book was used as a manual in the schools of hydrography (Restif 2005, 136; Chapuis 1999, 150–52).

In France, in addition to the prolific production of Jacques-Nicolas Bellin, who worked as much on descriptive geography as sailing directions and whose publications straddled the line between the official and the commercial, *Le Neptune oriental* (1745) by Jean-Baptiste-Nicolas-Denis d'Après de Mannevillette was remarkable for the quality of its text (published separately in 1745 and translated into English in 1758), which, along with his *Mémoire sur la navigation de France aux Indes* (1765), prefigured the shape of sailing directions in the following century (Restif 2005, 137–38; Chapuis 1999, 166–67, 249–50). The texts of the second edition of *Le Neptune oriental* (1775) were used elsewhere as the official French sailing directions in the Indian Ocean until 1847 (Restif 2005, 140–41). However, French fishermen plying the waters of Newfoundland had to wait for the sailing instructions gathered by ship's captain Guillaume-Jacques Liberge de Granchain, who adapted instructions in 1784 from the *Sailing Directions for the North-American Pilot* (1775), a commercial production though tacitly authorized. Published as *Instructions nautiques relatives aux cartes & plans du Pilote de Terre-Neuve*, these were the first anonymous sailing directions published collectively by the Dépôt des cartes et plans de la Marine (Chapuis 1999, 189, 838). In 1784, Antoine-Hyacinthe-Anne de Chastenet de Puységur surveyed the environs of Saint-Domingue, and his sailing directions (1787) were widely circulated by the Dépôt until 1821, their quality much superior to that of the maps he prepared from his survey (Chapuis 1999, 196, 228–29, 838). In Great Britain, the general mode of transmitting official survey material was through the channel of commercial publication, with either the tacit approval or the genuine encouragement of government authorities financially unable (or unwilling) to undertake the costs of publishing. In France, the state did intend to control the editing of sailing directions as it did nautical charts.

This variety of publications established a foundation for the process of standardization that began in the nineteenth century—in Great Britain at the Admiralty Hydrographical Office as well as through the work of Alexander Dalrymple, first hydrographer (1795), who published many pilot books for the East India Company, and in France with the Dépôt des cartes et plans de la Marine. The most accomplished reference work of the period was the *Description nautique de la côte de France sur la mer du Nord, de Calais à Ostende* published by Charles-François Beautemps-Beaupré (1804) (Chapuis 1999, 601, 836–37). Beautemps-Beaupré's volume surpassed all previous works, including the completely new *Mémoire pour servir d'instruction à la navigation des côtes depuis Dunkerque jusqu'à Port-Malo* (1802), prepared by Louis-Bon-Jean de la Couldre de La Bretonnière for the Nouveau neptune françois project (Chapuis 1999, 257–62, 601, 638, 836–37).

Translations were clearly indispensable for these texts, as opposed to maps that could be used more easily in their original edition. The numerous translations of Murdoch Mackenzie the Elder's sailing directions by



26 LE PETIT FLAMBEAU

Quand on eſt devant le Cap Dootmans à trois lieues de terre, la terre à l'Eſt de lui juſqu à l'lemue paroît ainſi.

Ainſi paroît la terre de Falmue, quand on la côtoye à une lieue de terre.

CAP DOOTMANS ou TESTES D'HOMMES MORTS.

ENviron 5 lieues au Sud-Oueſt quart d'Oueſt de Fauvic, eſt le Cap Dootmans qui veut dire en François *Têtes d'Hommes morts*; c'eſt un Cap fort haut & double avec une montagne ronde du côté de l'Oueſt : plus à l'Oueſt de cette montagne, on voit ſur la terre un moulin, une tour & des maiſons.

FALMUE.

DEux lieues à l'Oueſt Sud-Oueſt du Cap Dootmans, eſt la pointe de l'Eſt de l'entrée de la Baye de Falmue, c'eſt une grande Baye large d'une lieue & profonde de 2 lieues : dans le milieu de l'entrée de la Baye de Falmue eſt un gros rocher qui couvre de pleine Mer, ſur lequel il y a toujours un mât pour balize, à quoi il faut prendre garde quand ledit rocher eſt couvert : on peut paſſer des deux côtés du ſuſdit rocher à la ſonde, l'on ne trouve point moins que 7 ou 8 braſſes d'eau de baſſe Mer : entre la pointe de l'Eſt & icelui rocher, il ne faut pas ranger ladite pointe de l'Eſt de plus près que de deux longueurs de cable, à cauſe de pluſieurs roches qui ſont proches d'elle, dont le plûpart ſont ſous

DE LA MER. 81

l'eau ; l'on peut auſſi paſſer entre ladite roche du milieu & la terre de l'Oueſt.

DÉMONSTRATION DE FALMUE.

A quatre, cinq & ſix braſſes d'eau, ſur cette pointe de l'Oueſt, il y a une petite éminence ronde, où eſt une Forterеſſe de gazon,

FIG. 626. PAGES OF RENÉ BOUGARD'S PILOT BOOK. From his *Le Petit flambeau de la mer: Ou le véritable guide des pilotes côtiers* (Le Havre: Faure, 1763), [80; mislabeled as 26]–81. These pages show and describe the Bay of Falmouth and coastal views. In its first edition *Le Petit flambeau* contained sixty-four maps; it was used by many sailors throughout the eighteenth century and translated into English as *The Little Sea Torch* in 1801. Its fourteenth and final edition appeared in 1817 in Saint-Malo, a longevity attesting to its success, even though the maps remained unchanged, a sign of the formidable inertia found in much of the world of the coastal sailors. Size of each page: 19 × 15 cm. Image courtesy of the Bibliothèque nationale de France, Paris.

Élisabeth-Paul-Édouard de Rossel came out in 1803–4 (Chapuis 1999, 638, 838, 840) in order to prepare for the French invasion of England and to mitigate the deficiencies felt by the French from the wars at the end of the eighteenth century, both in the waters of the British Isles and in North America. This lack was felt in spite of a real French-British collaboration during peacetime and the privately funded translations that had been going on for many years (Chapuis 1999, 236–46).

While French marine maps underwent strict regimentation beginning in 1773, the private publication of sailing directions still remained rather unsupervised even if private editors denounced subsidies given by the state to some publications to lower their prices, since pilot books remained much too expensive all over Europe. Yet from the French Revolution and especially after 1800, the Dépôt des cartes et plans de la Marine undertook the publication of official nautical instructions, as did Great Britain's Admiralty Hydrographical Office a little later (Chapuis 1999, 500, 638). In his preface to his translation of British sailing directions (*Description nautique des côtes orientales de la Grande-Bretagne et des côtes de Hollande, du Jutland et de Norvège*, 1804), Pierre Lévêque justly described the systematic incorporation of local practices into the collection of hydrographic data, a process that would be developed by Beautemps-Beaupré in the nineteenth century (Chapuis 1999, 674, 838).

OLIVIER CHAPUIS

SEE ALSO: Marine Charting; Navigation and Cartography

BIBLIOGRAPHY

Chapuis, Olivier. 1999. *À la mer comme au ciel, Beautemps-Beaupré & la naissance de l'hydrographie moderne (1700–1850): L'émergence de la précision en navigation et dans la cartographie marine*. Paris: Presses de l'Université de Paris-Sorbonne.

———. 2007. *Cartes des côtes de France: Histoire de la cartographie marine et terrestre du littoral*. Douarnenez: Chasse-Marée.

Jonkers, A. R. T. 2007. "Sailing Directions." In *The Oxford Encyclopedia of Maritime History*, 4 vols., ed. John B. Hattendorf, 3:457–63. Oxford: Oxford University Press.

Restif, Manonmani. 2005. "Routiers de navigation et instructions nautiques." In *Le livre maritime au siècle des Lumières: Édition et diffusion des connaissances maritimes (1750–1850)*, ed. Annie Charon, Thierry Claerr, and François Moureau, 133–48. Paris: Presses de l'Université Paris-Sorbonne.

Plan-relief. See Military Map: *Plan-relief*

Plane Table. See Instruments for Angle Measuring: Plane Table

Poland. In the seventeenth and early eighteenth centuries, the Polish-Lithuanian Commonwealth (created by the Union of Lublin, 1569) was one of the largest and most populous countries in Europe, stretching from the Baltic very nearly to the Black Sea. Ethnically, the Commonwealth was diverse with large populations of Poles, Lithuanians, and Ruthenians (Ukrainians and Belarusians) and smaller groups of Germans, Jews, and Livonians all speaking their own languages. Religiously, greater Poland had large groups of Catholics (both Latin and Uniate rite), but was quite tolerant of minority religions including Judaism and Reformed Christian communities.

It was bordered to the west by the Duchies of Brandenburg and Pomerania and the Habsburg Empire (the Czech and Hungarian Kingdoms); to the south by the Ottoman Empire; to the east by the Russian Empire; and to the north, beyond Livonia, by Sweden (fig. 627). At the time of its largest extent (1619–29), the Commonwealth consisted of two viable states. The Crown of Poland comprised twenty-two voivodeships; the Duchy of Warmia, the Duchy of Prussia, and Lauenburg and Bütow Land as a fiefdoms; and some small enclaves in the Spisz (Spiš) region of Slovakia. The Grand Duchy of Lithuania consisted of nine voivodeships and the duchies of Samogitia, Courland, and Livonia, the last three being under joint Polish and Lithuanian rule (Grzybowski 2000, 319; Hajkiewicz 2008, 60–62; Tazbir 2002, 42–43). Despite its size, the Commonwealth lacked a strong central government. Its kings were elected by the nobility, and their power was always limited by the Sejm, a legislature dominated by the nobles. The highest-level administrative subdivisions, the voivodeships, enjoyed considerable autonomy, each having its own legislature.

Over the course of the next century, these expansive borders were contested in wars with Sweden and Russia and resulted in the loss of most of Livonia to Sweden in the Treaty of Oliwa (1660) and the annexation by Russia of the voivodeships of Smolensk, Chernihiv, and most of Kiev following the Truce of Andrusovo in 1667 (Gierowski 2001, 73–74, 101–3). As a result of the weakening of the Republic, ducal Prussia (a Polish fiefdom since 1525) was granted independence in 1657 and in 1701 joined with Brandenburg to create the Kingdom of Prussia (Gierowski 2001, 70–71, 94; Topolski 1978, 326–27, 335).

A number of military campaigns against the Turkish Empire took place in the years 1672 to 1699. Under King Jan III Sobieski (r. 1674–96) Polish armies led the celebrated defense of Vienna in 1683, resulting in the Treaty of Karlowitz (1699). By this treaty, the Commonwealth regained the previously lost province of Kiev along with Bracław and Podolia and with a powerful claim on Kamianets-Podilskyi (Gierowski 2001, 135–41, 155–67, 233–35).

The electors turned to Saxony's Wettin dynasty and chose August II (r. 1697–1706, 1709–33) to succeed Sobieski and be their new king. His son August III (r. 1734-63) was elected after him. The two kings initiated a sixty-six-year period of reorientation of the foreign policy of the Commonwealth. In alliance with Denmark and Russia, August II attempted to regain areas that had been lost to Sweden. In this Great Northern War (1700–1721), the Polish-Lithuanian Commonwealth became the scene of major operations as Swedish, Russian, Polish, and Saxon armies roamed through areas of the Republic, initially the northern and central parts of Poland, but later also in the Ukraine. The cartographic heritage of these campaigns can be seen in the many manuscript maps of Commonwealth lands in Swedish collections (Ehrensvärd 2008). For the victorious Peter I, the Treaty of Nystad (1721), which ended the war, became the basis for future Russian hegemony in Eastern Europe (Gierowski 2001, 243–90).

The last king of the Commonwealth, Stanisław August Poniatowski (r. 1764–95), delayed the collapse of the state but could not prevent it. He introduced economic, monetary, and parliamentary reforms, but given an overwhelming sense of confusion and lack of competence, strife between the supporters of a confederation, and the weakness of the military these reforms could not be effective and did not result in a stronger state (Grodziski 2001, 26–43). The bad domestic situation meant that the Commonwealth became easy prey. In a series of disastrous partitions in 1772, 1793, and 1795, Russia, Prussia, and Austria gradually annexed the entire Commonwealth. Poland and Lithuania ceased to exist as independent countries until 1918 (Topolski 1978, 370–80, 617–19).

Throughout the period, Poland's military needs for fortification and survey relied on foreign engineers, a pattern continued from the seventeenth century (Török 2007, 1840–42) and seen again in urban mapping. From

FIG. 627. TOBIAS CONRAD LOTTER, *MAPPA GEOGRAPHICA EX NOVISSIMIS OBSERVATIONIBUS REPRÆSENTANS REGNUM POLONIÆ ET MAGNUM DUCATUM LITHUANIÆ*, 1759, CA. 1:2,500,000. This map shows the provincial boundaries within the Kingdom of Poland and Grand Duchy of Lithuania in 1759. The coloring did not necessarily reflect political allegiance.
Size of the original: 47 × 56 cm. By permission of Pusey Map Library, Harvard University, Cambridge (MAP-LC G6520 1759 .L6).

the second part of the eighteenth century, local surveyors produced large-scale maps of local areas. However, mapping the entire Commonwealth proved more elusive. No fewer than three major efforts were launched in the late eighteenth century, any of which might have resulted in a comprehensive large-scale map of the Commonwealth, a goal that was only partially achieved in Giovanni Antonio Rizzi Zannoni's *Carte de la Pologne* (1772, 24 sheets, 1:692,000).

Stanisław August Poniatowski was an avid map collector, but most of the Polish royal collections ended up in St. Petersburg after the final partition of the country. In addition, World War II resulted in many losses of important Polish maps (Łodyński 1959).

Zsolt G. Török has provided a brief summary of the historiography of Polish cartography (2007, 1808–10). The Biblioteka Narodowa published two series relating to old maps: the monographic series *Studia i materiały z historii kartografii* (1981–2013), and a facsimile series *Zabytki Polskiej kartografii* (1978–2013).

LUCYNA SZANIAWSKA

SEE ALSO: Administrative Cartography; Map Trade; Poland-Lithuania, Partitions of; Property Mapping; Thematic Mapping; Topographical Surveying; Urban Mapping

BIBLIOGRAPHY
Ehrensvärd, Ulla. 2008. *Cartographica Poloniae, 1570–1930: Catalogue of Manuscript Sources in Swedish Collections to the History of Polish Territories*. Warsaw: Wydawnictwo Retro-Art.

Gierowski, Józef Andrzej. 2001. *Rzeczpospolita w dobie złotej wolności (1648–1763)*. Vol. 5 of *Wielka historia Polski*. Kraków: Fogra.
Grodziski, Stanisław. 2001. *Polska w czasach przełomu (1764–1815)*. Vol. 6 of *Wielka historia Polski*. Kraków: Fogra.
Grzybowski, Stanisław. 2000. *Dzieje Polski i Litwy (1506–1648)*. Vol. 4 of *Wielka historia Polski*. Kraków: Fogra.
Hajkiewicz, Izabela, ed. 2008. *Atlas historyczny: Od starożytności do współczesności*. Warsaw: Nowa Era.
Łodyński, Marian. 1959. "With Fire and Sword, VI." *Imago Mundi* 14:117.
Tazbir, Julia, 2002. *Atlas historyczny do 1815 roku, szkoła średnia*. 2d ed. Warsaw: Wydawnictwo Demart.
Topolski, Jerzy, ed. 1976. *Dzieje Polski*. Warsaw: Państwowe Wydawnictwo Naukowe.
Török, Zsolt G. 2007. "Renaissance Cartography in East-Central Europe, ca. 1450–1650." In *HC* 3:1806–51.

Poland-Lithuania, Partitions of. The three partitions of Poland-Lithuania in 1772, 1793, and 1795 nullified the dynastic union established in 1386 between the Polish Crown (Corona Regni Poloniae) and the Grand Duchy of Lithuania (Magnus Ducatus Lithuaniae), and confirmed in 1569 by the Union of Lublin. The architects of the partitions were Empress Catherine II (r. 1762–96) of Russia, Friedrich II (r. 1740–86) and Friedrich Wilhelm II (r. 1786–97) of Brandenburg-Prussia, and Empress Maria Theresa (r. 1740–80) and Franz II (r. 1792–1835) of the Austrian Habsburgs. (Their interests are visualized on the map in Magocsi 2002, 71).

The partitions exemplified European political opportunism and the politicization of geographic cartography during the Enlightenment. Through a complex system of shared power, Poland-Lithuania was a decentralized dual nation in relative decline. Yet its final dissolution was not inevitable. With the aim of acquiring mineral-rich Silesia, Friedrich II intrigued to reverse the sympathies of Russia and Habsburg Austria toward rival France by playing the two empresses against each other under the pretext that Russian troops were allowed to use military bases in Poland-Lithuania as a front. Not to be outwitted, Catherine II stymied domestic political reforms by manipulating the weakened king of Poland, Stanisław August Poniatowski, and the vested interests of pro-Russian magnates, led by the Czartoryski family. Ultimately, the czarina made the Polish king and key powerful nobles wholly dependent on her ambition to acquire access to the Black Sea and to transform Russia into a European state of the first rank.

This political paralysis encouraged revolts in Poland-Lithuania and Ukraine during the War of the Confederation of Bar (1768–72). Opposition to foreign state interference was disunited. Rebellions caused destruction, polarized borderland populations according to class, confession, and region, and further attracted the opportunistic Prussia and Habsburg Austria. Wanting to annex Silesia, Friedrich II proposed the triune partition at Polish-Lithuanian expense. He and Catherine II signed an accord in February 1772 in St. Petersburg; Maria Theresa signed in August 1772. Maps served as tools for this political fait accompli and imperial reinvention. The Austrian Habsburg sovereign and her successors revived the twelfth-century Hungarian claim to the "Kingdom of Galicia and Lodomeria," and ordered a topographical survey to determine them, resulting in new printed maps outlining the changed borders (Dörflinger 2004, 115). The Polish-Lithuanian king and the weakened parliament reluctantly assented to the first partition on 30 September 1773.

The American and French Revolutions overshadowed the second and third partitions of 1793 and 1795, which invalidated the Polish Constitution of 3 May 1791, in which reformist leaders, in violation of the 1773 accord, attempted to preserve political independence. (The Habsburgs abstained from the 1793 partition.) On 26 January 1797, at the Convention of St. Petersburg, the final annexations were confirmed. One modern estimate, based on nineteenth- and twentieth-century cartographic works and census records, asserts that the Russian Empire gained 178,900 square miles (463,200 square km) and about 5,500,000 inhabitants; Brandenburg-Prussia got 54,600 square miles (141,400 square km) and about 2,600,000 inhabitants; and the Habsburg monarchy received 49,800 square miles (128,900 square km) and about 4,150,000 inhabitants (Magocsi 2002, 71). At the Convention of St. Petersburg, Russia, Prussia, and Austria stressed "the need to abolish everything that can recall the memory of the existence of the kingdom of Poland" (Parry 1969, 411–27, quotation on 425; Lukowski 1999, 179–82). Thus, maps of the polity acquired special meaning among Polish revolutionaries as old map collections disappeared into private noble libraries and emigrated to Paris, London, and elsewhere. The cartographic erasure of the polity entered the European commercial map and print trade, as prints satirizing the autocrats' self-aggrandizing policies circulated (fig. 628).

(*facing page*)
FIG. 628. *LES GÂTEAU DES ROIS / THE TROELFTH CAKE*, PUBLISHED BY NOËL LE MIRE IN PARIS AND ROBERT SAYER IN LONDON [1773]. This copperplate print, drawn originally by the French artist Jean Michel Moreau, features "the royal cake" that shows the partitioning powers of Poland-Lithuania in 1772. From left to right: Empress Catherine II, Empress Maria Theresa, Stanisław August Poniatowski, and Friedrich II of Prussia. The king of Poland points to his lost Crown lands as the horrified angel of Fate (above) sounds an alarm.
Size of the original: ca. 23 × 17 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Estampes et photographie, FOL-QB-201 [108] RÉS).

LE GÂTEAU DES ROIS. | THE TROELFTH CAKE.

London

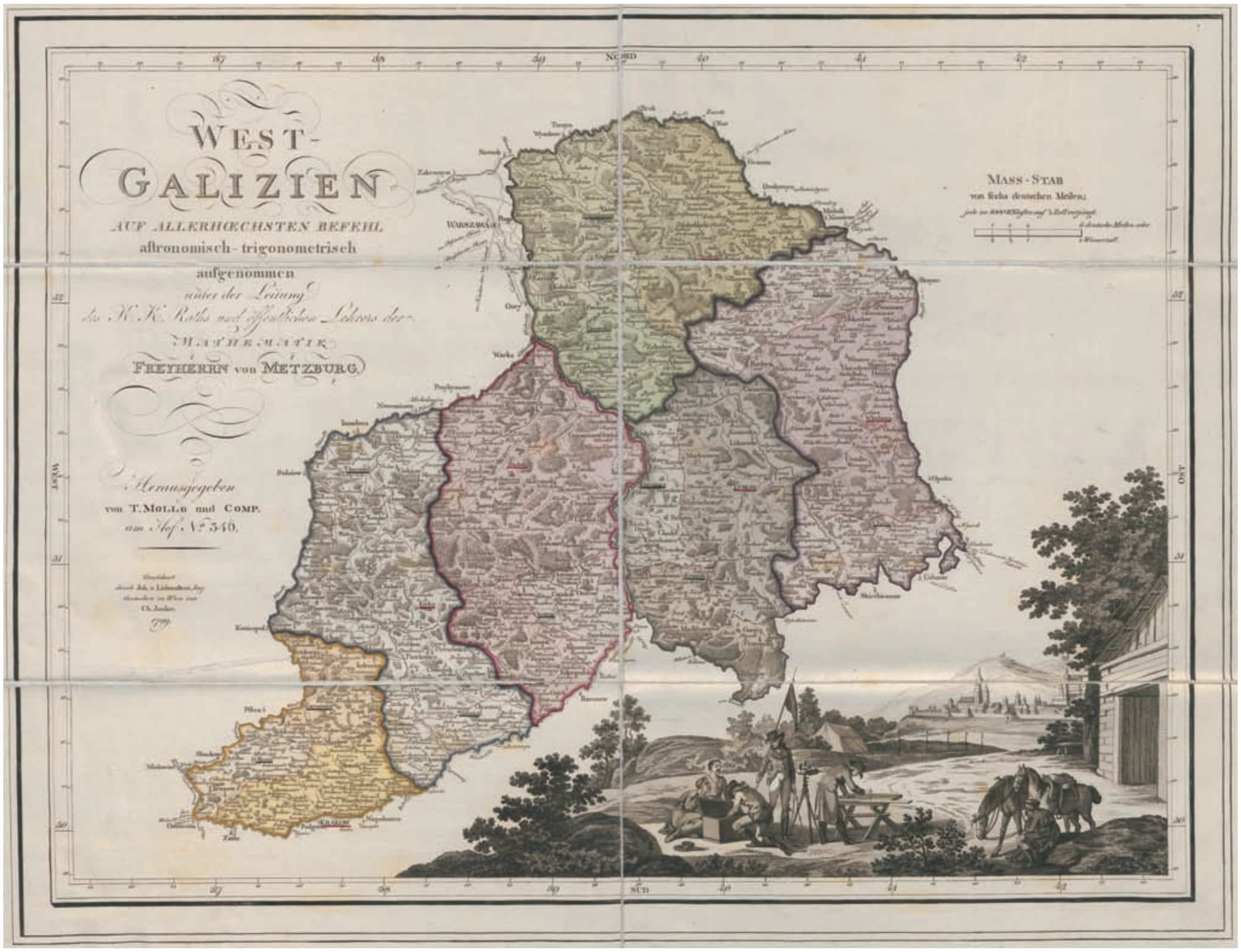


FIG. 629. GEORG IGNATZ VON METZBURG AND JOHANN VON LIECHTENSTERN, *WEST-GALIZIEN AUF ALLERHŒCHSTEN BEFEHL ASTRONOMISCH-TRIGONOMETRISCH AUFGENOMMEN*, 1799. Drawn at the behest of the Habsburg emperors, the map illustrates the Austrian renaming of lands of Lesser Poland (Małopolska) as Western Galicia (West-Galizien). Ca. 1:870,000.
Size of the original: ca. 46 × 60 cm. Image courtesy of the Bildarchiv, Österreichische Nationalbibliothek, Vienna (FKB C.117.3).

Because the partitions lie at the heart of nation- and state-based foundation myths, diplomatic motives and territorial outcomes remain a source of dispute across Central and Eastern Europe, from the Baltic to the Black Sea. The partitioning states claimed to redraw the map benevolently, to avoid European conflict and guard their own political interests, while those resisting partition claimed victimization. Faced with political instability in France, the dynastic monarchs reasoned that they had acted to preserve and enhance state power. The partitions channeled early modern nationalism into more modern forms, using language as criteria for mapping exclusively "ethnic" identities in East-Central Europe (Snyder 2003, 1–12). The Treaty of Tilsit (July 1807) slowed Napoleon from placing the Duchy of Warsaw under the dominion of Friedrich August, the king of Saxony, his neutral sympathizer (Wandycz 1974, 41–43). Reaffirming the triune nature of the partitions, the articles of the Congress of Vienna (1815) recognized that the rump Kingdom of Poland would be controlled by Czar Alexander I, grandson of Catherine II, although the Poles were granted limited rights.

After 1795, by codifying new historical toponyms such as Galicia, maps became commemorative icons and tools of empire (Wolff 2004) (fig. 629). Conversely, historical maps of the dual nation of Poland-Lithuania often reduced the former polity to Poland alone, reflecting an alternative political vision. Maps became contestable blueprints to restore Poland as an independent nation or state, including all or some of the lands and peoples before 1772. By the end of the eighteenth century, the partitions had politicized the use of geographical and thematic cartography.

STEVEN SEEGEL

SEE ALSO: Austrian Monarchy; Boundary Disputes and Cartography; German States; Poland; Russia

BIBLIOGRAPHY

Dörflinger, Johannes. 2004. "Vom Aufstieg der Militärkartographie bis zum Wiener Kongress (1684 bis 1815)." In *Österreichische Kartographie: Von den Anfängen im 15. Jahrhundert bis zum 21. Jahrhundert*, by Ingrid Kretschmer, Johannes Dörflinger, and Franz Wawrik, ed. Ingrid Kretschmer and Karol Kriz, 75–167. Vienna: Institut für Geographie und Regionalforschung der Universität Wien.

Lukowski, Jerzy. 1999. *The Partitions of Poland: 1772, 1793, 1795*. London: Longman.

Magocsi, Paul Robert. 2002. *Historical Atlas of Central Europe*. Rev. and exp. ed. Seattle: University of Washington Press.

Parry, Clive, ed. 1969. *The Consolidated Treaty Series*. Vol. 53, 1795–1797. Dobbs Ferry: Oceana.

Snyder, Timothy. 2003. *The Reconstruction of Nations: Poland, Ukraine, Lithuania, Belarus, 1569–1999*. New Haven: Yale University Press.

Wandycz, Piotr S. 1974. *The Lands of Partitioned Poland, 1795–1918*. Seattle: University of Washington Press.

Wolff, Larry. 2004. "Inventing Galicia: Messianic Josephinism and the Recasting of Partitioned Poland." *Slavic Review* 63:818–40.

Ponts et Chaussées, Engineers and École des (School of Bridges and Roads; France). The corps des Ponts et Chaussées (corps of bridges and highways) is a division of civil engineers created in France by a decree of the king's Conseil d'État on 1 February 1716 (Picon 1992, 31). The engineers of Ponts et Chaussées had not previously belonged to an organized administration. This legislation established the initial hierarchical structure of a *directeur général*, an *inspecteur général*, an *architecte-premier ingénieur*, three *inspecteurs*, and twenty-one *ingénieurs* divided among different administrative areas (*généralités*). Until the mid-eighteenth century, this corps existed without an apparatus for organized training. The engineers were recruited based upon recommendations, with neither a precise evaluation of their competence nor specific training. Instead, they gained firsthand experience in the field, where they replaced masons, carpenters, architects, and contractors who were traditionally employed to carry out public works (Picon 1988).

Throughout the eighteenth century, the corps des Ponts et Chaussées became more structured and professionalized, a development largely owed to Daniel-Charles Trudaine, the *intendant des Finances* who, from 1742, was entrusted with the administrative department of the corps. Trudaine understood road works well from his several years as *intendant* in Auvergne, a province known for its problematic roads. He conceived a very regimented organization for the corps des Ponts et Chaussées, with a training program adapted to the demands of transportation planning and execution. After his death in 1769, his son Jean-Charles-Philibert Trudaine de Montigny continued his work.

Very early on, the elder Trudaine was interested in the cartographic training of engineers. Observing that their inconsistent work methods and technical competence were insufficient for the rigorous execution of large-scale projects, he created the Bureau des dessinateurs de Paris in February 1744. The bureau's staff was specially recruited to draw plans of the royal roads ordered in 1737–38 by the *contrôleur général des Finances*, Philibert Orry. The assembled plan was known as the "Atlas de Trudaine" (fig. 630). The Bureau des dessinateurs offered several advantages: each employee used the same drawing methods and procedures that were centralized in Paris, a system that guaranteed better control while relieving provincial engineers of the long and burdensome task of putting rough drafts into final form.

In 1747, engineer Jean-Rodolphe Perronet became the head of the Bureau des dessinateurs. As *sous-ingénieur* (1736) and then *ingénieur* (1737) of the *généralité* of Alençon (Normandy), Perronet had demonstrated his great technical aptitude, his pedagogical talents, and his rigorous administration. He thought it impossible to carry out field operations at the same time as compiling and preparing final renderings of plans. In 1738, he created in Alençon a Bureau des Ponts et Chaussées staffed by individuals recruited and trained by him who could fulfill the technical requirements of this specific form of mapping. Thanks to a strict division of labor among employees, the cartographic production for roads in the province of Normandy went quickly, with great practical and aesthetic success. Won over by Perronet's approach, the elder Trudaine decided to bring him to Paris to direct the Paris bureau, which included about twenty draftsmen in 1747 (Blond 2014, 112).

The decree of the royal Conseil d'État of 14 February 1747 enumerated the prerogatives given to Perronet. This text contains an ambitious pedagogical project, often described as the "birth certificate" of the École des Ponts et Chaussées (Picon 1992, 33). The decree described an institution whose technical and pedagogical functions increasingly established themselves in the following decades. Perronet acted simultaneously as supervisor, teacher, and director of the Bureau des dessinateurs. The 1747 decree appointed Perronet "to have custody of all these plans, to have them put into final form, to have copies made of them, and to supervise all this work, and at the same time to train young people in drawing and other sciences that may equip them afterward to fill the posts of engineers of Ponts et Chaussées" (quoted in Picon 1992, 33). In fact, Perronet supervised all stages of the training of draftsmen

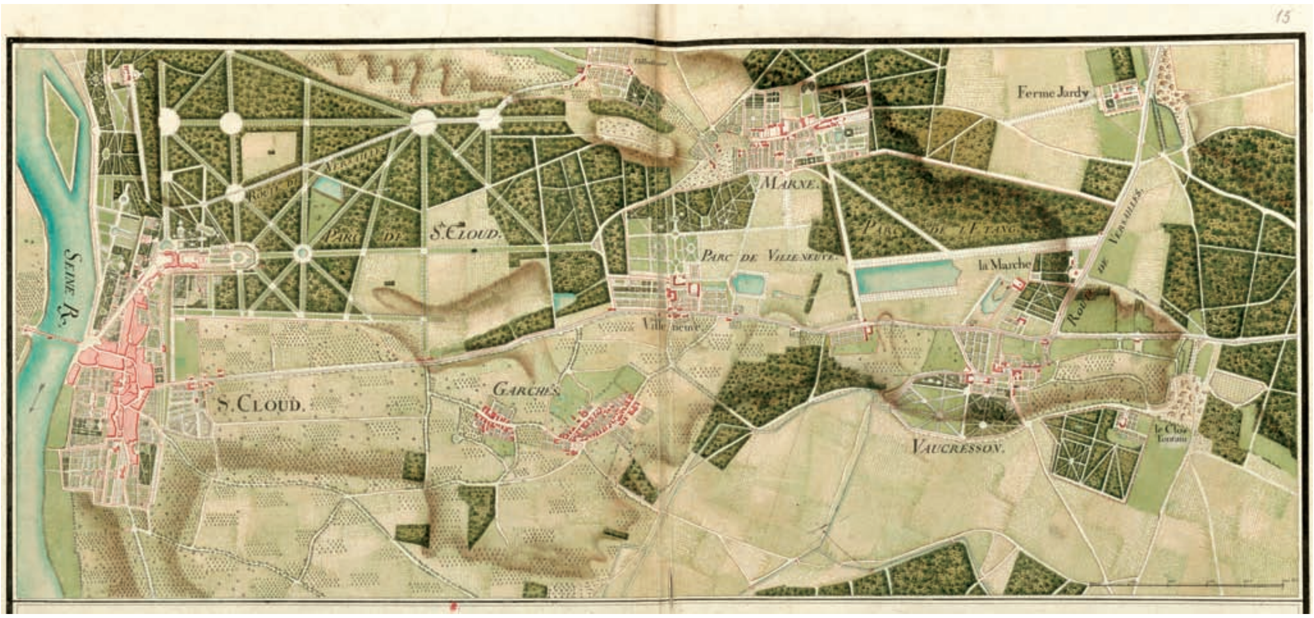


FIG. 630. "GRANDE ROUTE DE NEUBOURG EN NORMANDIE PASSANT PAR ST. NOM, CREPIERES, MANTES ET YVRY, DEPUIS ST CLOUD JUSQU'À LA FIN DE LA GÉNÉRALITÉ," SECTION OF THE "ATLAS DE TRUDAINE." This manuscript map, in the *au vrai* style taught by Jean-Rodolphe Perronet at the École des Ponts et Chaussées, employs natural colors and symbols and shows more than just roads: formal gardens and parks with their characteristic radiating *allées* (walkways), water features, ubiquitous vineyards, and shaded elevation all provide local context.
Size of the original pages: 60 × 87 cm; size of map: 35.5 × 76.0 cm. © Archives nationales (France) (CP/F/14/*/8448/15).

and students who were eligible to join the corps des Ponts et Chaussées.

Perronet conceived a vast instructional program based on his provincial experience and his knowledge of the techniques required for public works, as summarized in the "Instruction sur les fonctions des employés subalternes des Ponts et Chaussées" (Archives de l'École nationale des Ponts et Chaussées, Champs-sur-Marne, ms 2629bis [5]), officially validated on 11 December 1747 by Jean-Baptiste Machault d'Arnouville, *contrôleur général des Finances*. The program maintained the entry system based on recommendation, but added an interview that allowed Perronet to evaluate the capacities of each candidate. A successful candidate would enter an apprenticeship period of several months, after which he obtained the status of student of Ponts et Chaussées and began studies, which generally lasted from six months to two years.

In addition to the "Instruction," various legislative texts completed the organization of the corps des Ponts et Chaussées. Beginning in 1747, the Trudaines hosted a weekly assembly of specialists on administrative and technical questions to examine and approve road projects. In 1750, a new decree of the Conseil d'État modified the hierarchy of the corps with an *architecte-premier ingénieur*, four *inspecteurs généraux*, a *directeur* of the office of geographers and draftsmen, and twenty-five *ingénieurs* with posts in the provinces. Because of the extent of the *généralités* and the number of projects to be supervised, *sous-ingénieurs* of varying numbers aided the *ingénieurs*.

At the École, students were divided into three classes of increasing technical proficiency. The third class brought together the apprentices; the second or middle class included students of Ponts et Chaussées; the first class included the new *sous-ingénieurs* or *sous-inspecteurs* of the corps des Ponts et Chaussées. A system of degrees, competitive examinations, and remuneration was gradually put in place to assess the different stages in this progression (Picon 1992, 115–24, 149–207). At the end of each trimester, Perronet prepared tables charting the progress of different students and the advances made on their projects. Not everyone necessarily entered into the corps of engineers of Ponts et Chaussées, but those who failed could remain in the third class drawing road maps.

In addition to its practical aspects, the training of engineers of Ponts et Chaussées incorporated theoretical and intellectual dimensions. According to André Brunot and Roger Coquand, this training had four major characteristics: "admission based on recommendation, an indeterminate duration of study, mutual instruction, and integration of teaching and practice of the profession" (Brunot and Coquand 1982, 27). Above all, the training program emphasized the practical experience of road building and the determinant role of mapmaking. A solid knowledge of mathematics, arithmetic, instrumental techniques, and drawing was required. A student of the Ponts et Chaussées could not become an engineer without possessing the qualities expected of a mapmaker (Picon 1995). The competitive exams included a test that required students to demonstrate their capacity for drawing different types of plans and maps, including landscapes, gardens, cities, and works of art (fig. 631). In Perronet's program, students exercised their drawing skills by polishing the plans of roads and bridges sent by engineers in the provinces. In return, the students received a small stipend that covered part of their expenses in Paris. This pedagogic effort accelerated cartographic projects at a very low cost for the state. Students completed their training by spending approximately six months with engineers in the provinces during the clement weather to apply the techniques learned at Paris and to participate in preparing maps and plans (Coronio 1997, 26–27).

From its beginning, instruction at the École was based on a uniform cartographic approach defined by a characteristic and unchanging style, largely inspired by the drawing techniques used in the cartographic work of

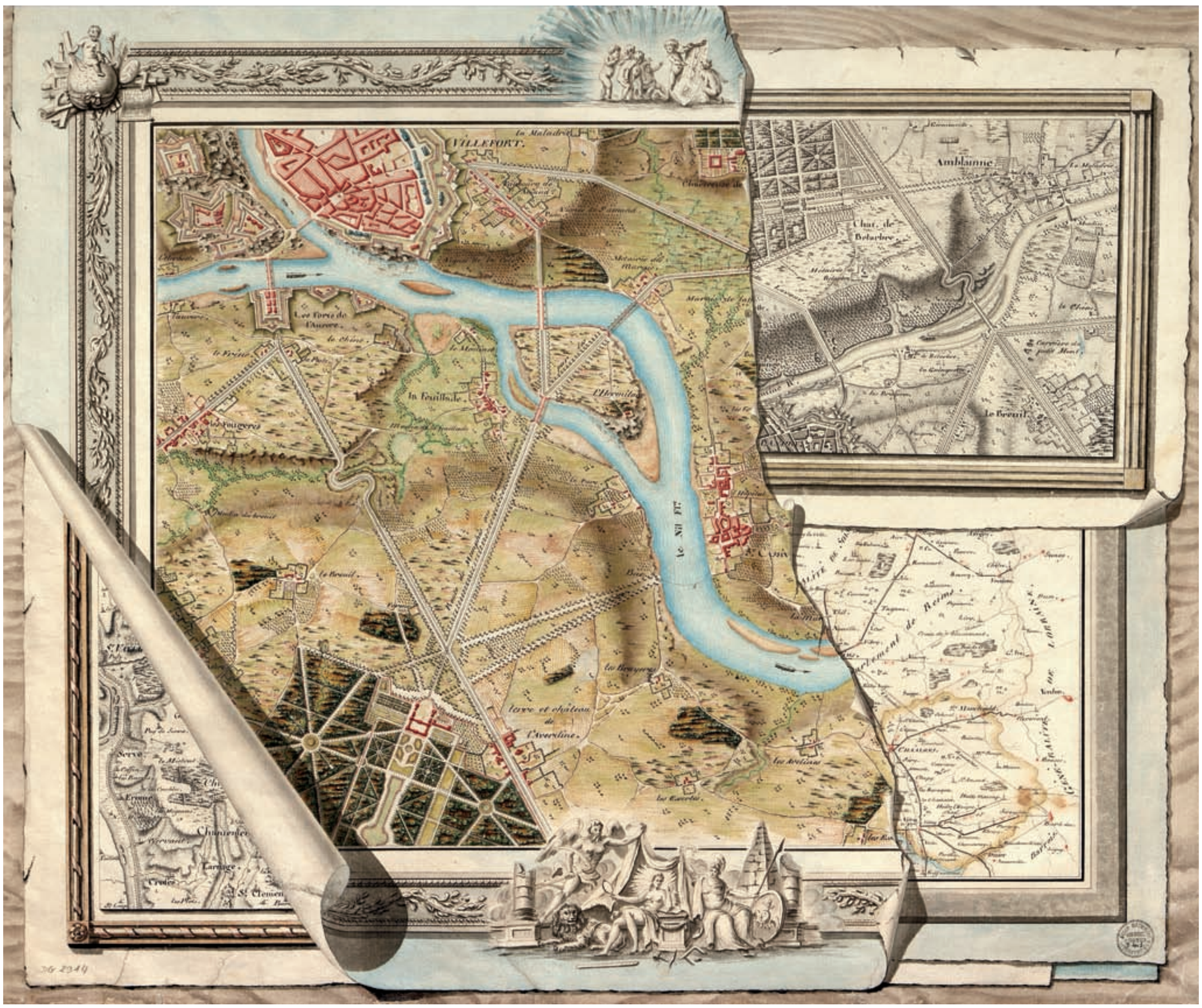


FIG. 631. "CARTE POUR LE CONCOURS DE L'ÉCOLE DES PONTS ET CHAUSSÉES," ANONYMOUS, END OF EIGHTEENTH CENTURY. This manuscript in trompe l'oeil style was prepared for the final competitive exam of the École des Ponts et Chaussées, one that challenged the student to create a map of an imaginary territory with a mixture of man-made and natural features. This example met the challenge with a collage of the various types of finished maps that an engineer from the Ponts et Chaussées would have created and used.
Size of the original: 46 × 55 cm. © École nationale des Ponts et Chaussées, Marne la Vallée (DG 2914).

Perronet at Alençon. His method consisted of representing the terrain *au vrai*—using symbols and colors closest to those found in nature, allowing the elements of the plan to be immediately understood without referencing a key or legend. This style matches the theoretical writings of Louis Charles Dupain de Montesson, who recommended using symbols based on the visual appearance of the landscape. The students at the École were not alone in adopting these principles: every member of the corps des Ponts et Chaussées was obliged to refer to these techniques. Some engineers had to come to the École to learn the methods, supporting the idea that this administration required the use of an easily recognizable common cartographic language.

Many other cartographers were similarly inspired by this type of representation of the environment. The renown of the École was transnational; by the end of the eighteenth century many foreign students had come to Paris to learn the drawing techniques of the Ponts et Chaussées. However, by the early nineteenth century, the cartographic style of the school began to fade, giving way to the standardized techniques that followed the work of the Commission topographique of 1802.

At its beginning, the Bureau-École was a "school without professors or plan of study" (Belhoste 2003, 69) operating on a principle of mutual instruction. The most advanced and gifted students from each class took courses with private professors, like the architect Jacques-François Blondel, and then summarized and passed on their learning to classmates. The students also made mock-ups and models for study and to learn different architectural techniques. Finally, they had to read and understand the works and treatises related to the engineer's work. The theoretical courses were mainly concentrated in the autumn and winter, when fieldwork was difficult. The "Instruction" of 1747 stipulated that teaching take place "everyday, except for feast days and Sundays, from eight in the morning until noon, and from two in the afternoon until eight; except for those who might be granted dispensation by *sieur Perronet*" (article 10). From 1747 on, everyone wishing to join the corps des Ponts et Chaussées first had to study at the École. The other engineers improved themselves through courses that served as ongoing training.

The corps and the École des Ponts et Chaussées were remarkable examples of institutions created to satisfy the needs of the central state and local administrative authorities, in particular the *intendants*. The development of the Ponts et Chaussées reveals the considerable role played by engineers in projects developing territory and public works (Vérin 1993). The reputation of the school attracted many, although the numbers of students in training and members of the corps fluctuated from year to year, varying with the budget (Blond 2014, 122). Nevertheless, under Trudaine and Perronet the school relocated several times to accommodate the ever-increasing number of students, including foreigners. In 1775, a new regulation adopted by the *contrôleur-général des Finances* Anne Robert Jacques Turgot and the younger Trudaine renamed the organization the École royale des Ponts et Chaussées and limited the number of students in the school to sixty.

During the French Revolution, the department of Ponts et Chaussées was briefly threatened as an establishment serving monarchic ambitions, especially the detested *corvée* (forced labor) for roads. In spite of the creation of the École centrale des travaux publics in 1794, renamed the École polytechnique (1795), the corps and the École des Ponts et Chaussées continued, a fact that constituted an implicit recognition of their essential role (Belhoste 2003, 105–29). Their survival owed much to the immense prestige of Perronet, named *architecte-premier*, *ingénieur des Ponts et Chaussées du royaume* in 1763; he remained at the head of the École for nearly fifty years, from 1747 until his death on 27 February 1794. A member of numerous European academies, he remained the supervisor of operations for the mapping of roads and contributed to its progress as a member and then as the director of the Société de la carte de France (Vacant 2006, 231–37).

STÉPHANE BLOND

SEE ALSO: Administrative Cartography; Engineers and Topographical Surveys; Topographical Mapping and the State; Topographical Surveying: France; Transportation and Cartography: Route Map

BIBLIOGRAPHY

Belhoste, Bruno. 2003. *La formation d'une technocratie: L'École polytechnique et ses élèves de la Révolution au Second Empire*. Paris: Belin.

Blond, Stéphane. 2014. *L'atlas de Trudaine: Pouvoirs, cartes et savoirs techniques au siècle des Lumières*. Paris: CTHS.

Brunot, André, and Roger Coquand. 1982. *Le corps des Ponts et Chaussées*. Paris: Centre National de la Recherche Scientifique.

Coronio, Guy, ed. 1997. *250 ans de l'École des Ponts en cent portraits*. Paris: Presses de l'École Nationale des Ponts et Chaussées.

Picon, Antoine. 1988. *Architectes et ingénieurs au siècle des Lumières*. Marseille: Éditions Parenthèses.

———. 1992. *L'invention de l'ingénieur moderne: L'École des Ponts et Chaussées, 1747–1851*. Paris: Presses de l'École Nationale des Ponts et Chaussées.

———. 1995. "Cartographie et aménagement du territoire: Les cartes des élèves des Ponts et Chaussées à la fin du XVIII^e siècle." In *L'œil du cartographe et la représentation géographique du Moyen Âge à nos jours*, ed. Catherine Bousquet-Bressolier, 107–25. Paris: Comité des Travaux Historiques et Scientifiques.

Picon, Antoine, and Michel Yvon. 1989. *L'ingénieur artiste: Dessins anciens de l'École des Ponts et Chaussées*. Paris: Presses de l'École Nationale des Ponts et Chaussées.

Vacant, Claude. 2006. *Jean Rodolphe Perronet (1708–1794): "Premier ingénieur du roi" et directeur de l'École des Ponts et Chaussées*. Paris: Presses de l'École nationale des Ponts et Chaussées.

Vérin, Hélène. 1993. *La gloire des ingénieurs: L'intelligence technique du XVI^e au XVIII^e siècle*. Paris: Éditions Albin Michel.

Portugal. In 1668, after nearly three decades of war with Spain, Portugal finally regained the recognition of other European powers as an independent state, maintaining its former borders but with fewer overseas possessions. The political entity was bounded by Spain in the north and east and the Atlantic Ocean in the west and south, as shown in the *Reyno de Portugal* (1729) (see fig. 310). For a short time, Portuguese cartographers were able to dedicate themselves to nonmilitary mapmaking projects. However, war returned several times throughout the eighteenth century, not only in the Iberian Peninsula but also in the colonies of South America, Africa, and Asia. Because of these conflicts, regional maps were produced for geostrategical planning and topographical surveys concentrated on cities and forts. The combined efforts of cartographers, engineers, and foreign military architects (French, Flemish, and German) continued to contribute to map production in Portugal (Alegria and Garcia 1995).

As a highly centralized state activity, nautical cartography responded to concerns regarding the navigation and defense of coasts, particularly the Atlantic and Indian ports. The routes of the fleets to and from Brazil and India were constantly studied, and identifying ports of call and provisioning became an aim of many investigations into coastal areas, depths, currents, and tides. Maps of various scales, some of which were printed in Lisbon, complemented detailed nautical rutters. However, these maps followed French, Dutch, and English models, taken both from foreign originals and translations. A particular sphere of Portuguese hydrographic cartography related to the slave trade between western and equatorial Africa and South America.

The restructuring of the absolute monarchy during the reigns of João V (1706–50) and José I (1750–77) and his minister Sebastião José de Carvalho e Melo, marquês de Pombal, gave rise to numerous maps related to the successful reforms of the judicial, ecclesiastical, and administrative divisions of the country and empire. During the first half of the eighteenth century, these maps were elaborated from foreign printed maps and also based on Portuguese sources from the seventeenth century, such as Pedro Teixeira Albernaz's map of Portugal (1662) (Alegria et al. 2007, 1044–45). However, during the second half of the century, field surveys helped to organize the pieces of the puzzle, providing images of the districts, dioceses, and provinces of Portugal: Entre-Douro-e-Minho, Trás-os-Montes, Beira, Estremadura, Alentejo, and Algarve (Mendes 1982; Coutinho 2007).

During this period, large-scale maps were essentially urban. The cartographic rendering of orthogonal plans showed towns and cities carefully laid out and protected by powerful defensive structures. Such plans were employed both in Portugal and across the empire, especially along the borders of Brazil. The project of rebuilding Lisbon following the great earthquake of 1755 was broadcast as a symbol of Portuguese enlightenment and engendered similar renewal projects elsewhere.

Portuguese interest overseas, as represented by Portuguese cartographers, focused on Brazil, its most important colony both in size and economic value from the eighteenth century until independence in 1822. Portuguese America was mapped at a variety of scales, from large-scale urban plans to geographical maps of the entire continent. These works reflected both terrestrial and maritime interests and served administrative, religious (missionary), and economic purposes (sugar and the exploration of mines). Important centers of production for cartographic manuscripts were formed in Brazil that supported many administrative decisions regarding the organization of the territory.

In Africa, Portuguese colonization was divided between forts and commercial posts, stretches of coast, and the control of communication lines with the interior. The maps of these spaces, which varied in scale, stretched from Morocco (Mazagão/El Jadida) to Senegambia and the Gulf of Guinea, to the Atlantic archipelagos of Cape Verde, São Tomé, and Fernando Pó (Bioko, Equatorial Guinea), to Angola, Mozambique, and Mombasa (Kenya). In southern Asia and Oceania, urban and regional maps detailed the Portuguese cities in India and Sri Lanka, in China (Macao), and on some islands, such as Timor. The majority of these documentary collections were connected to administrative institutions, such as the Conselho Ultramarino, to local cartographic schools, such as those in Luanda and Goa, and also to the private collections of viceroys and governors.

Several attempts to institutionalize cartographic production were made in Portugal by the academies of history and sciences as well as the military and maritime academies. The principal objectives of these efforts were the scientific construction of a map of the country and the control of the mapping of Portugal and its empire by the Portuguese themselves, obviating any foreign dependence (Dias 2003). These objectives faced several problems.

One problem was the question of whether to employ the compilation approach of geographical mapping, usually carried out at a medium scale by scholar-geographers who were capable of undertaking the laborious process of analyzing texts and documents, or whether to focus on a larger-scale mapping based on topographic surveying, which relied on significant manpower generally supplemented by engineers and surveyors (Garcia 2006). Defenders of the first method remained in power until the last decade of the eighteenth century.

Another problem centered on map production: manuscript versus printed. On the one hand, central power was not particularly interested in the diffusion of knowledge, preferring to maintain the secrecy of such documents (Moreira 2011, 29–53). On the other hand, a knowledgeable few were accustomed to acquiring atlases and maps abroad from booksellers. Thus, the editing and publication of maps developed slowly, both in quantity and in quality. The consumption and reading of maps in Portugal therefore continued to be dependent on images from abroad until the middle of the nineteenth century.

João Carlos Garcia

see also: Academies of Science; Administrative Cartography; Boundary Surveying; Celestial Mapping; Geodetic Surveying; Geographical Mapping; Map Collecting; Map Trade; Marine Charting; Military Cartography; Portuguese Africa; Portuguese America; Portuguese East Indies; Property Mapping; Topographical Surveying; Urban Mapping

bibliography

Alegria, Maria Fernanda, and João Carlos Garcia. 1995. "Aspectos da evolução da cartografia portuguesa (séculos XV a XIX)." In *Os mapas em Portugal: Da tradição aos novos rumos da cartografia*, ed. Maria Helena Dias, 27–84. Lisbon: Edições Cosmos.

Alegria, Maria Fernanda, et al. 2007. "Portuguese Cartography in the Renaissance." In *HC* 3:975–1068.

Coutinho, Ana-Sofia de Almeida. 2007. "Imagens cartográficas de Portugal na primeira metade do século XVIII." Masters diss., Faculdade de Letras da Universidade do Porto.

Dias, Maria Helena. 2003. "As explorações geográficas dos finais de setecentos e a grande aventura da Carta geral do Reino de Portugal." *Revista da Faculdade de Letras da Universidade do Porto—Geografia* 19:383–96.

Garcia, João Carlos. 2006. "Manoel de Azevedo Fortes e os mapas da Academia Real da História Portuguesa, 1720–1736." In *Manoel de Azevedo Fortes (1660–1749): Cartografia, cultura e urbanismo*, ed. Mário Gonçalves Fernandes, 141–73. Porto: GEDES (Gabinete de Estudos de Desenvolvimento e Ordenamento do Território), Departamento de Geografia da Faculdade de Letras da Universidade do Porto.

Mendes, H. Gabriel, ed. 1982. *Cartografia portuguesa do Marquês de Pombal a Filipe Folque, 1750–1900: O património histórico cartográfico do Instituto Geográfico e Cadastral*. Lisbon: Fundação Calouste Gulbenkian.

Moreira, Luís Miguel. 2011. *O Alto Minho na obra do engenheiro militar Custódio José Gomes de Villasboas: Cartografia, geografia e história das populações em finais do século XVIII*. Lisbon: Centro de Estudos Geográficos, Universidade de Lisboa.

Portuguese Africa. The Portuguese presence in Africa during the eighteenth century must be measured against Portugal's increasing commitments in Brazil and its declining influence along the coasts of the Indian Ocean. The coastal areas of Africa controlled by the Portuguese were essentially ports of call along extensive maritime routes and staging points for the traffic in slaves sent to the Americas. It is also important to note that until 1752, East Africa was considered administratively part of the Portuguese East Indies (Magalhães 1998–2000).

The patterns of Portuguese colonial, political, and economic history explain the spurts of activity in the corpus of extant cartography found in Portuguese administrative and military archives. Small-scale geographical maps for diplomatic purposes from the reign of João V (1706–50) were followed by larger-scale maps of urban spaces and fortifications made during the government of Sebastião José de Carvalho e Melo, marquês de Pombal (1756–77), and by colonial scientific expeditions conducted during the reign of Maria I (1777–1816) toward the end of the century. Within this period, the importance of these spaces to the Portuguese administration varied, explaining the quantity and diversity of maps (Mendes 1969; Santos 1988).

There are few Portuguese images of the African continent as a whole. The existing maps correspond to large geographic regions and subregions (such as Angola and Mozambique) and in particular to topographical and urban cartography (Guinea, Cape Verde, and São Tomé). These images are imbued with military features, suggesting their strategic importance and centrality to defensive planning.

A notable manuscript atlas of Africa (1665) by João Teixeira Albernaz II (Archives nationales [France], NN*20, Afrique noº1) includes a general map plus twenty-eight charts of the coasts of the continent: two of the north coast, twelve of the west coast, one of the Monomotapa Empire, eleven of the east coast, and two of the Red Sea with details of its principal ports. Teixeira Albernaz's images provided the sources for Pieter Mortier's maps of Africa published in the *Suite du Neptune françois* (1700) (Alegria et al. 2007, 1021; Cortesão and Teixeira da Mota 1960–62, 5:36–41).

In 1708, Guillaume Delisle published a new image of equatorial Africa, also based on Portuguese textual and cartographic sources from the seventeenth century. Delisle's influence on Portuguese cartography continued with the publication of "Détermination geographique de la situation et de l'étenduë des differentes parties de la terre," presented in 1720 at the Académie des sciences and published in 1722 in the academy's *Mémoires*. Its political, diplomatic, and scientific consequences were felt in both Portugal and Spain as Delisle considered the problem of determining longitudes to establish the borders of the South American colonies (Teixeira da Mota 1964, 83–87; Furtado 2013, 105–11). The geopolitical negotiations surrounding the exploration of colonial territories based on this updated cartography extended to the African continent.

Luís da Cunha, the Portuguese ambassador to France, had discussed the longitude problem with Delisle and charged Delisle's successor as *premier géographe du roi*, Jean-Baptiste Bourguignon d'Anville, to conduct geographic and cartographic studies of Portugal's interests and holdings in southern Africa based on Portuguese sources. At stake were Portugal's commercial interests

FIG. 632. MAP OF THE MOZAMBIQUE CHANNEL AND THE STATES OF MONOMOTAPA, JEAN-BAPTISTE BOURGUIGNON D'ANVILLE, CA. 1725. This manuscript map of the channel between the west coast of Madagascar and the east coast of Mozambique and the states of Monomotapa resulted from discussions and the sharing of sources in Paris by the Portuguese ambassador to France, Luís da Cunha, and the map's author, d'Anville. D'Anville's work with Cunha informed his later printed maps of Africa and its regions, and they were followed by others.
Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [8322]).

advanced by the exploration of the territories between Angola and Mozambique but threatened by the increasing presence of other colonial powers (Teixeira da Mota 1962).

Four manuscript maps by d'Anville dating from 1725 represent the kingdoms of Congo, Angola, and Benguela; the space between Cabo Delgado and the equator and between Cabo Negro and Delagoa Bay (Maputo); Zambézia; and Monomotapa (fig. 632). These images were used to construct the *Carte de l'Ethiopie orientale* (1727), inserted in Portuguese Jesuit Jerónimo Lobo's posthumously translated and published *Voyage historique d'Abissinie* (1728). D'Anville later prepared new maps that significantly corrected the distance between the coasts of southern Africa: *Carte particuliere du royaume de Congo* (1731), *Carte particuliere des royaumes d'Angola, de Matamba et de Benguela* (1731), and *L'Ethiopie occidentale* (1732); maps that were included in Jean-Baptiste Labat's *Relation historique de l'Ethiopie occidentale* (1732). All these works were based on Portuguese geographical knowledge, which served d'Anville for his general map of Africa: *Afrique publiée sous les auspices de Monseigneur le Duc d'Orléans* (1749). This cartographic model was followed by many authors until the first quarter of the nineteenth century.

In 1783–84 in Lisbon, Jacinto José Paganino engraved six charts of the coasts of the African continent from Morocco to the Red Sea as a complement to a pilot book. These small-scale charts depict only the principal features of the coast, with significant ports drawn in detail and produced as insets on the printed charts, such as Mozambique Island or the port of Sofala (see fig. 523). Although they contain little new information, Paganino's works have an important place in the sparse history of printed Portuguese cartography in the eighteenth century.

In Portugal, where the technical capacities for engraving and editing maps were not extensive and where a consuming and collecting public was restricted, maps continued to be mostly manuscript. It was their international recognition derived from publication in foreign countries that in many cases allow these images to reach us.

JOÃO CARLOS GARCIA AND
JORGE MACIEIRINHA RIBEIRO

SEE ALSO: Geographical Mapping; Portugal; Topographical Surveying: Portuguese Africa, with Urban Mapping

BIBLIOGRAPHY

Alegria, Maria Fernanda, et al. 2007. "Portuguese Cartography in the Renaissance." In *HC* 3:975–1068.

Cortesão, Armando, and A. Teixeira da Mota. 1960–62. *Portugaliae monumenta cartographica*. 6 vols. Lisbon. Reprinted with an introduction and supplement by Alfredo Pinheiro Marques. Lisbon: Imprensa Nacional–Casa da Moeda, 1987.

Furtado, Júnia Ferreira. 2013. *The Map that Invented Brazil*. Trans. Flora Thomson-DeVeaux. São Paulo: Odebrecht; Rio de Janeiro: Versal.

Magalhães, Joaquim Romero. 1998–2000. "Os territórios africanos." In *História da expansão portuguesa*, 5 vols., ed. Francisco Bethencourt and K. N. Chaudhuri, 3:60–83. Lisbon: Temas e Debates.

Mendes, H. Gabriel. 1969. *Catálogo de cartas antigas da mapoteca do Instituto Geográfico e Cadastral*. Lisbon: Instituto Geográfico e Cadastral.

Mota, A. Teixeira da. 1962. *D. Luís da Cunha e a carta da África meridional de Bourguignon d'Anville (1725)*. Lisbon: Junta de Investigações do Ultramar.

———. 1964. *A cartografia antiga da África central e a travessia entre Angola e Moçambique, 1500–1860*. Lourenço Marques: Sociedade de Estudos de Moçambique.

Santos, Maria Emília Madeira. 1988. *Viagens de exploração terrestre dos portugueses em África*. 2d ed. Lisbon: Centro de Estudos de História e Cartografia Antiga.

Portuguese America. *America Portugueza* and *Brasil* were synonyms that identified a colonial possession of Portugal. Defined in 1494 by an imaginary line and divided into hereditary captaincies in 1534, the territory initially occupied the coastal zone of eastern South America. The discovery of gold mines (Minas Gerais, Goiás, Mato Grosso) and the development of cattle herding in the northeastern interior conditioned the expansion of territory well beyond the Tordesillas Line.

The end of the Iberian Union (1580–1640) resulted in a renewed discussion of the boundaries of the kingdom and colonies with Spain. These issues loomed larger in the eighteenth century, compelling João V (r. 1706–50), José I (r. 1750–77), and Maria I (r. 1777–1816) to encourage the diffusion of geographic science in Portugal, focusing on creating maps of the kingdom, colonies, bishoprics, and ecclesiastical territories.

The politics of overseas expansion was accompanied by increased knowledge and mapping with the desire to control the newly discovered lands. The Crown invested in training professionals capable of topographic, chorographic, and hydrographic surveying as well as designing complex military systems of defense. In this context, military engineers, Jesuit priests, and astronomers replaced cosmographers in importance.

Qualitative and quantitative changes occurred in eighteenth-century Portuguese cartography, with terrestrial maps predominating over nautical maps, especially coastal charts, and over the atlases that had flourished in the golden period of overseas expansion. In 1720, the kingdom's recently appointed *engenheiro-mor* (chief engineer), Manoel de Azevedo Fortes, was charged with designing a curriculum in the Academia Militar da Corte, Lisbon, that would prepare a new generation of engineers who could draw geographic, chorographic, and topographic maps. To compensate for the lack of books published in Portuguese and to fulfill a need to build a common method for surveying teams, Azevedo Fortes published the *Tratado do modo o mais facil, e o mais exacto de fazer as cartas geograficas* (1722) and *O engenheiro portuguez* (1728–29). These synthesized earlier French works on applied geometry and trigonometry, such as Claude-François Milliet Dechales's editions of Euclid's *Les éléments* (French editions from 1672) and Jacques Ozanam's *Methode de lever les plans et les cartes de terre et de mer* (1693) (Bueno 2011, 206–10).

However, sensing the urgency of mapping Portuguese America, João V decided not to wait for the Azevedo Fortes program to take effect; instead he contracted the services of Jesuit astronomers from Naples, Giovanni Battista Carbone and Domenico Capassi, to produce a "Novo atlas da América portuguesa" (Almeida 2001, 100–142), with latitudes and longitudes observed in loco. A decree of João V ordered Carbone to stay in Portugal, replaced by a Portuguese Jesuit priest, Diogo Soares, who accompanied Capassi to Brazil to participate in the so-called *missão dos padres matemáticos* (mission of the mathematician priests). Their legacy was twenty regional maps (covering Rio de Janeiro, São Paulo, Minas Gerais, and Goiás) and coastal surveys (from Cape Frio to Laguna). Their efforts provided the Portuguese with data on geographic coordinates of major villages in the south and in the interior. This information helped future negotiations with Spain in the preparation of the Treaties of Madrid (1750) and San

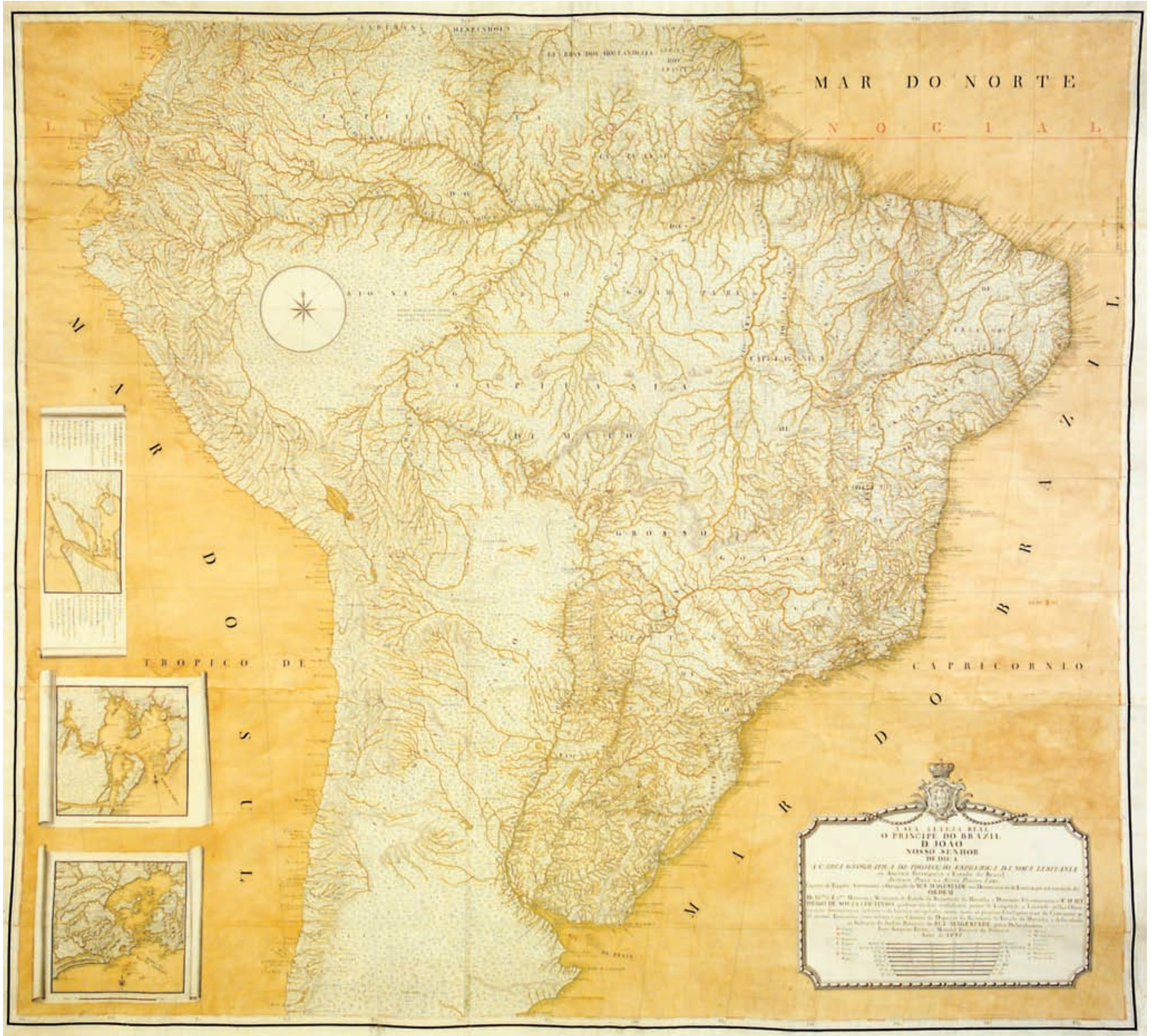


FIG. 633. JOSÉ JOAQUIM FREIRE AND MANOEL TAVARES DA FONSECA, DESIGNERS, "CARTA GEOGRAFICA DE PROJECÇÃO ESPHERICA DA NOVA LUSITANIA OU AMERICA PORTUGUEZA E ESTADO DO BRAZIL," 1797. This manuscript geographical map was compiled from more than seven dozen partial maps, using latitudes and longitudes observed in loco, involving thirty-four astronomers, engineers, and illustrators.
Size of the original: 128 × 142 cm. Image courtesy of the Observatório Astronómico da Universidade de Coimbra (Inv. de 2000, D-027).

Ildefonso (1777). The Jesuit data were combined with other cartographic sources into the "Mapa dos confins do Brazil com as terras da Coroa de Espanha na America meridional," called the Mapa das Cortes (Ferreira 2001, 55–90), which served as a foundation of the Treaty of Madrid (see fig. 447). Yet noticeable distortions in the Mapa das Cortes were carefully drawn in order to manipulate diplomatic decisions, such as mistakes in the longitude of the Mato Grosso zone that did not happen by chance; they dissimulated the true geodetic contours of the province in favor of Portugal.

Two expeditions sent to Brazil to survey the new frontiers produced innumerable topographic, chorographic, and geographic maps, representing the true contours, as seen in the "Carta geografica de projecção espherica da Nova Lusitania ou America portugueza e estado do Brazil" (1797) (fig. 633), drawn under the supervision of António Pires da Silva Pontes Leme (Bueno 2004, 229–43), the first general map of Brazil (Garcia 2001, 107–29).

Eighteenth-century maps of Portuguese America were made using improved instruments and scientific methods. The natural environment was measured mathematically and its representation codified, with an emphasis on relief, vegetation, fluvial areas, roadways, and urban centers as well as territorial frontiers in question. Most of the maps remained in manuscript, produced by and for the state for predominantly administrative purposes. In France during the Enlightenment, among the major contributors to the science of cartography were civil engineers. By contrast, Portuguese cartography was created by military engineers, Jesuit mathematicians, and astronomers. The maps of Brazil attest to the quality of those professionals during this period.

Growing ever larger, the territory of Portuguese America is represented in the 1797 "Carta geographica de projecção espherica da Nova Lusitania" at the end of eighteenth century consisting of the captaincies of Rio Negro, Pará, Maranhão, Piauí, Pernambuco, Bahia, Rio de Janeiro, Minas Gerais, Goiás, Mato Grosso, São Paulo, Rio Grande de São Pedro, and Colônia do Sacramento. Except for Colônia do Sacramento (Uruguay) and the Acre, it is almost the same image as today's Brazil.

BEATRIZ PICCOLOTTO SIQUEIRA BUENO

SEE ALSO: Administrative Cartography; Boundary Surveying; Geographical Mapping; Madrid, Treaty of (1750); Portugal; Property Mapping; Topographical Surveying; Urban Mapping

BIBLIOGRAPHY

Almeida, André Ferrand de. 2001. *A formação do espaço brasileiro e o projecto do Novo atlas da América portuguesa (1713–1748)*. Lisbon: Comissão Nacional para as Comemorações dos Descobrimentos Portugueses.

Bueno, Beatriz Piccolotto Siqueira. 2004. "A produção de um território chamado Brasil." In *Laboratório do mundo: Idéias e saberes do século XVIII*, ed. Artur Soares Alves et al., 229–43. São Paulo: Pinacoteca; Imprensa Oficial.

———. 2011. *Desenho e desígnio: O Brasil dos engenheiros militares (1500–1822)*. São Paulo: Editora da Universidade de São Paulo.

Ferreira, Mário Olímpio Clemente. 2001. *O Tratado de Madrid e o Brasil meridional: Os trabalhos demarcadores das partidas do sul e a sua produção cartográfica (1749–1761)*. Lisbon: Comissão Nacional para as Comemorações dos Descobrimentos Portugueses.

Garcia, João Carlos, ed. 2001. *A Nova Lusitânia: Imagens cartográficas do Brasil nas colecções da Biblioteca Nacional (1700–1822): Catálogo*. Lisbon: Comissão Nacional para as Comemorações dos Descobrimentos Portugueses.

Portuguese East Indies. By the beginning of the eighteenth century, the Portuguese Empire in the Orient had been considerably weakened after losing various outposts necessary to maintain the commercial, political, and military networks established during the sixteenth century, and the continued weakness of Portuguese forces threatened its demise. Strategically, the empire's presence in India was reduced to the territory of Goa, the so-called Northern Province (Chaul and Bassein until 1739), the coastal enclaves of Daman and Diu, and a few less profitable fortress settlements, like Mangalore, Calicut, and on the island of Angediva; in East Africa, Portugal controlled Sofala, Mombasa (until 1698 and between 1728 and 1729), the island of Mozambique and nearby Cabaceira, along with the Zambezi Valley. As for the Far East, in China the empire maintained a presence in the mercantile republic of Macao and in the Timor Sea on the islands of Solor and Timor, where a kind of Portuguese protectorate was created by Dominican clerics as a mission rather than a political outpost (Boxer 1969, 54–55; Marques 1998–2003, 2:18–19).

In the seventeenth century, as a result of attacks made by soldiers under orders from merchants of the Verenigde Oost-Indische Compagnie (VOC; United East India Company), the Portuguese lost the Moluccas (1605), Malacca (1641), and Ceylon (1658), along with their establishments in Malabar, namely Cochin (1663). Persians and English occupied Ormuz (1622), and the British Empire in India expanded: Bombay went to Charles II in 1662 as part of the dowry of Catherine of Braganza, and the English East India Company installed itself. The French and the Danish, also interested in India, tried to establish themselves on the Coromandel Coast and thus were not in direct competition with the Portuguese. Moreover, and because of the Jesuit proselytizing efforts, the Portuguese were prohibited from negotiating with Japan beginning in 1639, terminating an extremely lucrative trade agreement involving Chinese gold and silk for Japanese silver.

Toward the end of the seventeenth century and throughout the eighteenth, the Portuguese had to fight on the coasts and on the sea against other emerging powers, including Arab Omanis expanding from Muscat. In Hindustan, the first conquests of the Maratha Federation led to a Portuguese defeat between 1737 and 1740, resulting in the loss of the Northern Province. The Marathas, organized as a federation of princes, led a revival of the Hindu ruling classes as the Islamic Mughal Empire declined. Attacks against the Portuguese presence also increased at sea in an upsurge of piracy that upset not only local commercial activities but also what remained of the region's ties to Lisbon, which continued to maintain infrequent but valuable contact with India (two or three ships per year). In 1743, the Portuguese increased their area of conquest in the region surrounding Goa, quadrupling the contiguous area under their control. This brought renewed attention to the Orient by government officials in Lisbon.

The American Revolution (1775–83) further strengthened Portuguese commercial activities with Asia because colonial products were sought after in Europe and because of difficulties navigating in the North Atlantic. Due to further disturbances caused by the Napoleonic Wars, by the end of the century Lisbon became the entry point for nearly all goods from India and China being supplied to Europe. The principal imports were tea, raw and prepared silk, cotton fabrics, dyed cotton, and porcelain. Raw cotton fabrics were essential for the growing stamping industry. Silks also continued to be important, a factor explaining why trade with China, centered in Macao, regained importance.

Its own position having improved, Macao renewed its trade with the west coast of India (Goa, Surat, and Bombay), with Bengala, and with the Malaysian archipelago. From 1773, travel reopened to Cochinchina and trade continued with Manila. Betel nuts, peppers, cotton, camphor, ivory, and sandalwood were added to the sale of teas, porcelains, and lacquers. The Portuguese fleet expanded and business became even more profitable as the consumption of opium increased in China. Macao's wealth increased and its trade expanded, but the Portuguese were not alone in their interest in Macao, which was after all a Chinese space. Although Lisbon and Goa may have controlled the trade routes, China demanded taxes and customs rights. To the detriment of the Leal Senado (Portuguese municipal council of Macao), the city and its merchants constituted the real governing power. The increased presence of the Crown with its regulations disrupted these long-standing market patterns. However, Chinese silks, tea, and porcelain—products that had always been appreciated by Europe—remained in demand. The Portuguese trade with Asia continued to be active, even though it no longer occupied the center of Portugal's mercantile activity as had occurred during the golden years of the 1500s.

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SEE ALSO: Geographical Mapping: Portuguese East Indies, with Topographical Mapping; Portugal; Urban Mapping

BIBLIOGRAPHY

Ahmad, Afzal. 1997. *Os portugueses na Ásia*. Lisbon: Imprensa Nacional–Casa da Moeda.

Boxer, C. R. 1969. *The Portuguese Seaborne Empire, 1415–1825*. London: Hutchinson.

Godinho, Vitorino Magalhães. 1993. "The Portuguese and the 'Carreira da India,' 1497–1810." In *Ships, Sailors and Spices: East India Companies and Their Shipping in the 16th, 17th and 18th Centuries*, ed. J. R. Bruijn and Femme S. Gaastra, 1–47. Amsterdam: NEHA.

Guinote, Paulo, Eduardo Frutuoso, and António Lopes. 2002. *As armadas da Índia, 1497–1835*. Lisbon: CNCDP.

Lopes, Maria de Jesus dos Mártires, ed. 2006. *O império oriental, 1660–1820*, 2 vols. Vol. 5 of *Nova história da expansão portuguesa*, ed. A. H. de Oliveira Marques and Joel Serrão. Lisbon: Editorial Estampa.

Magalhães, Joaquim Romero. 1998–2000. "As tentativas de recuperação asiática." In *História da expansão portuguesa*, 5 vols., ed. Francisco Bethencourt and K. N. Chaudhuri, 3:43–59. Lisbon: Temas e Debates.

Marques, A. H. de Oliveira, ed. 1998–2003. *História dos portugueses no Extremo Oriente*. 5 vols. in 6. Lisbon: Fundação Oriente.

Post-Route Map. See Transportation and Cartography: Post-Route Map

Prime Meridian. See Meridians, Local and Prime

Printing. See Reproduction of Maps: Engraving and Printing

Privilege and Copyright. The functions of privilege and copyright as they concerned cartography in the eighteenth century centered on the protection of creators of the engraved copperplates from which maps were printed and the intellectual property of the map's contents. This latter protection covered not only the geographical contents but also the form or shape of a printed map, if such form could be argued to be original, as a unique product of creative or mental endeavor. The difference between privilege and copyright lay in the fact that privilege or permission had to be requested (and often paid for) from a specific authority, while copyright was enacted as a statute giving a legal right to the creator to take action against unauthorized copying (provided certain requirements were met) without involving application or fees.

Privilege antedated copyright in the history of publishing and was its legal precursor (Scott 2010, 255). Permission or privilege was granted by a specific authority to make and sell a map, atlas, or globe. It protected the right of ownership to the exclusion of others for a specific time and for a specific geographic location. Any reproductions of the privileged item made within the specified time period or locale could legally be classified as counterfeits; privilege carried no authority outside of the specified time and place. During the long eighteenth century, the privilege-granting authorities might be individuals, such as a king, prince, mayor, bishop, officer of the court (e.g., Chancellor of the Seals), or institutions, such as an artisanal guild, city council, academy, university, or political entity (fig. 634).

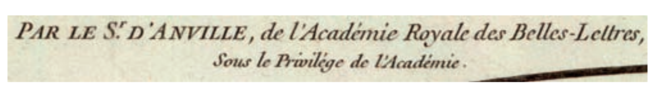

FIG. 634. PRIVILEGE FROM AN INSTITUTION, THE ACADÉMIE DES SCIENCES. Detail from Jean-Baptiste Bourguignon d'Anville, *Hémisphère oriental ou de l'Ancien Monde* (Paris: Chez l'Auteur, 1761); see figure 290.
Size of the entire original: 65 × 59 cm; size of detail: ca. 1.0 × 10.5 cm. Image courtesy of the David Rumsey Map Collection, David Rumsey Map Center, Stanford Libraries.

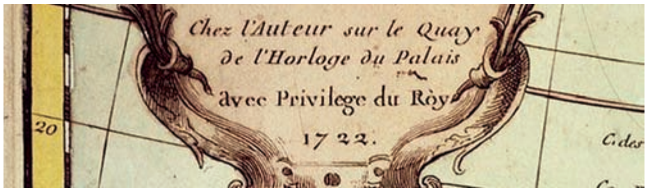

FIG. 635. *PRIVILÈGE DU ROI*, 1722. Detail from the cartouche of Guillaume Delisle, *Carte d'Afrique dressée pour l'usage du roy* (Paris: Chez l'Auteur, 1722); see figure 289.
Size of the entire original: 50.0 × 64.5 cm; size of detail: ca. 4.0 × 13.5 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [7771]).

Peter Fuhring (1985–86) offered a detailed analysis of privilege and the print trade in France, aspects of which may be understood to affect the map trade. He described two types of privilege: *privilège exclusif* (exclusive rights), also called *privilège général*, by which the owner could make, distribute and sell products in France for a limited period (three to twenty years) with the provision that counterfeits would be confiscated and a fine imposed on the copyist, and the *privilège simple* or *permission simple* (nonexclusive rights), which allowed the owner to sell his work to more than one publisher within a three- to six-year time limit and with no protection against counterfeits. From 1714, the Académie royale de peinture et de sculpture enjoyed a general privilege without a time limit, allowing any engraver who was an academy member (*graveur du roi*) to publish his work "avec privilège du roi" with no fee and the deposit of two copies of his prints to the academy (Fuhring 1985–86, 176, 187–89) (fig. 635).

In France, a government decree (*arrêt du Conseil*, 16 December 1704) forbade anyone with the title *géographe du roi* from publishing a map without receiving a privilege first and enjoined the map from being sold without a privilege. While this was designed to protect the author of the work and the owner of the printing plate, it also served to control information regarding the kingdom's cities and citadels from falling too easily into enemy hands (although the chancellor Louis II Phélypeaux, comte de Pontchartrain, noted that such commercial maps did not serve military purposes as well as specially produced cartography, and that *ingénieurs géographes* and clerks of the army made such maps for profit) (Pastoureau 1988, 296–98). A further decree (*arrêt du Conseil*, 27 July 1734) determined that a privilege would protect the owner of the copperplate from the loss of revenue that a counterfeit copy could cause; the fine to a forger was between 1,500 and 10,000 livres and the confiscation of the copies, the forged plates, and the forger's tools (Fuhring 1985–86, 177–78).

The seeker of privilege applied to the chancellor or to the keeper of the seals. The price of a royal privilege varied according to its exclusivity and duration and the exact costs for engravers and prints; Fuhring cites parallels with the book trade for a general sense of costs. *Privilèges generales*, including the cost for the seal, were 31 livres 10 sous; a variant, the *privilège local*, operative in just one city, was about one third of the cost, ca. 10 livres; and the *permission simple*, around 5 livres (Fuhring 1985–86, 176, 178). The privilege was recorded in the register of the Communauté de la Librairie (the organization of the book trade), and an example of the print was deposited in the office of the Librairie, with another copy signed by the royal censor and retained for checking against any possible forgeries. Infringements of privilege in the print trade were brought to the attention of the lieutenant of police and the director of the book publishers trade, in whose archives in Paris such cases may be found (Fuhring 1985–86, 179).

In the Netherlands, protection for the publisher of a map was simplified by allowing the seller to receive copyright protection for a publication by being the first one to advertise it. This did not protect the contents of the map, which could be covered only by application for privilege or patent, a lengthy and expensive process, and which, like French privilege, applied only for a certain time period within a certain jurisdiction. The most common privilege of the period was that of the states of Holland and West Friesland, usually valid for fifteen years with a fine for infringement of 3,000 guilders and sequestration of the counterfeits (Van Egmond 2009, 213) (fig. 636).

One aspect of the Dutch system of privilege that affected the international map trade was the granting to Dutch map publishers the right to copy and distribute foreign maps. This allowed Pieter Mortier to acquire the sole rights to reprint the *Atlas nouveau* of Nicolas Sanson, originally published in Paris, for fifteen years (from 15 September 1690) and the privilege to copy and sell the French Dépôt de la Marine's *Le Neptune françois* from June 1693 (Van Egmond 2009, 213, 216;

FIG. 636. PRIVILEGE FROM A POLITICAL ENTITY, THE STATES OF HOLLAND AND WEST FRIESLAND, IN THE NETHERLANDS. Detail from the title page of Romeyn de Hooghe, *Cartes marines a l'usage des armées du roy de la Grand Bretagne*, 1693.
Size of the detail: 7 × 25 cm. Image courtesy of the Stephen S. Clark Library, University of Michigan, Ann Arbor (G 5833 .S65 1693 .H6).

FIG. 637. TEN-YEAR PRIVILEGE FROM THE AUSTRIAN MONARCHY. Detail from Georg Matthäus Vischer, *Archiducatus Austriæ inferioris accuratissima geographica descriptio* (Augsburg, 1670); see figure 945.
Size of the entire original: 118.5 × 174.0 cm; size of detail: ca. 4.5 × 8.5 cm. Image courtesy of the Woldan Collection, Österreichische Akademie der Wissenschaften, Vienna (Sammlung Woldan, K-III: OE/Inf. 36).

Pastoureau 1988, 293). Louis Renard similarly acquired the rights to publish and sell maps by Guillaume Delisle (Pedley 2005, 105). On the other hand, Dutch publishers such as Johannes Covens and Cornelis Mortier also maintained noncopy agreements with foreign publishers, promising not to copy either directly or indirectly each other's works. Upon application, Dutch privileges were subject to the scrutiny of the local booksellers' guild, which might protest the granting of exclusive privilege if it meant financial loss for others in the trade (Van Egmond 2009, 212–14, 218). It also occurred that once a privilege was granted, a publisher like Pieter Mortier might use his outdated privilege for one work as a protection for an entirely different one. "Perhaps at Covens & Mortier it was felt that by continuing to mention these privileges people would be frightened away from copying documents" (Van Egmond 2009, 216). Similar situations of privilege and permission (fig. 637) in other countries of Europe remain to be explored and analyzed.

Great Britain was the only European country in which copyright was legally established. While the Copyright Act of 1709/10 is "the foundation of modern copyright law in Britain, the Commonwealth and America," it offered protection only for literary work, usually printed from letterpress (Hunter 1987, 128). Three subsequent copyright acts affected printed map production: the Engraving Copyright Act of 1734/5 (8 Geo. II. c. 13), also known as "Hogarth's Act"; the Engraving Copyright Act of 1766 (7 Geo. III. c. 38); and the Prints Copyright Act of 1777 (17 Geo. III. c. 57). Each act progressively increased protection for both the map engraver and/or publisher and for the map's content.

The Engraving Copyright Act of 1734/5 was "for the Encouragement of the arts of designing, engraving, and etching, historical and other Prints, by vesting the Properties thereof in the Inventors and Engravers" (Hunter 1987, 133). Its chief provision was to vest the property of designs, engravings, and etchings in the inventors and engravers for fourteen years. This is the act referred to by the engraved phrases found on printed maps: "Published according to Act of Parliament," or "Published as the Act directs," or "Published in accordance with the Act" along with the name of the publisher and a date. This line of text constituted a copyright mark. The penalty for illegal copies was the forfeiture of the plates and the printed sheets, 5 shillings for every print in the custody of the pirate, and a fine of 2s 6d to the king and the same amount to the plaintiff. Hogarth's Act did not protect content before publication nor did it protect the person or publisher who had employed an artist or engraver, even though the publisher had paid for the work (Hunter 1987, 132–33).

The Engraving Copyright Act of 1766 began to remedy the problems and lacunae of Hogarth's Act as "An Act to amend and render more effectual an Act made in the eighth year of the reign of King George the Second, for encouragement of the arts of designing, engraving, and etching, historical and other prints." This act expanded protection from designer to any engraver who produced prints from "any portrait, conversation, landscape, or architecture, map, chart, or plan, or any other print or prints whatsoever" (quoted in Hunter 1987, 143). The duration of the copyright, the first to specifically mention maps, was extended to twenty-eight years; recovery costs were expanded to the full amount; and the time period in which an offense could be prosecuted was extended to six months (fig. 638).

The ability to pursue a counterfeiter or pirate of engraved work was reinforced with the Prints Copyright Act of 1777: "An Act for effectually securing the property of prints to inventors and engravers, by enabling them to sue for and recover penalties in certain cases." Maps, charts, and plans were once again specifically included in the list of protected work, and the penalties

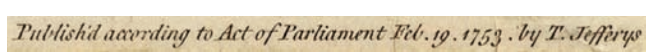

FIG. 638. COPYRIGHT STATEMENT FROM GREAT BRITAIN. Detail from John Green, *A Chart of North and South America including the Atlantic and Pacific Oceans*, 1753. The date was an important element in the statement, since it marked the beginning of the time-limited duration of copyright and of the period in which an offense could be prosecuted.
Size of detail: ca. 0.5 × 10.0 cm. Image courtesy of the David Rumsey Map Collection, David Rumsey Map Center, Stanford Libraries.

included damages and double costs upon conviction. No limit was placed on the time in which a suit could be brought (Hunter 1987, 145).

The copperplates of the map publisher or print engraver represented intellectual property convertible into capital, explained in the words of the French engraver Pierre-François Basan: "My plate represents my house, my proofs, my lodgers; it is the income built on my work and must last until the capital is used up [i.e., the plate exhausted]" (quoted in Casselle 1976, 25). The laws and statutes alone reveal little about the process of protection as enforced by licensing authorities or by the law courts. Among the impediments to the legal pursuit of copyists or counterfeiters was the cost of the chase. The plaintiff or aggrieved party had to hire lawyers for representation in civil (Chancery) or criminal (King's Bench) court in England. In France, complaints were lodged with a representative of the *lieutenant général de police*, who was charged with supervising the book and print trade, and such a complaint could be expensive (3 livres for the *commissaire* and 15 sous for his clerk) (Garrioch 1986, 8). An increase in legal cases is evident in England after the passage of the acts of 1766 and 1777, which specifically enumerated maps, charts, and plans, thus emboldening publishers and creators of maps to pursue their perceived counterfeiters under the law (Alexander 2013). Complaints of copying or plagiarism were also lodged informally, through the periodical press or printed pamphlet, but such descriptions had only the power of advertising, not enforcement except through the marketplace.

Case law provides clues to the legal standing of the intellectual property of the map in terms of its claim to copyright by meeting the requirements of registration and by meeting a standard of originality in its conveyance of information. The precise definition of what constituted originality inherent in the map's contents was the stumbling block in many suits. Most printed maps subject to copyright were compiled from a variety of sources, chief of which were often previously published maps. Commentary and judgment to substantiate charges of plagiarism or counterfeiting necessarily revolved around the extent to which a map was an original work. Two cases, one each from France and England, from the two ends of the century, will serve to illustrate this point regarding originality, which lay at the heart of proving infringement.

In France, Guillaume Delisle charged Jean-Baptiste Nolin with plagiarism. The adjudication of his claims, which appeared in the pages of the *Journal des Sçavans*, beginning with the issue of 8 March 1700, revolved around what geographical information could be construed as public knowledge and what was the result of scholarly compilation of varied sources (Broc 1970). At issue was a series of maps (the world and five continents) published by Nolin in 1700 that incorporated certain unpublished geographical ideas of Delisle, gleaned from Delisle's manuscript globe prepared for the private use of Chancellor Louis Boucherat. These conjectures included the Sea of the West and the depiction of California as a peninsula. Because Delisle's globe was in manuscript, he had no need to present it for the assignment of privilege. The "case," which was argued by Delisle and Nolin in the *Journal des Sçavans* from 1700 to 1705, was finally summarized by Delisle in a *memoire* to the king and his council in 1706. A panel comprising persons knowledgeable in geography, including Giovanni Domenico Maraldi (II) and Jacques Cassini (II), was called to examine the maps and the two geographers closely. Delisle was able to justify the construction of his maps from which the manuscript globe was compiled, while Nolin, admitting to knowing little mathematics, was barely able to explain the use of geographical *memoires* and he "ignore[d] . . . the basic principles of geography" (quoted in Broc 1970, 148; Pastoureau 1988, 298). The judges made clear that geographical knowledge that was secure and agreed upon was the property of everyone, but that "discoveries," that is, the intellectual work of compilation from varied sources, requiring judgment and knowledge, belonged to the geographer who created them. The experts recommended on behalf of Delisle, and the Conseil du Roi fined Nolin fifty livres, ordering the plate of his *mappemonde* to be effaced (though he was allowed to keep the copperplate for reengraving) (illustrated in Pedley 2005, 108). Meanwhile, Pieter Mortier in Amsterdam copied and sold the disputed Nolin map with impunity (illustrated in Pastoureau 1988).

The results of the Delisle-Nolin case led to the government decree (*arrêt du Conseil*, 19 July 1706) that determined that the counterfeiting of maps should be judged on the basis of how the maps had been composed, not their superficial appearance. In the words of the decree: "One will judge the counterfeits by the works themselves following the example of these two men [Delisle and Nolin]. The mystery of the construction of maps, which so many people regard as a kind of black magic, will be revealed through the diligence of the examiners" (quoted in Pastoureau 1988, 301). Further control of cartographic content was instituted with the decree of 10 June 1786 requiring all geographers, engravers, and anyone else wanting to publish and sell maps to obtain permission from the *garde des Sceaux* and to present the manuscript design and engraved proofs along with supporting materials before publication (*arrêt du Conseil d'État du roi*, 10 June 1786), thus acknowledging the creative and mental labor involved in the compilation and design of a map, the process itself constituting the intellectual property.

At the other end of the century and across the Channel, the case of *Sayre* [*sic*] *v. Moore* (1785; 102 Eng. Rep. 139) elucidated the difference between geographic content subject to copyright and geographic content that could be construed as public domain. The case rested on whether John Hamilton Moore had infringed on Robert Sayer's copyright by copying four charts published by Sayer and combining them into a single map on which Moore had made alterations and improvements. The judge, Lord Mansfield, found for Moore, holding that "whoever has it in his intention to publish a chart may take advantage of all prior publications. There is no monopoly of the subject." In fact, Mansfield found that Sayer's charts had been drawn "upon a wrong principle, inapplicable to navigation. The defendant therefore has been correcting errors, and not servilely copying" (quoted in Hunter 1987, 147; see also Skelton 1960; Alexander 2010, 303). At the same time, the lawsuits emanating from the publication of *Paterson's Roads* (1771) and similar itineraries in the 1780s (*Carnan v. Bowles* and *Cary v. Newbery*) also tackled the problem of representation of geographical "facts" and the originality of design and improvement of information, as well as concerns regarding the duration of copyright (Alexander 2015).

In almost every instance, infringement of copyright or privilege was rooted in the desire to save on production costs and had economic consequences for all participants (Pedley 2005, 96–118). In addition to their legal importance, court cases and published complaints reveal much about the working practices of map publishers, their financial arrangements, their sources of material, and the conditions of the marketplace, and thus deserve further research.

MARY SPONBERG PEDLEY

SEE ALSO: Map Trade; Public Sphere, Cartography and the; Reproduction of Maps: Engraving and Printing

BIBLIOGRAPHY

Alexander, Isabella. 2010. "The Genius and the Labourer: Authorship in Eighteenth- and Nineteenth-Century Copyright Law." In *Copyright and Piracy: An Interdisciplinary Critique*, ed. Lionel Bently, Jennifer Davis, and Jane C. Ginsburg, 300–308. New York: Cambridge University Press.

———. 2013. "A Map, a Poem and Two Copyright Statutes." *Australia & New Zealand Law & History E-Journal*, Refereed paper no. 5.

———. 2015. "The Legal Journey of *Paterson's Roads*." *Imago Mundi* 67:12–32.

Bently, Lionel, and Martin Kretschmer, eds. *Primary Sources on Copyright (1450–1900)*. Online publication.

Broc, Numa. 1970. "Une affaire de plagiat cartographique sous Louis XIV: Le procès Delisle-Nolin." *Revue d'Histoire des Sciences et de Leurs Applications* 23:141–53.

Casselle, Pierre. 1976. "Le commerce des estampes à Paris dans la seconde moitié du 18ème siècle." Thèse, École nationale des chartes, Paris.

Egmond, Marco van. 2009. *Covens & Mortier: A Map Publishing House in Amsterdam, 1685–1866*. Houten: HES & De Graaf.

Ehrensvärd, Ulla. 1977. "Peter Gedda's Maritime Atlas of the Baltic, 1695." *Imago Mundi* 29:75–77.

Fisher, Susanna. 2001. *The Makers of the Blueback Charts: A History of Imray Laurie Norie & Wilson Ltd*. Ithaca: Regatta Press.

Fordham, Herbert George. 1922. *Une piraterie littéraire au dix-huitième siècle: Les contrefaçons de la Liste générale des postes de France des Jaillot, 1708–1779*. Cambridge: Imprimerie de l'Université.

Fuhring, Peter. 1985–86. "The Print Privilege in Eighteenth-Century France—I and II." *Print Quarterly* 2:175–93, 3:19–33.

Garrioch, David. 1986. *Neighbourhood and Community in Paris, 1740–1790*. Cambridge: University Press.

Hofmann, Catherine. 2000. "Les 'théâtres de la guerre' ou la carte entre mémoire et anticipation (XVII^e^ et XVIII^e^ siècle)." *Revue de la Bibliothèque Nationale de France*, no. 4:39–42.

Hunter, David. 1987. "Copyright Protection for Engravings and Maps in Eighteenth-Century Britain." *Library*, ser. 6, 9:128–47.

Pastoureau, Mireille. 1988. "Contrefaçon et plagiat des cartes de géographie et des atlas français de la fin du XVI^e^ au début du XVIII^e^ siècle." In *Les presses grises: La contrefaçon du livre (XVI^e^–XIX^e^ siècles)*, ed. François Moureau, 275–302. Paris: Aux Amateurs de Livres.

Pedley, Mary Sponberg. 2005. *The Commerce of Cartography: Making and Marketing Maps in Eighteenth-Century France and England*. Chicago: University of Chicago Press.

Scott, Katie. 2010. "Maps, Views and Ornament: Visualising Property in Art and Law, the Case of Pre-Modern France." In *Privilege and Property: Essays on the History of Copyright*, ed. Ronan Deazley, Martin Kretschmer, and Lionel Bently, 255–88. Cambridge: Open Book Publishers.

Skelton, R. A. 1960. "Copyright and Piracy in Eighteenth-Century Chart Publication." *Mariner's Mirror* 46:207–12.

Probst Family. See Seutter, Probst, and Lotter Families

Projections.

GEOGRAPHICAL MAPS
MARINE CHARTS
TOPOGRAPHICAL SURVEY PLANS

Projections Used for Geographical Maps. Enlightenment geography featured a profound tension between graphic and mathematical approaches to describing and creating the networks of meridians and parallels that structured world and regional maps. The graphic approach described how to draw meridians and parallels to make a map, while the mathematical approach expressed the relationship of meridians and parallels to the sphere of the earth in geometrical terms. While it is tempting to emphasize the increasingly analytical treatment of map projections by Enlightenment mathematicians, and especially by Johann Heinrich Lambert in 1772, most geographical maps were made on easily drawn projections that were among the many designed during the Renaissance (Snyder 2007). In outlining the contrasts between the graphic and the mathematical, this entry builds on the substantial work of John Snyder (esp. 1993, 55–94), to which reference should be made, especially for information about technical details not covered here.

That projections were essentially geometrical in nature was repeatedly asserted by books on general and mathematical geography, beginning with Bernhardus Varenius's highly influential *Geographia generalis* (1650). These works all began their accounts of map projections with explanations of the geometry underpinning the polar aspect of the three projections known since antiquity. Each of the three projected the earth's surface onto an imaginary plane touching the earth at a pole but differed in their point of perspective: the center of the earth (gnomonic projection), the opposite pole (stereographic), and infinity (orthographic) (Snyder 1993, 4, 16–28). (The three are today known as azimuthal projections because they preserve the angles [azimuths] between great circles at the center of projection.) Yet most of the other map projections described in geographical texts—including the azimuthal equidistant and the equatorial (transverse) and oblique aspects of the three anciently known azimuthal projections—were not easily defined by such straightforward perspective geometry. They were instead explained in terms of their graphic construction. In this respect, Enlightenment geographers pragmatically favored existing projections that required only easily drawn straight lines, arcs of circles, or relatively simple sequences of arcs of circles. A complex issue was constructing the projection so that it would fit the geographer's paper, especially for a printed map (Hildyard 2014, 26–29).

Most practicing geographers were not interested in making any adjustments for the earth's spheroidal shape, even when it became progressively refined, because the effects of the earth's flattening were minimal at the small scales of world and regional maps. Nonetheless, many geographers wanted to use projections that maintained some correspondence between the map and the earth's surface, whether by maintaining scale along certain lines (equidistance), preserving angles and shapes (conformality), or conserving the relative sizes of different areas (equal-area or equivalency). And, of course, a few scholars did seek to mathematize that correspondence, as when Edmond Halley proved in the 1690s that the stereographic projection is indeed conformal (Snyder 1993, 20–21).

In these circumstances, geographers used only a small repertoire of projections for almost all geographical maps. They favored the azimuthal stereographic projection for regions bounded by small circles (such as polar caps) or great circles (hemispheres). They did so for several reasons. In all aspects, the projection used either straight lines or arcs of circles to draw meridians and parallels. It enlarged rather than unduly compressed regions around the limb of the hemisphere, as can be seen in the increasing spacing of parallels on Guillaume Delisle's 1714 polar-aspect map of the Southern Hemisphere (see fig. 762). Moreover, the stereographic projection is conformal and was extensively used for mapping the celestial sphere; mapping the earth in the same manner was very much in line with contemporary ideas of the unity of the cosmos. Indeed, stereographic projections of celestial and terrestrial spheres were both commonly called "planispheres" (Snyder 2007, 376). The stereographic was used in its polar aspect for maps of the Northern and Southern Hemispheres and in its equatorial aspect for the Eastern and Western Hemispheres on the innumerable double-hemisphere world maps. Beyond the intrinsic properties of the stereographic projection, depicting the world as two hemispheres had a marked iconographic benefit. In addition to cleanly distinguishing between the Old and New Worlds, geographers could fill the spandrels with cosmographical imagery: small celestial hemispheres and allegories of the seasons, elements, planets, and continents were common throughout the era, and geographers also increasingly included astronomical diagrams and information in the gaps between hemispheres and neatline.

The oblique aspect of the stereographic, first described by Varenius (Snyder 1993, 27–28), was used only sporadically and then generally to represent the natural division between the land and water hemisphere (Bode 1783, 1). However, each geographer's decision to center the land hemisphere on his own nation's capital—whether London, Paris, Vienna, or Berlin (fig. 639)—was clearly politically inspired. Geographers rarely used the other azimuthal projections: the orthographic and gnomonic were each used only in celestial mapping; the nonperspective, equidistant azimuthal was uncommon, although it was famously used by Jacques Cassini (II) for his 1696 world map (see fig. 147), based on his father's map of 1682 drawn on the floor of the Paris Observatory.

In mapping particular regions, geographers generally used just six projections that were all easily drawn, with most possessing a consistent correspondence with the earth. The first three, all featuring straight meridians, were associated with Renaissance editions of Claudius Ptolemy's *Geography*. The equirectangular projection (or *plate carrée*), with its grid of equally spaced straight meridians and parallels, was used terrestrially to display the results of topographical surveys over small areas, but was sometimes used for larger regions (fig. 640, upper). The trapezoidal projection modified the equirectangular grid by angling the meridians to approximate their convergence toward the poles (fig. 640, middle). The trapezoidal projection was completely displaced by 1800 by the simple equidistant conic projection, constructed from concentric arcs of circles for parallels and straight meridians converging at a pole (fig. 640, lower). The

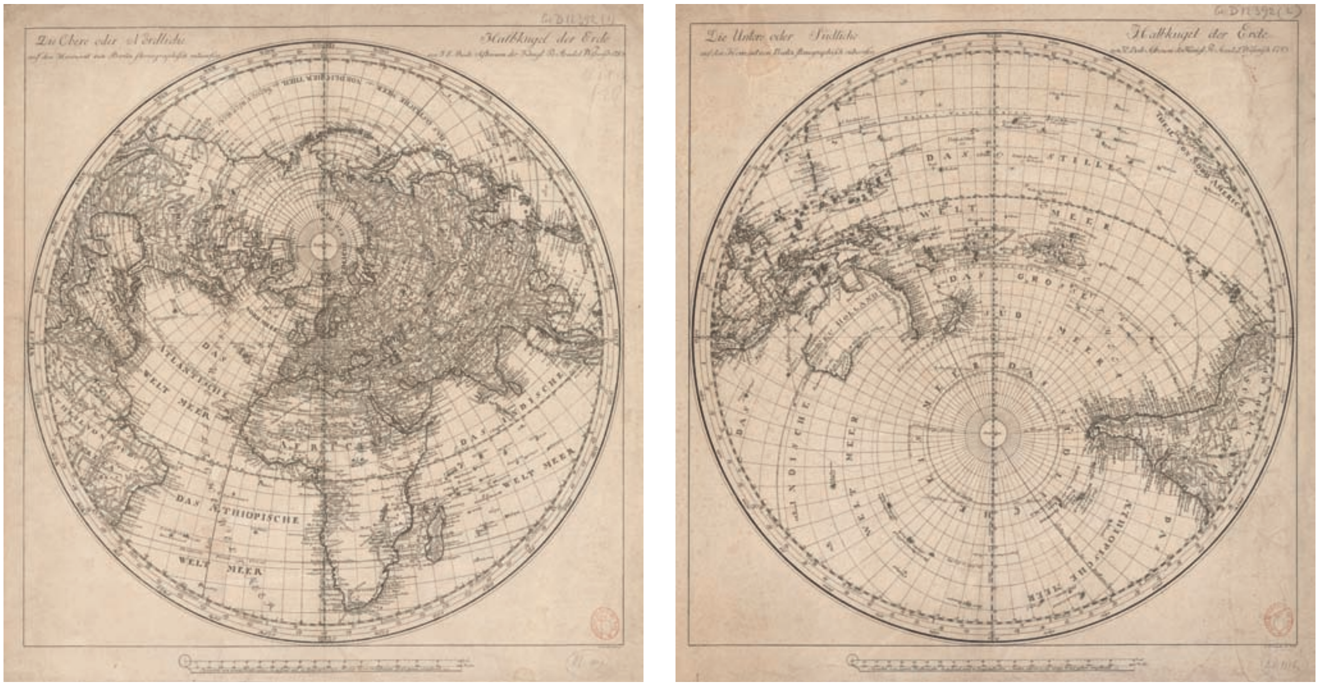

FIG. 639. OBLIQUE-ASPECT STEREOGRAPHIC PROJECTIONS OF THE LAND AND WATER HEMISPHERES, CENTERED ON BERLIN AND ITS ANTIPODES. Johann Elert Bode, *Die obere oder nordliche* [and *Die untere oder südliche*] *Halbkugel der Erde auf den Horizont von Berlin stereographisch entworfen* (Berlin, 1783).

Size of each original: 47 × 43 cm. Images courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge D 12392 [1] and [2]).

conic projection was occasionally modified by defining two standard parallels along which scale was preserved; Joseph-Nicolas Delisle described such a projection for mapping Russia in 1728 (Gnucheva 1946, 127–29) and it was first used for the general map of the empire in the *Atlas Rossiyskoy* (1745) (see fig. 316).

The other three commonly used regional projections were developed in the Renaissance with curved meridians to better capture the sense of the earth's curvature. The equal-area sinusoidal, often known as the Sanson-Flamsteed projection after two prominent Enlightenment advocates, Nicolas Sanson and John Flamsteed, is effectively a modified trapezoidal projection: the parallels are drawn as straight, equally spaced lines; each parallel is then divided into equal portions for the appropriate separation of meridians at its latitude; finally, the meridians are drawn as series of arcs of circles between the points so defined (fig. 641, upper). The Bonne projection, defined before 1600 but again named after an Enlightenment proponent, Rigobert Bonne, was constructed in the same manner as the sinusoidal, but with the parallels being first drawn as equally spaced, concentric arcs of circles (fig. 641, middle). Finally, geographers also commonly used the equatorial aspect of the conformal stereographic projection (fig. 641, lower); the equatorial stereographic was also the usual foundation of globe gores (fig. 642).

The manner in which the equatorial stereographic exaggerated areas away from the center of projection, as evident around the limb of any hemisphere on the projection, led a few geographers to develop replacement projections for mapping hemispheres that were low error rather than equidistant, equal-area, or conformal. In 1660, Giovan Battista Nicolosi introduced a simplified projection for an equatorial aspect hemisphere in which all parallels and meridians remained as arcs of circles but were equally spaced along the equator and central meridian (see fig. 483). Nicolosi's innovation remained little used until Aaron Arrowsmith resurrected it for his 1794 world map; in line with established English practice for labeling any projection with curved meridians and parallels, Arrowsmith called it the "globular" projection, a name that has been retroactively applied to Nicolosi's projection and to its medieval and Renaissance predecessors (Snyder 1993, 40–42, 67). Alternative low-error azimuthal projections were proposed by Philippe de La Hire in 1701 and Antoine Parent in 1702, who both selected alternate perspective points from which to geometrically project the earth onto the plane; their projections were equally little used (Snyder 1993, 65–67).

Another conformal alternative to the equatorial stereographic, applicable to both regional and world maps, was the rectangular projection famously designed by Gerardus Mercator for his 1569 world map. Mercator had intended this projection to assist mariners: by exponentially increasing the distance of parallels from the equator, lines of constant bearing (rhumb lines) appear as straight lines cutting all meridians at a constant angle, so a course might be easily determined (Snyder 1993, 44–47) (see fig. 643). However, general navigational practice deterred mariners from using charts on the projection, and its key property came at the cost of excessive areal distortions that deterred geographers (Green 1717, 106). The ever-increasing separation of the parallels also made it rather difficult to construct well.

The occasional adoption of the Mercator projection by Enlightenment geographers thus suggests the involvement of factors other than functionality. The projection was sometimes used, as in Henry Popple's *A Map of the British Empire in America* (1733), to map extensive regions that were not well suited to the standard projections (Snyder 1993, 59–60). More generally, the projection's use by English geographers manifested a protonationalism: in the later seventeenth century both Robert Hooke (Hildyard 2014, 25) and Edmond Halley (Snyder 1993, 47) asserted that the projection had actually been invented by the Englishman Edward Wright, from whom Mercator had stolen it, so that it should properly be called "Wright's projection." The claim was quite wrong: Wright had explained the mathematics of the projection in his *Certaine Errors in Navigation* (1599), but he had been only eight years old in 1569. Nonetheless, John Green (1717, 94–95) repeated and further popularized the nationalistic claim.

Green's own use of the Mercator projection also possessed markedly maritime connotations. In his 1753 six-sheet "chart" of North and South America on the projection, Green emphasized the tracks of marine explorers

Equirectangular (Duval, 1684)

Trapezoidal (Nolin, 1704)

Simple Conic (Bowen, 1752)

FIG. 640. COMMONLY USED REGIONAL MAP PROJECTIONS: STRAIGHT MERIDIANS. The equirectangular projection (or *plate carrée*), used in the earliest Latin manuscripts of Claudius Ptolemy's *Geography*, was recommended by its simplicity; it was equidistant along meridians but markedly exaggerated the lengths of parallels away from the equator. The trapezoidal projection was a fifteenth-century refinement: almost equidistant along the parallels, meridians make sharp angles at the equator. Renaissance geographers also reconfigured Ptolemy's first world-map projection to produce the simple conic projection, equidistant along the meridians. From top down: Pierre Duval, *La Barbarie, le Biledulgerid, le Zaara, la Nigritie, &c.*, 1684 (ca. 40 × 102 cm); Jean-Baptiste Nolin, *L'Afrique*, 1704 (44 × 58 cm); and Emanuel Bowen, *A New & Accurate Map of the Southern Parts of Africa*, 1752 (33 × 41 cm).
Images courtesy of the Universität Bern, Zentralbibliothek, Sammlung Ryhiner (respectively, Ryh 7604:1, Ryh 7601:36, and Ryh 7605:15).

Sinusoidal or Sanson-Flamsteed (Sanson, after 1721)

Bonne (Delisle, 1700)

Equatorial stereographic (Lotter and Lotter, after 1777)

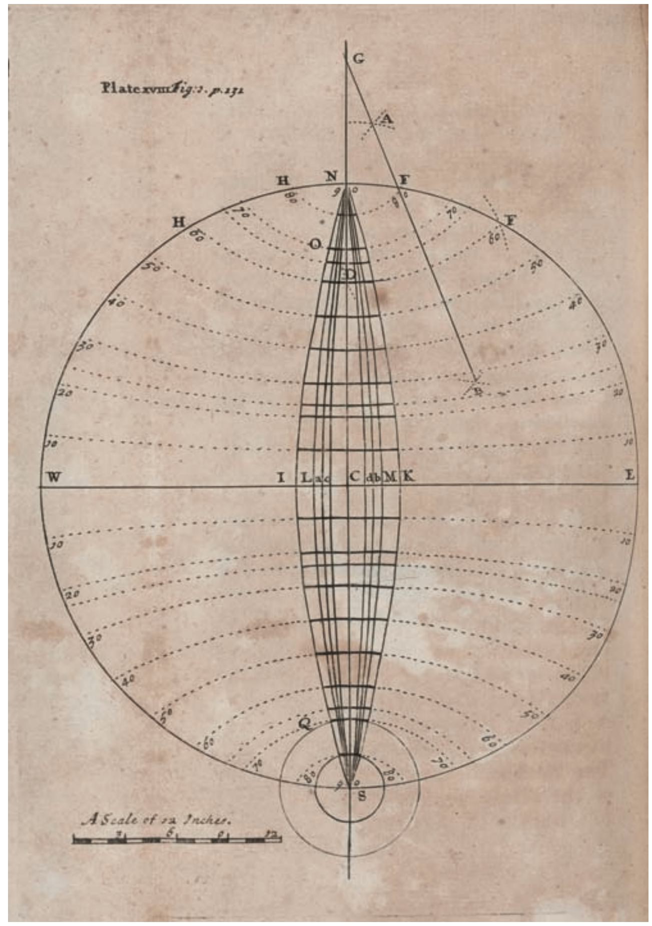

FIG. 642. THE CONSTRUCTION OF A GLOBE GORE FROM THE EQUATORIAL ASPECT OF THE AZIMUTHAL STEREOGRAPHIC PROJECTION. From Green 1717, pl. 18, fig. 3.
Image courtesy of the Osher Map Library and Smith Center for Cartographic Education at the University of Southern Maine, Portland (OS-1717-1).

FIG. 641. COMMONLY USED REGIONAL MAP PROJECTIONS: CURVED MERIDIANS. Renaissance geographers turned the trapezoidal projection into the equal-area sinusoidal by having curved meridians cut the straight parallels at intervals that were true to scale. Then, constructing the parallels as arcs of circles produced the equal-area Bonne projection. The equatorial sterographic projection was conformal; it is marked by the curving of its parallels away from the straight equator. From top down: Guillaume Sanson, *L'Afrique*, after 1721 (52 × 85 cm); Guillaume Delisle, *L'Afrique*, 1700 (44 × 57 cm); Matthäus Albrecht Lotter and Georg Friedrich I Lotter, *Afrique*, after 1777 (46 × 56 cm).
Images courtesy of the Universität Bern, Zentralbibliothek, Sammlung Ryhiner (respectively, Ryh 7601:28, Ryh 7601:45, and Ryh 7602:39).

FIG. 643. A SEA CHART OF THE WORLD ON THE MERCATOR PROJECTION. The projection is indicated both by the enlargement of the northern continents toward the poles and by the marginal scales for latitude. Except for the colored lines marking the equator, the tropics, and the Arctic circle, what seem to be parallels of latitude are part of the mesh of rhumb lines inherited from plane charts. Gerard van Keulen, *Nieuwe wassende graaden paskaart vertoonende alle de bekende zeekusten en landen op den geheelen aard boodem of werelt* (Amsterdam, after 1720).

Image courtesy of the Osher Map Library and Smith Center for Cartographic Education at the University of Southern Maine, Portland (OS-1720-10).

and their astronomical observations of latitude and longitude (see fig. 342). The use in geographical mapping of the Mercator projection as a visual appeal to maritime experience and the growth of empirical knowledge was not limited to British geographers. Gerard van Keulen, whose family firm would become official chartmaker to the Dutch Verenigde Oost-Indische Compagnie (VOC), produced a world map on the projection in 1720 (fig. 643). Its title ("the new increasing-degrees sea chart displaying all the known seacoasts and lands of the whole world") emphasized the chart as a product of marine skill and labor, graphically indicated by its crisscrossing rhumb lines. The chart's allegorical depiction of the four continents in the title cartouche highlighted the commodities of global trade, in return for which Europe offered knowledge, the arts, and true religion (Wintle 2008, 24–25). The two purposes, the practical and the metaphorical, support the idea that this work was intended as much for the Dutch public as for mariners.

Unlike double-hemisphere world maps, world maps on the Mercator projection presented the earth as a continuous and uninterrupted surface. Edmond Halley used it for maps of magnetic variation and winds, and Didier Robert de Vaugondy for maps of the global distribution of religions, skin color, and physiognomy in his *Nouvel atlas portatif* (1762). Such use of the Mercator projection for world maps removed the earth from the single cosmos commonly celebrated by the double-hemisphere world maps, with their spandrels full of cosmographical images. The result was the same as when some Enlightenment geographers stripped all surrounding imagery from their double-hemisphere world maps, as Guillaume Delisle did in 1700 (see fig. 201). The Mercator projection offered the geographer the ability to redirect attention from the cosmos to the sublunar, terraqueous globe.

Wright's analysis of the Mercator projection was the first mathematical analysis of any map projection. Additionally, Wright had also published in 1599 a table of meridional parts, that is, the length of each degree of latitude along a meridian on the projection (Snyder 1993, 47–48). In 1741, after the French expeditions to Peru and Lapland had proven the earth to be flattened, Patrick Murdoch recalculated the meridional parts for the earth as an ellipsoid; later, around 1760, a better estimation of the earth's shape permitted him to revise them (Snyder 1993, 70–71). In a further contribution to the study of projections, Murdoch mathematically described three conic projections in 1758: one of them was the first explicit description of a geometrical projection of the earth onto a cone; the other two, like Delisle's in 1728, were the product of trial-and-error construction. The most important element of Murdoch's work was that he consciously sought to design projections that preserved correspondence with the earth, not only maintaining equidistance along the meridians but also ensuring that meridians and parallels intersected at right angles (Snyder 1993, 71–73). In this respect, Murdoch anticipated Johann Heinrich Lambert's fuller treatment of map projections in 1772.

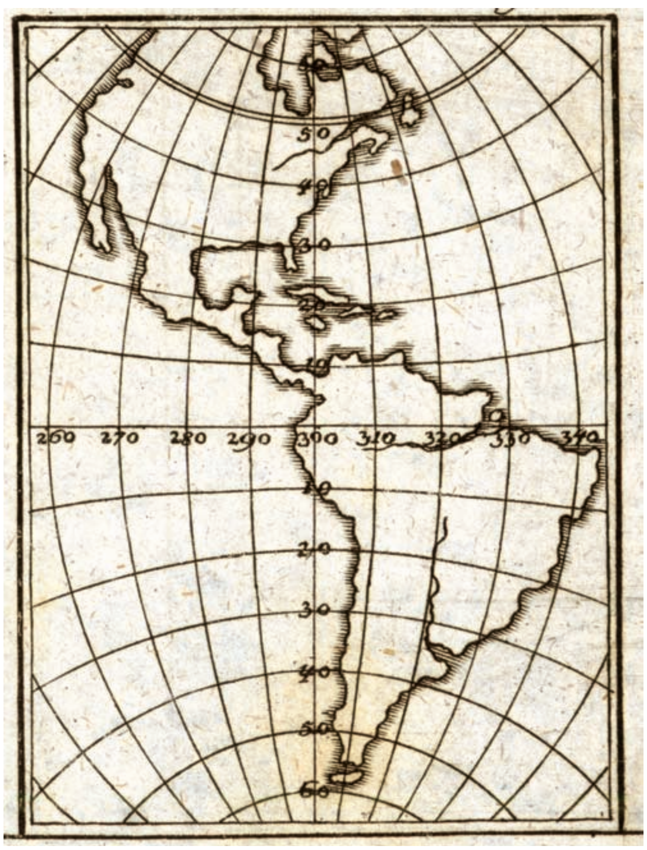

FIG. 644. LAMBERT'S TRANSVERSE MERCATOR PROJECTION. Lambert designed this projection to represent geographical regions of large north-south extent, such as the Americas, in a conformal manner but with less overall distortion than the sinusoidal projection. The transverse Mercator would be adopted in the twentieth century for large-scale military topographical surveys. From Lambert 1772, pl. 4, fig. 13. Size of the detail: ca. 7.5 × 5.5 cm. Image courtesy of the Harlan Hatcher Graduate Library, University of Michigan, Ann Arbor.

A mathematician rather than a geographer, Lambert considered some geometrical problems of representing both the earth and the celestial vault on a plane. In part, he responded to existing projections—for example, noting that the stereographic and Mercator projections were both conformal and wondering what intermediary versions might look like. But he also sought a more general treatment of the subject (Tobler 1972, x). He began by noting the several different ways in which a flat map might preserve some correspondence to the spherical earth (Lambert 1772, 105), and he then defined general solutions to maintaining these properties by ingenious applications of calculus to projections both directly onto the plane and onto the intermediate surfaces of cones and cylinders. He described seven new projections of the sphere. Three were conformal: a conical with two standard parallels (also ellipsoidal), the transverse Mercator (fig. 644), and a projection of the whole earth (fig. 645) now named after Joseph-Louis Lagrange. Four were equal-area: two cylindricals in both normal and transverse aspects, an azimuthal, and a conical. He also briefly derived formulae for the equatorial and oblique aspects of the azimuthal equidistant projection. None of these new projections was actually adopted by geographers until the twentieth century,

FIG. 645. LAMBERT'S CONFORMAL PROJECTION OF THE EARTH WITHIN A CIRCLE, NOW KNOWN AS THE LAGRANGE PROJECTION. From Lambert 1772, pl. 6, fig. 11.
Diameter of the original: ca. 12.5 cm. Image courtesy of the Harlan Hatcher Graduate Library, University of Michigan, Ann Arbor.

when his conformal conic, azimuthal equal-area, and transverse Mercator projections became widely used for regional maps or for systematic topographical surveys (Snyder 1993, 76–91).

But the principle behind Lambert's work, that map projections might be analytically defined, prompted further attention from other mathematicians. In a set of three papers delivered in 1775, Leonhard Euler analyzed Delisle's conical projection and defined a new minimal-error one; he laid out a general approach to conformal projections and proved that it is indeed mathematically impossible to represent the curved surface of the earth on a plane without some kind of distortion (*Euler Archive*, docs. 490–92; Snyder 1993, 73–74). Lagrange developed a general treatment of Lambert's conformal projection of the earth in which parallels and meridians are all circles and extended the treatment to the spheroid as well as the sphere (Lagrange 1781; Snyder 1993, 80–82). Early in the nineteenth century, as Carl Friedrich Gauss worked on the geometry of curved surfaces, he determined the ellipsoidal equations for the transverse Mercator (Snyder 1993, 98). Lambert's work thus stands at the threshold between pragmatic design and use of map projections throughout the early modern era and the proliferation of new projections designed by mathematical analysis after 1800.

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SEE ALSO: Geographical Mapping; Lambert, Johann Heinrich

BIBLIOGRAPHY

Bode, Johann Elert. 1783. *Beschreibung und Gebrauch einer auf den Horizont von Berlin entworfenen neuen Weltcharte in zween Hemisphären worauf die neuesten Entdeckungen angezeigt werden*. Berlin and Stettin: Friedrich Nicolai.

Euler Archive. Website hosted by the Mathematical Association of America.

Gnucheva, V. F. 1946. *Geograficheskiy departament Akademii nauk XVIII veka*. Ed. A. I. Andreyev. Moscow-Leningrad: Izdatel'stvo Akademii Nauk SSSR.

Green, John (Bradock Mead). 1717. *The Construction of Maps and Globes*. London: T. Horne et al.

Hildyard, Daisy. 2014. "John Pell's Mathematical Papers and the Royal Society's *English Atlas*, 1678–82." *BSHM Bulletin: Journal of the British Society for the History of Mathematics* 29:18–31.

Lagrange, Joseph-Louis. 1781. "Sur la construction des cartes géographiques." *Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-Lettres, année 1779*: 161–210.

Lambert, Johann Heinrich. 1772. "Anmerkungen und Zusätze zur Entwerfung der Land- und Himmelscharten." In *Beyträge zum Gebrauche der Mathematik und deren Anwendung*, 3 bks. in 4 vols., 3:105–99. Berlin: Verlag der Buchhandlung der Realschule.

Snyder, John Parr. 1993. *Flattening the Earth: Two Thousand Years of Map Projections*. Chicago: University of Chicago Press. Reprinted with corrections 1997.

———. 2007. "Map Projections in the Renaissance." In *HC* 3:365–81.

Tobler, Waldo R. 1972. "Introduction." In *Notes and Comments on the Composition of Terrestrial and Celestial Maps (1772)*, by Johann Heinrich Lambert, trans. Waldo R. Tobler, vii–xvi. Ann Arbor: Department of Geography, University of Michigan.

Wintle, Michael. 2008. "Europe as Seen from the Outside: A Brief Visual Survey." In *Imagining Europe: Europe and European Civilisation as Seen from Its Margins and by the Rest of the World, in the Nineteenth and Twentieth Centuries*, ed. Michael Wintle, 23–48. Brussels: P.I.E. Peter Lang.bookmark

Projections Used for Marine Charts. Plane charts (also known as flat maps, *cartes plates*, or *à point carré*) were still in use in the eighteenth century despite their shortcomings and the earlier invention of the Mercator projection. Plane charts are defined by their cylindrical projection, with both meridians and parallels (when they appear) represented as straight lines equidistant from one another with the meridians perpendicular to the parallels. The degrees of latitude and longitude have the same value and compose an orthogonal framework of equal squares. Plane charts are generally distance maps, with rhumb lines and local scales but without scales for latitude or longitude. These maps were called "plane" or "flat" because the part of the globe that they represent is treated as not having perceptible curvature. This is actually true only in the case of maps at large scale representing a small portion of coast (i.e., coastal plans). Although Mercator charts are infinitely preferable for navigating, many navigators in the eighteenth century did not share this opinion.

On a plane chart, the relation of breadth (east-west) to height (north-south) becomes increasingly distorted in proportion to the distance of the latitude depicted from the equator. While minutes of latitude and longitude are assigned the same value on the map, these dimensions only reflect reality at the equator; plane charts are therefore suitable to represent only a very small proportion of the earth's curvature. Plane charts conserve neither angles (except at the center of the zone depicted) nor distances. Nevertheless, plane charts seem to have moved to minority status in the catalog of French hydrographic charts only around 1772, the time of Jacques-Nicolas Bellin's death (Chapuis 1999, 724). Similarly, in England, in the early nineteenth century, the hydrographers to the Admiralty Board noted that, while mariners were submitting coastal plans, often as a plane chart, there was a shortage of accurate astronomical positions from which reliable smaller-scale passage-planning charts could be constructed on the Mercator projection.

The Mercator projection was also known as the *carte réduite* (or reduced map) because of its utility for resolving the reckoning or "day's work" by rhumb line sailing. It provides a graphical solution in which the courses steered and estimated distances run can be expressed as differences in latitude and longitude on an orthogonal grid of meridians and parallels perpendicular to one another, the circles of each having become parallel lines. This projection is conformal, in that it preserves angles. Rhumb lines, or loxodromes, are thus depicted on the

Mercator projection as straight lines that intersect the meridians at a constant angle for a steady course.

The Mercator projection corrected the problem of plane charts by adopting a variable scale (i.e., with increasing latitudes). This projection distorts geography but is perfectly adapted to the needs of navigation. Established at the end of the sixteenth century, it was not truly introduced into France until more than a century later, by *Le Neptune françois* (1693), although Sir Robert Dudley had employed the projection in his *Arcano del mare* (1646–47). But new navigational techniques, including the projection, were slow to be accepted by most navigators (Ash 2007, 526), a situation that restricted the diffusion of *Le Neptune françois* (Chapuis 1999, 150–52, 170–71; 2007, 118–21). The *Hydrographie françoise* used charts on the Mercator projection rather than plane charts in the second half of the eighteenth century, with only large-scale plans rendered as plane charts.

Since the Mercator projection utilizes a cylindrical surface tangential to the earth's surface at the equator, the length of a minute of latitude is increasingly exaggerated with distance from the equator, both north or south, and the consequent representation of area is distorted. This makes the Mercator projection unsuitable for charts of higher latitudes in the polar regions. Since the scale of the map thus increases with latitude, distances are measured on a Mercator chart on the adjacent portion of the graticule of latitude. Similarly, although the marine league had a standard value, it was acknowledged that the distance covered in a particular voyage should be expressed in terms of the value of a minute of the mid-latitude during that voyage. Pierre Bouguer, who had taken part in one of the mid-eighteenth-century expeditions that measured arcs of the meridian and confirmed that the earth was flattened at the poles, provided an improved table of latitude values in his treatise *Nouveau traité de navigation* (1753). He explained the principles involved in the construction of the Mercator projection, matching the increasing lengths of each minute of latitude with corresponding elongations of each minute of longitude (Bouguer 1753, 117–18).

Finally, it had been widely understood in navigational circles since at least the beginning of the seventeenth century that a portion of a great circle, i.e., a circle on a sphere—such as the equator or the meridians—whose plane passes through the center of that sphere, represents the shortest path between two points (Chapuis 1999, 728). Such an arc of a great circle intersects each meridian at a different angle. Independent of meteorological constraints, navigation along the arc of a great circle is the best option for long transoceanic voyages. In contrast to following a steady rhumb line course on a Mercator chart, navigation along a great circle route

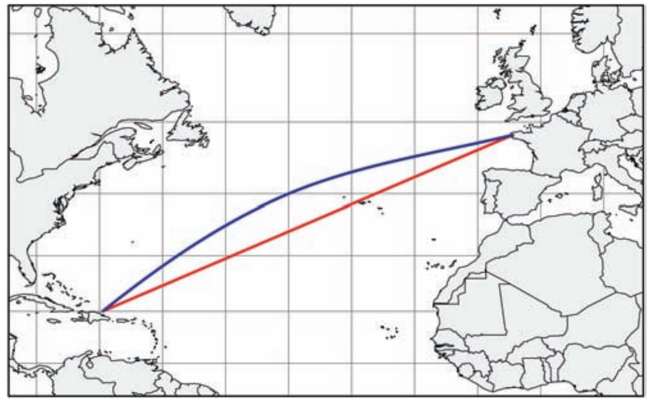

FIG. 646. RHUMB LINE AND GREAT CIRCLE ON A MERCATOR CHART. On this Mercator chart, the rhumb line is the red line (course to steer is constant 235°, distance 3407 NM) and the great circle is the blue line (initial course to steer is 255°, to change; distance is the shortest: 3363 NM).

will involve alterations of headings with change in longitude (fig. 646). Thus, this practice is more complex and demands greater precision to travel along the curvature of the earth as faithfully as possible. A great circle is represented as a straight line on a chart constructed on the gnomonic projection. Alexander Dalrymple ([1790?], 94–96) envisaged the use of this type of projection in navigation. However, such charts would not really be produced until the middle of the nineteenth century with the development of steam-powered ships for transoceanic voyages. The irony of this history is that sailors actually practiced orthodromy, as generations of sailors had done before, often unwittingly without fully realizing that any shortest distance between two points in sight on the curved surface of the globe is in fact a portion of a great circle arc.

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SEE ALSO: Marine Chart; Marine Charting; Navigation and Cartography

BIBLIOGRAPHY

Ash, Eric H. 2007. "Navigation Techniques and Practice in the Renaissance." In *HC* 3:509–27.

Bouguer, Pierre. 1753. *Nouveau traité de navigation, contenant la théorie et la pratique du pilotage*. Paris: Guérin & Delatour.

Chapuis, Olivier. 1999. *À la mer comme au ciel, Beautemps-Beaupré & la naissance de l'hydrographie moderne (1700–1850): L'émergence de la précision en navigation et dans la cartographie marine*. Paris: Presses de l'Université de Paris-Sorbonne.

———. 2007. *Cartes des côtes de France: Histoire de la cartographie marine et terrestre du littoral*. Douarnenez: Chasse-Marée.

Cotter, Charles H. 1966. *The Astronomical & Mathematical Foundations of Geography*. London: Hollis & Carter.

[Dalrymple, Alexander]. [1790?]. "Practical Navigation." Printer's proof found in the author's collected works, bound under the title *Nautical Memoirs and Journals, Published by ADalrymple, before 1st June 1789*, in the National Library of Scotland, Edinburgh, and the Bibliothèque nationale de France, Paris.

Snyder, John Parr. 1993. *Flattening the Earth: Two Thousand Years of*

Map Projections. Chicago: University of Chicago Press. Reprinted with corrections 1997.

Projections Used for Topographical Survey Plans. Prior to the 1750s, topographical surveys produced plane maps of each particular district. It was facetiously observed that in such maps "the distances plotted with a compass [i.e., dividers] at a uniform scale constitute the whole projection" ([Soulavie] 1802–3, 82). The extension of topographical surveys across entire countries, starting with France, made apparent the effects of the earth's curvature. To maintain mathematical accuracy, such topographical maps required that parallels and meridians be drawn according to a constant geometrical law (Lagrange 1781). The particular solution was to construct the separate sheets of the topographical map as a series of sections of a single plane surface. Mathematicians and geographers created several appropriate projections, although they were not widely adopted until after 1800.

While planning the comprehensive topographical survey of France, César-François Cassini (III) de Thury devised a projection that he presented along with his full project to the Académie royale des sciences in November 1745 (Cassini III 1749). A competing proposal by Louis Godin and Charles-Marie de La Condamine to employ a conic projection would have required a large number of latitude and longitude measurements ([Soulavie] 1802–3, 83–84); Cassini's projection was adopted by the academy because it was much easier to work with.

Cassini's system was a transverse equidistant cylindrical projection, or transverse *plate carrée*, so that scale was constant but not true along lines parallel to the central meridian; neither equal-area nor conformal, it was effectively a compromise of the two features (Snyder 1987, 92–95). This central meridian was rendered as a straight line, while other meridians and parallels were complex curves. But those other lines did not have to be drawn; Cassini instead used a system of 60,000-toise squares with rectangular grid coordinates, with the Paris Observatory as the origin. Easy for computation, thanks to the formulas developed by Achille-Pierre Dionis du Séjour, the projection "was undoubtedly preferred above all others because it supplies coordinates as they were obtained directly by field operations and because it would have been necessary to change those coordinates in another projection" (Lacroix 1802, 43). The projection was especially suitable for regions extending north-south along a central meridian, such as Britain and Italy, and the Cassini projection was soon used by Giovanni Antonio Rizzi Zannoni for his forty-five-sheet topographical map of the Kingdom of Naples and in some regions of the Austrian monarchy. Even after 1803, Nicolas-Antoine Nouet used the projection for the topographical survey of Savoy. Once Johann Georg von Soldner corrected its formulae in 1809, the Cassini projection became one of the major topographic mapping projections until the early twentieth century, as evidenced by its use for the Ordnance Survey of Great Britain.

In January 1803, France replaced the Cassini projection with a projection popularized by Rigobert Bonne in his maritime atlas of the French coast in 1752 and so known as the Bonne projection. A special commission including the mathematician Sylvestre-François Lacroix completed the work of the 1802 Commission topographique by recommending the use of the Bonne projection. In this pseudoconical equal-area projection, the central meridian is still a straight line, while all other meridians are complex curves, and parallels are concentric circular arcs (see fig. 641, middle). The scale is true along the central meridian and all parallels, and there is no distortion along the central meridian and the standard parallel (Snyder 1987, 138–40). Better for east-west extents (e.g., France), this projection was especially suitable for the whole of Europe, which became one huge field of war with Napoleon's military expansion.

Two other projections were briefly used in the last decade of the eighteenth century for large-scale maps. In 1789, the Venetian engineer and mathematician Anton-Maria Lorgna derived the polar aspect—where all the meridians are straight lines—of the azimuthal (zenithal) equal-area projection (*Principi di geografia astronomico-geometrica*, 1789), first designed by Johann Heinrich Lambert in 1772. It was eventually chosen for use by the Corpo topografico of the young Italian Republic (Visconti 1802). Lastly, Gaspard Marie Riche de Prony used the so-called central projection—later called gnomonic projection—for cadastral plans from 1794 to 1802 (Lacroix 1802, 29–30). Despite its higher distortion away from the center of the map, it is quite suitable for restricted areas and so would later be applied separately to each of several latitudinal zones covering a large country or state; it was very easy to use, since all the great circles are shown as straight lines (Snyder 1987, 164). Ultimately all the military services of the French and their allies turned to Bonne's projection.

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SEE ALSO: Topographical Survey Map; Topographical Surveying: (1) Enlightenment, (2) France

BIBLIOGRAPHY

Cassini (III) de Thury, César-François. 1749. "Sur la description géométrique de la France." *Mémoires de l'Académie Royale des Sciences, année 1745:* 553–60.

Lacroix, Sylvestre-François. 1802. "Notice historique et analytique sur la construction des cartes géographiques: S.II. Analyse." *Mémorial Topographique et Militaire, rédigé au Dépôt Général de la Guerre*, no. 1:24–49.

Lagrange, Joseph-Louis. 1781. "Sur la construction des cartes géographiques." *Nouveaux Mémoires de l'Académie Royale des Sciences et Belles-Lettres, année 1779*, 161–210.

Puissant, Louis. 1820. *Traité de topographie, d'arpentage et de nivellement*. 2d ed. Paris: M[me] V[e] Courcier.

Snyder, John Parr. 1987. *Map Projections—A Working Manual*. Washington: United States Government Printing Office.

[Soulavie, Jean-Louis]. 1802–3. "Notice sur la topographie considérée chez les diverses nations de l'Europe avant et après la carte de France par Cassini; suivie d'un catalogue des meilleures cartes." *Mémorial Topographique et Militaire, rédigé au Dépôt Général de la Guerre*, no. 3:57–201.

Visconti, Ferdinando. 1802. "Memoria sulla costruzione delle carte topografiche secondo il metodo di Lorgna." *Giornale dell'Accademia Militare* 2:159–78.

Property Map.

CADASTRAL MAP
ESTATE PLAN

Cadastral Map. Cadastral maps are maps of properties. Their essential feature is that they identify property owners, usually by linking properties on a map to a written register in which details of the property, such as the owner's name and its area, are recorded. Cadastral maps are differentiated from private maps of individual domains by the fact that they record a number of properties within administrative units, from perhaps only one parish, as do English enclosure maps, to whole territories, as do the eighteenth-century cadastral maps of Corsica. This definition of "cadastre" is at once narrower than in some cartographic literature, which considers the private estate map cadastral, and much broader than the view of others, who would restrict the appellation "cadastral" to taxation mapping. Cadastral maps were used in many European countries during the Enlightenment for management of state resources, especially of forests from the second half of the seventeenth century, and for the enclosure and redistribution of land. Land colonization cadastres were important across this whole period reflecting the successive opening of new lands for colonization. The largest single group of state-sponsored mapped cadastres are those that had tax reform as their primary objective. (Much of this entry draws directly from the fuller treatment by Kain and Baigent 1992.)

In the seventeenth century, deforestation in much of western and southern Europe by agriculture and by felling of trees for fuel and construction timber was a matter of growing government concern. In England, John Evelyn lectured to the Royal Society on the economic role of forests and what he termed "this im-politick diminution of our *Timber*" (Evelyn 1664, 1). Governments commissioned surveys of their dwindling forest resources and some of these surveys had a cartographic base. In Russia, the forests around Bolkhovsk were measured and mapped in 1647, and the program had been extended to other areas by the 1670s (Bagrow 1975, 2). To the rulers of Ancien Régime France, the forest was simultaneously of economic significance for building timber, of military importance for the construction of naval vessels, and of recreational value for hunting. An essential part of Louis XIV's late-seventeenth-century forest reforms was the compilation of a complete cartographic inventory of the French royal forests. These maps, updated, copied, and recopied, continued to be used through the eighteenth century to regulate the felling and sale of timber (Froidour 1759, esp. 160–61, 164–65). In eighteenth-century Norway, it was not so much the depletion of forest as its economic development that was the main concern. The Generalforstamtet (forestry board) saw detailed mapping as the basis of systematic exploitation of the forests (Fladby, Imsen, and Winge 1974, 301). Similarly, in much of Germany, forests were a potentially valuable but underused resource at this time. In Baden-Württemberg, for example, forests that had passed out of church ownership in the Reformation were surveyed and mapped to help organize their more intensive exploitation (Oehme 1961, 43–45). This activity indicates that by the seventeenth century, European governments and provincial rulers were not only adopting maps for plotting national strategy and for organizing fortifications and warfare but were also were using large-scale maps as land inventories.

Enclosure and redistribution of communally held land and of land divided into small strips was instituted to introduce more efficient farming, to expand the area under the plow, or to create improved pastures from moors or heaths. In England, the use of maps both to determine the existing cadastre and to record the new cadastre was an integral part of enclosure by parliamentary act from about the middle of the eighteenth century onward (Kain, Chapman, and Oliver 2004). Cadastral maps were required by legislation, but their production was entrusted to private surveyors with estate mapping experience. In Sweden and Finland, on the other hand, enclosure mapping was carried out by the state surveying agency, although it was paid for by the farmers. Agrarian reform in Germany in the eighteenth century mirrored that elsewhere in having two physical components: the common lands were divided into plots held in severalty, and strip fields were amalgamated into larger, enclosed parcels (Leerhoff 1985, 162–63). In many German states, notably Brunswick, state-sponsored enclosure was either proposed or took place with maps as the base (fig. 647). Maps were used, as elsewhere in Europe, both in the reorganization process itself and to record its effects. It is rare to find village enclosure in Europe after about 1750 that does not use a map for devising and/or recording the new cadastre.

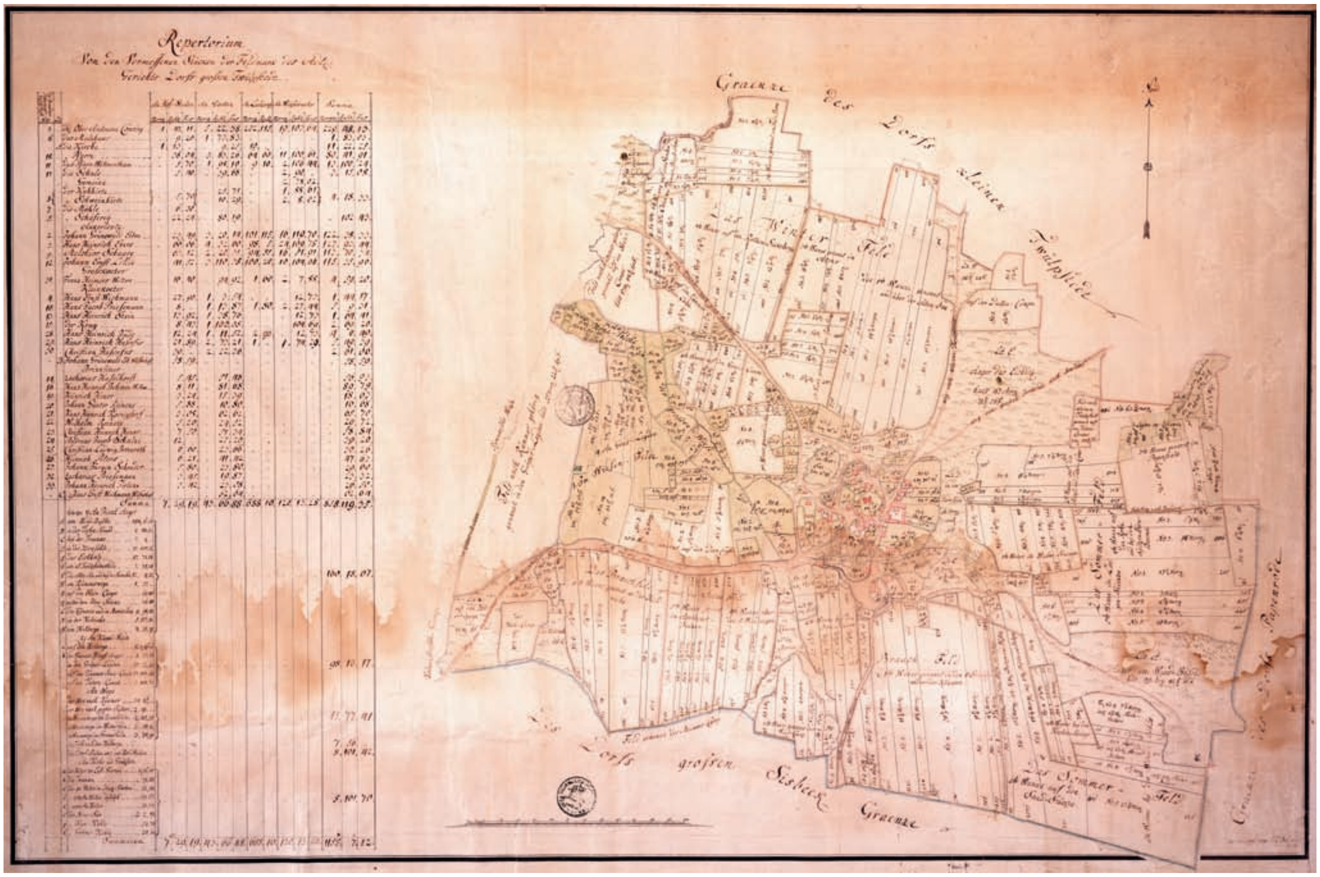

FIG. 647. MAP OF GROß TWÜLPSTEDT DRAWN IN 1758. Part of the Braunschweigische Landesvermessung enclosure and agrarian reform survey. The scale is 1:4,000. The manuscript map shows the cadastral situation after consolidation. Size of the original: ca. 58.5 × 88.5 cm. Image courtesy of the Niedersächsisches Landesarchiv–Standort Wolfenbüttel (K3311).

Cadastral maps had been used since the end of the Middle Ages by individuals and institutions to establish title to land, and in the seventeenth and eighteenth centuries cadastral maps were used by state governments in the Old and New Worlds to organize, control, and record the settlement of "empty" lands. Examples in the Old World are the settlement of the Alheden in Jutland in the eighteenth century, the expansion of settlement in the eighteenth century over forested wasteland in Sweden, and the *allmenning* (Crown land) disposals in northern Norway from the 1750s. Each was accompanied by systematic programs of mapmaking.

If cadastral maps were useful to governments wishing to promote the orderly settlement of underexploited parts of their home territory, they were soon established as a desideratum for settling overseas colonies. In the New World, the cadastral map was the instrument that enabled the settlement ideals of colonial governments to be realized. These were of all varieties, from encouraging large plantations, as on the southern seaboard of North America, to individual proprietorship of holdings disposed with the regularity of the grid, as with the federal land disposals of the United States. From the viewpoint of the individual settler, the cadastral map that defined his claimed, granted, or purchased land was important for providing security of title.

In the Old World, more cadastral maps were made and used by state governments for setting and recording land taxes than for any other single purpose. Such initiatives are related to the fact that by the seventeenth century, taxes in some provinces were being more closely identified with the soil, which was held to generate wealth. Cadastral maps provided a concise and accurate method of both fairly assessing and permanently recording such charges on particular pieces of land.

In Austrian Habsburg territories, the Thirty Years' War (1618–48) brought such increased demand for tax revenue and such economic dislocation and devastation that the tax system was in almost total disarray by 1648. Both Leopold I in the seventeenth century and Charles VI in the early eighteenth century gradually reformed or rectified the *Landeskontribution* (land tax), but their reforms were obstructed by vested interests in the various Diets of the Habsburg lands. By far the most significant early tax reform, for the Austrian Habsburgs and subsequently for Spain, the Kingdom of Sardinia, and France, was that instituted by Charles VI in the Duchy of Milan, one of the smallest but richest of the Habsburg lands. The *censimento* of Austrian Lombardy (fig. 648) undertaken from 1718 was the earliest fully surveyed and mapped cadastre in Austrian Habsburg territory and is widely recognized as a pioneering example of modern taxation cadastres as it surveyed and mapped at a large scale all land, not just productive fields (Zangheri 1980). It inspired parallel undertakings in eighteenth-century Spain, where tax reform was modeled directly on the Milanese method, and also in the neighboring Principality of Piedmont (Massabò Ricci 1983) and the Duchy of Savoy (fig. 649) both ruled at this time by the King of Sardinia (Guichonnet 1955; Bruchet 1896). Not only was the method copied in Piedmont and Savoy, but the same personnel were involved, as surveyors moved from Milan to Piedmont and then to Savoy.

Enlightenment monarchs needed precise, detailed statistics as the basis for administrative reforms and mercantilist state direction of the economy. Where underused resources such as forests or "empty" colonial lands were under the direct control of the ruler, there was a further impetus to produce a map as an accurate medium for recording and displaying such information. But for none of these was the employment of a map absolutely indispensable. In North America, land could be and was patented without a plat. In Europe, property taxes had been long collected without a cadastral map base and they continued to be so levied in some countries. Similarly, buying and selling of land, its drainage and improvement, and its valuation and day-to-day management could be done without maps. Even enclosure and redistribution of land parcels, for which maps would be considered indispensable today, were

FIG. 648. PORTION OF GIOVANI GIACOMO FRASTI, "MAPPA DI AGLIATE CAPO DI PIEVE," 1722, 1:8,000. Upper sheet of three from one of the manuscript fair copies of each *commune* reduced from field work at 1:2,000 in the Milanese *censimento*, 1720–23, made for levying land tax.

Size of the original: 50 × 65 cm. Image courtesy of the Archivio di Stato, Milan (Segnatura 3048).

FIG. 649. DETAIL FROM THE FAIR COPY MADE IN 1732 OF THE *CADASTRE SARDE*. Manuscript map of the commune of Metz, surveyed in 1730, portraying the village and fields of the village of Fessy.

Size of the entire original: ca. 172.0 × 110.5 cm; size of detail: ca. 19.5 × 27.0 cm. Image courtesy of the Archives départementales de la Haute-Savoie, Annecy (1 C d 253 - COPIE).

conducted quite satisfactorily in England up to the third quarter of the eighteenth century with only a written terrier to place a particular strip in the context of its furlong and field.

Cadastral mapping is feasible, regardless of whether it is desirable or not, only when there is a physical division of land and not just a division of its value. In Norway, for example, until as recently as the late eighteenth century it was *skyld*, or value, rather than land itself that was owned and leased. Owners of *skyld* could not point to any individual piece of land that was theirs. What they owned was a share in the value of the *gård* (cadastral farm). *Skyld* possessed no spatial coordinates and was thus impossible to map, just as it is today impossible to map the shareholdings in a joint stock company. The establishment of a system of private title to land in which individuals have absolute property rights over discrete plots of land is, however, not a sufficient condition for mapping. In some Austrian Habsburg territories (before the nineteenth century) and in England and Wales, absolute property rights existed but were not recorded by the state in a mapped cadastre. Nevertheless, in many territories the association between cadastral mapping and the emergence of capitalist land owning and agrarian systems is clear.

Maps, notably those accurately surveyed, could provide the precise and complete information about land that came to be seen as necessary for effective, enlightened government in the eighteenth century. If such detail and precision were not perceived as important or where there was judged to be little evasion of, or opposition to, the measure being effected (as with the land tax in England), there was not much point in incurring the expense of mapping.

Not surprisingly, surveyors and cartographers everywhere were enthusiastic proponents of surveying and mapping. Physiocratic convictions proved a spur to mapping throughout Europe. Yet conviction was not enough. Joseph II was convinced of the merits of the physiocratic position but could not bring his survey to fruition in the face of powerful opposition.

It is thus power, whether economic, social, or political, that lies at the heart of the history of the cadastral map. The cadastral map is not simply an antiquarian curiosity, a cultural artifact, or a useful source for the historian. It is an instrument of control that both reflects and consolidates the power of those who commissioned it. The cadastral map is partisan: where knowledge is power, it provides comprehensive information to be used to the advantage of some and the detriment of others, as rulers and ruled were well aware during the tax struggles of the eighteenth century. Finally, the cadastral map is active: in portraying one reality, as in the settlement of the New World, it helps obliterate the other. As an instrument of power, the cadastral map can be understood only in the context of the balance of power and balance of interest in each area and in each period.

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SEE ALSO: Cadastral Surveying; Property Mapping; Taxation and Cartography

BIBLIOGRAPHY

Bagrow, Leo. 1975. *A History of Russian Cartography up to 1800*. Ed. Henry W. Castner. Wolfe Island: Walker Press.

Bruchet, Max. 1896. *Notice sur l'ancien cadastre de Savoie*. Annecy: Abry. Reprinted, intro. Paul Guichonnet, Annecy: Archives de la Haute-Savoie, 1988.

Evelyn, John. 1664. *Sylva, or A Discourse of Forest-trees, and the Propagation of Timber in His Majesties Dominions*. London: Royal Society.

Fladby, Rolf, Steinar Imsen, and Harald Winge, eds. 1974. *Norsk historisk leksikon: Næringsliv, rettsvesen, administrasjon, mynt, mål og vekt, militære forhold, byggeskikk m. m., 1500–1850*. 2d ed. Oslo: J. W. Cappelen.

Froidour, Louis de. 1759. *Instruction pour les ventes des bois du roi*. Paris: Brunet. First ed., Toulouse, 1668.

Guichonnet, Paul. 1955. "Le cadastre savoyard de 1738 et son utilisation pour les recherches d'histoire et de géographie sociales." *Revue de Géographie Alpine* 43:255–98.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Kain, Roger J. P., John Chapman, and Richard Oliver. 2004. *The Enclosure Maps of England and Wales, 1595–1918: A Cartographic Analysis and Electronic Catalogue*. Cambridge: Cambridge University Press.

Leerhoff, Heiko. 1985. *Niedersachsen in alten Karten*: *Eine Auswahl von Karten des 16. bis 18. Jahrhunderts aus den niedersächsischen Staatsarchiven*. Neumünster: Karl Wachholtz.

Massabò Ricci, Isabella. 1983. "Conoscenza, memoria, gestione della Terra nella rappresentazione catastale." In *Arte e scienza per il disegno del mondo*, ed. Carlo Pirovano, 187–94. Milan: Electa.

Oehme, Ruthardt. 1961. *Die Geschichte der Kartographie des deutschen Südwestens*. Constance: Jan Thorbecke.

Touzery, Mireille, ed. 2007. *De l'estime au cadastre en Europe, l'époque modern*. Paris: Comité pour l'Histoire Économique et Financière de la France.

Zangheri, Renato. 1980. *Catasti e storia della proprietà terriera*. Turin: Einaudi.

Estate Plan. Estate plans are maps drawn to show the property owned by one landowner (personal or corporate) or family. They can thus be of urban or rural possessions, but in all cases they concentrate solely on the owner's land. In plans of open-field land in England, estate plans can often show the scattered strips owned by an individual and will give very little information about the surrounding countryside. They are typically drawn at a large scale and are in manuscript. Commissioned by landowners, estate plans can therefore be distinguished from state-sponsored cadastral maps.

The production of estate plans in Europe depended on the particular circumstances of individual countries. Favorable conditions for making estate plans included having an awareness of the value of maps, a capitalist rather than feudal economy, skilled people to make large-scale maps, a period of peace and stability, and the absence of a general large-scale survey that rendered estate plans unnecessary. Estate plans were made only when all or most of these conditions were satisfied.

Estate plans first developed in England in the 1570s, and they both reflected and influenced socioeconomic changes of the times and the transformation of the economy from feudal to capitalist. A private property market developed in the mid-sixteenth century when land became available after the Dissolution of the Monasteries in the late 1530s, and the sale of this land by the Crown, inflation, and a rising population all led to an increased awareness of the value of land. There had been a long tradition of written surveys, and as surveying practices developed in the sixteenth century, landowners became more conscious of the possibility of drawing maps to scale and of the uses of such plans to manage estates, to define boundaries, and to impress neighbors. Perception of the value of maps increased, so that estate plans became ever more common in the seventeenth and eighteenth centuries. It was the Tithe Commutation Act of 1836, followed by the development of the six-inch Ordnance Survey maps from the 1840s, that led to the end of purpose-made estate plans.

J. H. Andrews (1985) has demonstrated that seventeenth-century estate mapping in Ireland was connected with legal needs for boundary definition and therefore needed to show little internal detail. In the eighteenth century, concern with land quality increased and the French Huguenot John Rocque and his pupil Bernard Scalé introduced a new topographic style. As in England, the introduction of the Ordnance Survey, which had mapped the whole of Ireland by 1846, largely removed the need for separate estate surveys.

Estate plans did not become common until the 1740s in Scotland and 1760s in Wales. In Scotland, production of maps was linked closely with agricultural improvements, and after the stimulus of inflation and demand for agricultural produce from the Napoleonic Wars (1799–1815), opportunities for mapmaking declined in the 1820s and competition from the Ordnance Survey increased. In Wales, more efficient estate management in the later eighteenth century, employment of professional stewards, and the introduction of shorter leases and annual tenancies led to increased demand for estate plans, which continued into the nineteenth century as some estates were broken up and a new class of landowner emerged with estates founded on industrial or commercial wealth.

In contrast with England and Ireland, as David Buisseret discusses (1996, 5–26), estate mapping was much slower to develop in many other European countries. While in Spain and France there were large agricultural estates, in both cases these supplied traditional markets and there was little need to develop a capitalist agricultural economy and to increase output from the land. France went through a period of war and conflict, although Spain enjoyed internal peace and security. While Spanish leaders were aware of the potential of maps, their energies were directed at establishing colonies overseas. Similarly in France, while many of the nobility were aware of maps, in this case from their education with Jesuits, they did not commission estate plans. In both countries, maps of this type started to appear in the eighteenth century, especially after 1740 in France, where *plans parcellaires* became much more common with nobility keen to maximize the output from their land. Buisseret found little evidence of estate plans being drawn in Italy before the eighteenth century, again possibly a result of agricultural methods practiced there and traditional local markets for produce. In the Netherlands, there were many surveyors or *landmeter*s, but they were primarily occupied with mapping dykes and land reclamation projects, and the resulting maps often removed the need for estate plans until the eighteenth century. In German-speaking lands, too, there were few estate plans until the eighteenth century. Here again, another type of map probably filled the need for estate plans, in this case the larger-scale *Landtafel*, or bird's-eye view, not drawn to scale. As in France and Spain, the land market was sluggish and capitalist ideas were slow to affect agriculture. In contrast with England, political authority and management were carried out over larger areas of land, which resulted in smaller-scale maps being drawn. And while large-scale mapping started to develop in the early seventeenth century, it came to a halt with the outbreak of the Thirty Years' War in 1618. The production of other types of maps, which replaced the need for estate plans, is also an explanation for their absence from Scandinavian countries, where large-scale seventeenth-century cadastral surveys provided much of the information that landowners might need.

Surveying manuals gave instructions about how to draw estate plans, and William Leybourn, in his *Compleat Surveyor* (1653), included a simple example. Topographical features were to be identified by pictures and color, thus showing trees, hills, bogs, roads, and rivers; buildings were to be drawn in bird's-eye or perspective drawings, including the manor house, other "houses of note," watermills, and windmills; and the acreage of each plot was to be given. The direction of north was to be indicated with a compass rose, the scale given, and the coat of arms of the lord of the manor, so that "these things being well performed, your plot will be a neat Ornament for the Lord of the Mannor to hang in his Study, or other private place, so that at pleasure he may see his Land before him, and the quantity of all or every parcell thereof without any further trouble" (Leybourn 1653, 275). The exact style and content of estate plans depended on many factors, such as the use to which the plans were to be put, the wishes of the landowner, the skills and habits of the mapmaker, and contemporary styles of decoration, but most maps followed the general format described by Leybourn and others (fig. 650).

A typical seventeenth-century and early eighteenth-century English estate plan would be manuscript, drawn on parchment at a scale of three, four, or six sixty-six-foot Gunter's chains to the inch (1:2,376, 1:3,168 or 1:4,752), and would show the owner's holdings in detail. The map of Callice Court in Ryarsh, West Malling, and Offham in Kent is a good example (fig. 651). It was drawn in 1742 by Thomas Hogben for Edward Austen, shortly after Austen had acquired the estate by marriage to Susanna Walsingham in August 1740. The map is beautifully drawn, at four chains to the inch; it shows the buildings of Callice Court Farm and West Malling, Offham, and Ryarsh churches in perspective drawings. Austen's land is shown in some detail, including fields and their acreages, woodland, trees and an orchard, fences, gates and stiles, roads and footpaths, watercourses and ponds, and parish boundaries. Tables list field names and acreages, distinguishing between outbound, plough, and waste. The farm is shown in isolation; surrounding fields are not drawn, and there are just the names of the neighboring owners. The map is decorated in the style that Hogben typically used at the time, with a decorative cartouche for the title, a scale bar surmounted by dividers and decorated with a ribbon, an ornate compass rose, and a cartouche surrounding the surveyor's name decorated with fruit, flowers, and cherubs holding up a scroll on which are geometrical calculations.

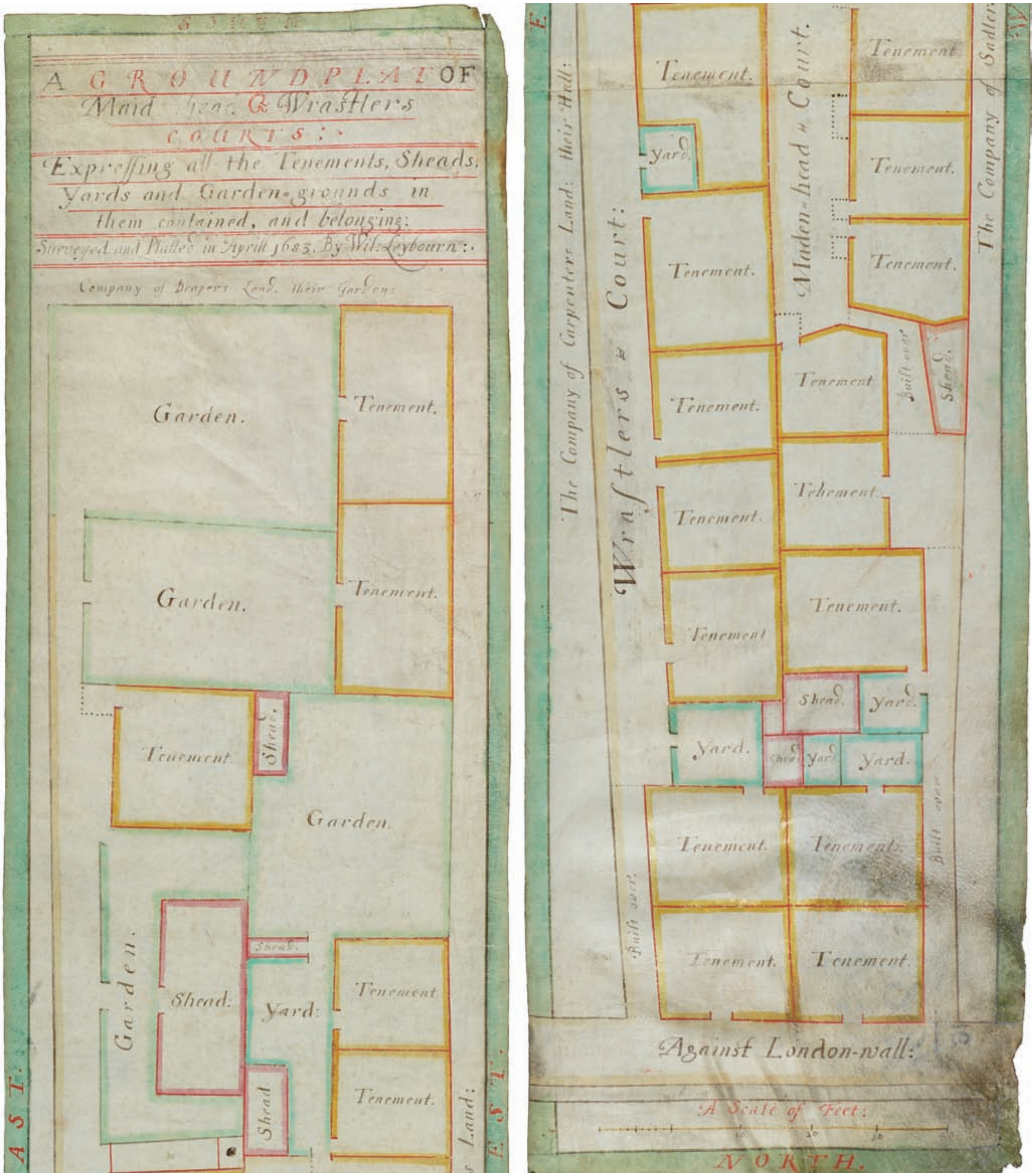

FIG. 650. WILLIAM LEYBOURN, "A GROUNDPLAT OF MAIDENHEAD & WRASTLERS COURTS," APRIL 1683. Oriented south and "expressing all the Tenements, Sheads, Yards and Garden-grounds," the manuscript plan employs color to distinguish types of building and land use. The long and thin original map is shown here in two halves.

Size of the original: 82.1 × 17.8 cm. Image courtesy of the London Metropolitan Archives (Corporation of London Collection, Reference Code: COL/CCS/PL/01/202/16).

FIG. 651. THOMAS HOGBEN, ESTATE PLAN OF CALLICE COURT, 1742. Hogben's manuscript map, "The Topography and Mensuration of Callice Court and the Land thereto belonging," is of an early eighteenth-century style. Size of the original: ca. 82.5 × 84.5 cm. Image courtesy of the Kent History & Library Centre, Maidstone (Q/ZP/2).

As was common at the time, Austen's surveyor was a local schoolmaster of Smarden whose father was also a land surveyor; his son, Henry Hogben, became a land surveyor after him.

Estate plans were drawn for many purposes, and it is highly likely that Austen used his map, which also shows his coat of arms, to display his importance, his wealth, and his newly acquired land. Other landowners used maps in a similar way and hung them on walls and from bookcases or had them in beautifully bound volumes in their libraries to impress friends and neighbors. In some instances, two copies of a map or atlas were made: one for display, and one for daily use. Estate plans were also made for a wide variety of practical purposes; examples included an atlas of the estates of Queens' College, Cambridge, in 1825 by Alexander Watford, with a working copy for the bursar and a display copy for the master (Bendall 1996, 78–79), and an atlas of the estates of the Duchy of Lancaster in Staffordshire in 1834, compiled by Joseph Bennett Hankin Bennett for the Duchy of Lancaster Office with a copy for the surveyor general of woods, which, based on later annotations, was clearly heavily used (Duchy of Lancaster Office, Bennett's Atlas of Needwood, 1834). Austen probably also used his map of Callice Court to help in estate management, to show the boundaries of his land and his responsibility for maintaining fences and the parochial dues for which his land was liable (noted at the bottom of one of the tables). Maps were one of many types of document used in estate management and are found alongside valuations, terriers, and surveys. They could be drawn when land was about to change hands or had just done so, to help with property disputes, and to determine a boundary when an estate was to be let, or when land was to be improved or enclosed. Enclosure was probably the most influential stimulus to estate plan production in the early nineteenth century, and maps were also drawn at this time in connection with sales of land for the railways.

By the early nineteenth century, the appearance of estate plans had changed, with decorative styles becoming more restrained and buildings shown in plan. Maps became more common and were drawn for a larger number of landowners with smaller holdings. Many landowners employed professional land agents to supervise the daily running of their estates. For example, Emmanuel College Cambridge had its farm at Chequer Court in Ash, Kent, mapped in 1824 (fig. 652). The surveyor was George Quested, who had taken over the lease of the farm from his godmother in 1821. The map was drawn for the college probably in connection with the renewal of the lease in 1823. Quested was a farmer and also a mapmaker, and his map has many similarities to the one by

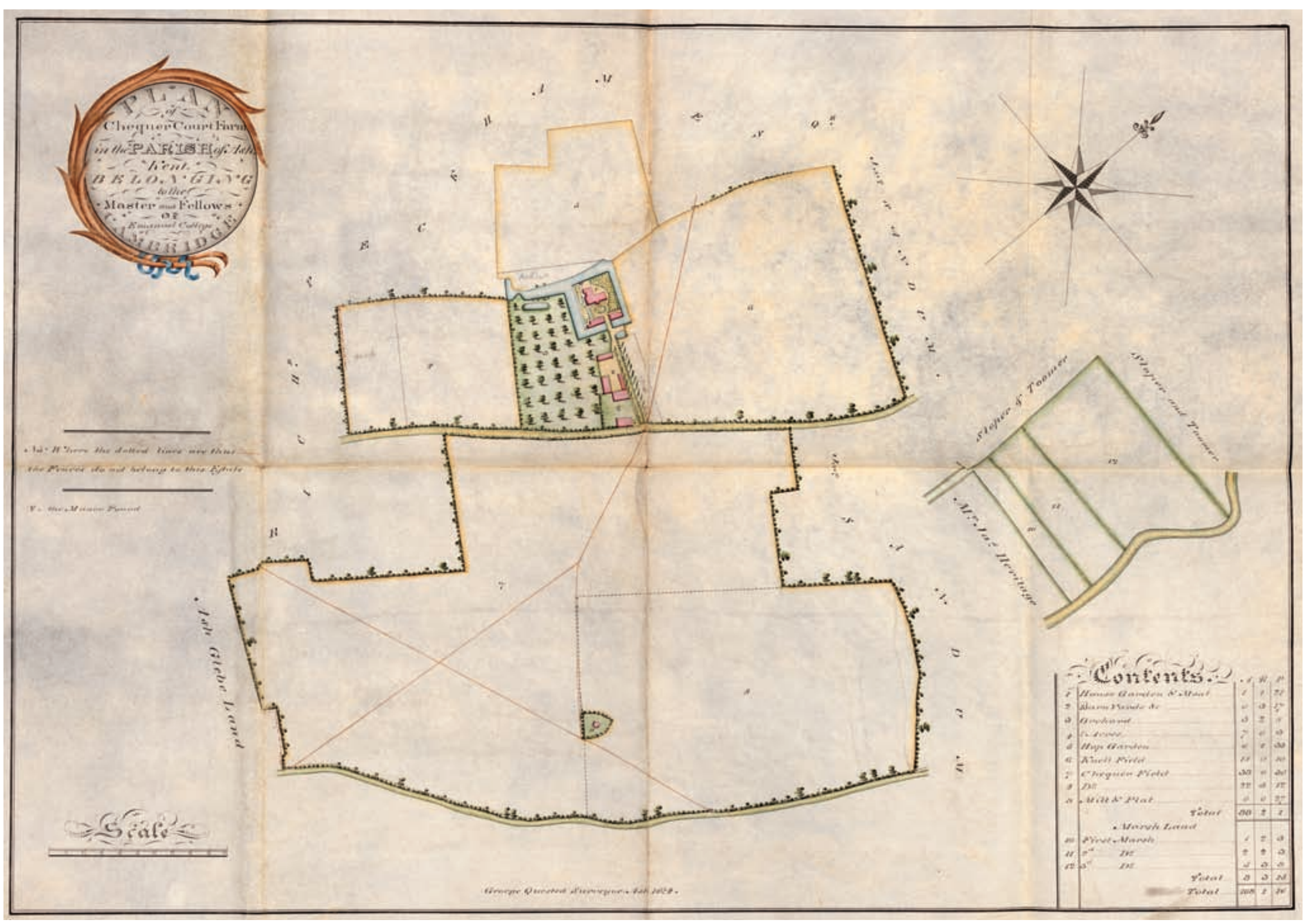

FIG. 652. GEORGE QUESTED, "PLAN OF CHEQUER COURT FARM IN THE PARISH OF ASH, KENT, BELONGING TO THE MASTER AND FELLOWS OF EMANUEL COLLEGE CAMBRIDGE," 1824. This manuscript map is typical of an early nineteenth-century map of an institutional landowner.
Size of the original: 42 × 61 cm. Image courtesy of the Master and Fellows of Emmanuel College Cambridge (KE 5).

Thomas Hogben eighty years earlier; it too concentrates on the owner's land and shows buildings, fields with their names, roads and footpaths, gates and stiles, hedges and an orchard, a moat, names of neighboring owners, and responsibility for maintaining hedges and fences. A hop garden also is shown, along with marshland. However, the buildings—the farm, barn, mill, and pond—are shown in plan. The style of decoration is much simpler, with compass points rather than a rose, a scale bar but no dividers, a less elaborate title cartouche, and the surveyor's name simply written at the bottom of the map.

Estate plans played a significant role in the development of cartography from the mid-seventeenth to mid-nineteenth century. They both caused and were a result of the spread of an awareness of maps and an ability to think cartographically. Surveyors were often local men; for some, very few maps survive, and it is possible that these mapmakers only produced a small number while other surveyors earned a living from mapmaking and related activities. Many employed the simplest of techniques using a chain, plane table, and compass, with an assistant to act as a guide and to help with chaining. Landowners used estate plans for a wide variety of purposes, some helping with land management and some connected to political position and influence. A plethora of other large-scale local maps were produced, and estate plans formed part of this canon.

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SEE ALSO: Consumption of Maps; Property Mapping

BIBLIOGRAPHY

Andrews, J. H. 1985. *Plantation Acres: An Historical Study of the Irish Land Surveyor and His Maps*. Belfast: Ulster Historical Foundation.

Barber, Peter. 2007. "Mapmaking in England, ca. 1470–1650." In *HC* 3:1589–1669, esp. 1637–47.

Bendall, Sarah. 1992. *Maps, Land and Society: A History, with a Carto-Bibliography of Cambridgeshire Estate Maps, c. 1600–1836*. Cambridge: Cambridge University Press.

———. 1996. "Estate Maps of an English County: Cambridgeshire, 1600–1836." In *Rural Images: Estate Maps in the Old and New Worlds*, ed. David Buisseret, 63–90. Chicago: University of Chicago Press.

———. 2000. "Merton College and the Mapping of Its Estates, 1601–1836." *Oxoniensia* 65:79–110.

———. 2003. "Mapping and Displaying an English Marshland Landscape in the Mid-Eighteenth Century." In *The Faces of Nature in Enlightenment Europe*, ed. Lorraine Daston and Gianna Pomata, 39–59. Berlin: Berliner Wissenschafts-Verlag.

Buisseret, David. 1996. "The Estate Map in the Old World." In *Rural Images: Estate Maps in the Old and New Worlds*, ed. David Buisseret, 5–26. Chicago: University of Chicago Press.

Fletcher, David H. 1995. *The Emergence of Estate Maps: Christ Church, Oxford, 1600 to 1840*. Oxford: Clarendon Press.

Hodge, Anne. 2001. "The Practical and the Decorative: The Kildare Estate Maps of John Rocque." *Irish Arts Review Yearbook* 17:133–40.

Leybourn, William. 1653. *The Compleat Surveyor: Containing the Whole Art of Surveying of Land*. London: Printed by R. & W. Leybourn, for E. Brewster and G. Sawbridge.

Ravenhill, Mary R., and Margery M. Rowe, eds. 2002. *Devon Maps and Map-Makers: Manuscript Maps before 1840*. 2 vols. Exeter: Devon and Cornwall Record Society.

Property Mapping.

Property Mapping in the Enlightenment. This entry considers not the manifestations of the phenomenon of property surveying and large-scale land mapping in the Enlightenment—that is, specific surveys and surveyors, the instruments and techniques used, and the related social institutions—but the phenomenon itself: what it was; how it was effected; its material outcomes, namely plans and their alternatives or complements; when and why it took place, or did not; differences from earlier and later practices; and interconnections with Enlightenment ideology and practice. Enlightenment property mapping was often part of processes that ended local particularism: new valuations and cadastres ended exemptions from taxation; enclosure ended ad hominem or ad hoc rights to use common land; and customary laws, which applied to particular places, were effectively challenged by national statute law. Property surveys themselves did not do these things, but they were part of processes that did and were often emblematic of radical new ways of understanding land and the relationship of people with it.

It is important to ask who benefited from the processes effected by Enlightenment property mapping, but not to accept uncritically either contemporary rhetoric of universal benefit or later arguments that the Enlightenment was largely a conspiracy of the powerful. Property survey and mapping in the Enlightenment, as at other times, were often a result of negotiation between initiators and those affected, and they found advocates and opponents in all classes of society. In this entry the use of "man" (rather than "person") reflects contemporary language and the fact that survey and cartography remained resolutely masculine practices. However, where contemporaries used "reform" to describe the innovations they advocated or effected using survey and/or maps, this essay uses "change" to emphasize that many innovations produced losers as well as winners. Property mapping has been little studied compared with topographical mapping, not least because property maps often remained in manuscript (so there was no contemporary market for them) and often in institutional archives (so there is no collectors' trade in them), but recent studies include area-specific volumes (e.g., Andrews 1985), studies of technologies (e.g., Richeson 1966), and a general survey (Kain and Baigent 1992).

Property survey and mapping comprise the systematic investigation of land with the aim of recording where plot boundaries run and any or all of the extent, ownership, occupation, use, value, and registration number of the plots. They may be commissioned by local people or imposed by an outside power; they may be undertaken by local people, who have detailed knowledge of the area, or by outsiders, who apply professional skills of land law, survey, estimation, measurement, valuation, or mapping, to a variety of areas.

The term "Enlightenment" suggests that the light of reason was to fall universally and uniformly, but while by 1800 few European countries and colonies escaped property survey entirely, there were temporal and regional variations, and it was far from universal in occurrence or uniform in nature. It is useful to ask when property surveying was possible, desirable, likely, and perhaps even necessary, recognizing that costs and benefits were measured not only economically and might be erroneously perceived, and that reason could never achieve in reality the sway it held in Enlightenment rhetoric.

CONTEXTS OF PROPERTY MAPPING As with all types of survey, money, time, suitably qualified and equipped personnel, and the power to overcome opposition were necessary for property surveys, and "map consciousness" (awareness of maps' properties and value) was necessary for mapped surveys. Money was often a stumbling block, despite the use of relatively simple technologies and instruments and the fact that surveyors were not notably well paid, and sometimes not paid at all (Konvitz 1987, 42). Cost might scupper the reform to be effected with the survey or rule out expensive surveys (for example those based on comprehensive triangulation) or mapping. Lack of time might drive the same decisions, as Joseph II discovered in his attempts at cadastral survey in Austrian Habsburg lands at the end of the eighteenth century, when he was close to death and knew his successor would not carry through his reforms (Lego [1968]). Surveyors grew in number during the Enlightenment, helped by the growth of military surveying and vocational education, yet in some places their scarcity hindered survey. Norway lacked surveyors experienced in forest survey and relied on German men for its mid-eighteenth-century mapped surveys (Nissen 1937). The city of Schwäbisch Hall at the end of the century relied on a Swiss, Daniel Meyer, for surveys of its lands (Grenacher 1960). Commissioners of surveys had to have the power to overcome suspicion (e.g., by providing letters requiring that surveyors not be impeded) or opposition (e.g., by providing guards to protect surveyors from cottagers who stood to lose their livelihoods after enclosure or nobles who feared greatly increased tax liabilities after cadastral survey). Map consciousness increased in the Enlightenment as maps became familiar and proved their worth in other projects and, perhaps, as people developed a different way of seeing the landscape (Buisseret 2003).

The ratio of anticipated costs to perceived benefit (both hard to estimate) determined when land would be surveyed and mapped. Private estate mapping was most common where capitalist agriculture and a culture of improvement were best established and where land, labor, and surveyors' skills were most completely commodified. Thus, estate maps are most abundant in the southeast of England, where agriculture was most market oriented (Delano-Smith and Kain 1999, 118). In the Netherlands, a thriving capitalist land market ensured that sales of plots covered the costs of reclamation and survey. Where capitalism was less well established, the cost-to-benefit ratio of survey was more complex and less completely monetized. Often costs, including surveyors' services, had to be paid for in cash while benefits were restricted by the prevailing precapitalist system. In Norway, for example, for much of the period landowners owned, leased out, and were taxed on *skyld* (the value of land), not the land itself. After 1764, farmers came increasingly to hold land in fee simple rather than to lease *skyld*, and for the first time this made systematic survey and mapping of land potentially profitable, although in fact it was a long time before many property surveys were effected (Holmsen 1979). Much of the extensive English Crown estate went unsurveyed because "the recurrent collection of nearly identical sums from the estates year upon year made up-to-date surveys and rentals, the regular return of court rolls or even a familiarity with the lie of the land of the individual estates otiose" (Hoyle 1992a, 47; Baigent 2005b).

The cost-to-benefit ratio was affected by natural, economic, political, and social conditions. Favorable natural conditions for property survey were low elevation and fertile soils. The Swedish seventeenth-century *geometriska jordeböcker* (geometric land books) and eighteenth-century Brunswick agricultural reform maps are some of the many that show only valuable cultivated plots and buildings around the village center and not relatively infertile pasture or forest. The Milanese *censimento* was unusual among early cadastres in showing all land, both fertile and infertile (Kain and Baigent 1992, 57, 140–41, 185). Favorable economic conditions for property survey occurred when agricultural prices or rents were rising or when landowners could sell land for house building or industrial or commercial uses. Favorable political conditions occurred where the need for tax revenues was high, where taxing land was easy and/or lucrative, and where power and administrative machinery were sufficiently centralized to force through a comprehensive project. In Germany after the dislocations of the Thirty Years' War (1618–48), at a time when princes needed money for their new standing armies, there was a great increase in survey and mapping for land taxation (Schön 1970). This prompted the cadastral mapping of Cleve, although disputes meant that mapping did not get under way until the eighteenth century (Aymans 1986). Fiscal strain after wars with France was one reason behind the cadastre of Zenón de Somodevilla y Bengoechea, marqués de la Ensenada, in Castile (Domínguez Ortiz 2002, 450). Favorable political conjunctions also occurred when national policy moved toward schemes that entailed survey. In 1650, the consolidation and enclosure of plots that were to be owned outright was typically a piecemeal, partial, and slow process, but by 1800 national governments in many parts of Europe promulgated legislation to make enclosure faster, more radical, and less dependent on consensus, though in some areas, such as Norway and France, parliamentary enclosure did not get under way until the nineteenth century.

Favorable social conditions for property survey occurred in newly created land (reclamation projects) or newly settled land. Within Europe, model settlements, such as Carlsdorf in Hesse, founded for Huguenot refugees in 1696, were often planned with the help of survey, but allocation of "empty" lands, often accompanied by survey and/or mapping, was particularly important in European colonies. These were often mapped earlier and more thoroughly than land in their metropoles in a process that allied mapping squarely with expropriation and imperialism (Kain and Baigent 1992, 133, 265–331).

Survey generated its own momentum. Private surveyors advertised their services and boasted of their benefits (e.g., Bendall 1997, 1:8). States looked to the cadastral experience of others: the Milanese *censimento* of 1718–60 was consciously emulated by other princes, such as Vittorio Amedeo II in Savoy, and ministers, such as Ensenada in Spain, while surveyors from Milan moved on to surveys in other parts of Italy and Spain (Alimento 2002, 455; Gómez Urdáñez 2002, 467; Massabò Ricci 1983).

The costs and benefits of property survey were not measured only in economic terms. Economic power entailed coercive power (owners demanded rents, and rulers demanded taxes), and the products of survey linked economic with coercive power. Records of private and state-sponsored survey mediated power, being used to effect "improvements" or collect taxes, and property maps hung on walls brought the additional benefit that they reminded owners, rulers, guests, tenants, and subjects of the right ordering of the land and its inhabitants.

There were circumstances where a decision was made not to survey property. Though reason alone might suggest that property survey would benefit princes or patrons, if the survey or the project to be effected by it was contentious, prudence might dictate leaving well enough alone. The reasonably lucrative English land tax was collected with neither map nor survey from 1692 to 1798 by local gentry or tradesmen who resisted alternative forms of revenue raising, such as borrowing or a general excise. They, not officers of central government, controlled land tax, which confirmed their local status and made paying it tolerable (Beckett 1985).

The above reasoning, though it accounts for much property surveying, takes the Enlightenment too much on its own terms by suggesting that property survey depended on rational calculation alone. While this was a time of reason, it remained a period of absolutism, when both the whim and the reason of monarchs and ministers could rule. The Swedish *geometriska jordeböcker* mapping, begun just before the Enlightenment but continuing well into it, rested on Gustavus Adolphus's project of building an all-encompassing military state. While this project might be rational taken as a whole, its individual elements were governed more by personal preference and grandiose ideas (Gustavus ordered the survey of all lands that might one day be part of Sweden), which stretched reasonableness to its limits (Baigent 2005a). Moreover, reason did not obliterate self-interest—individual or institutional. When surveyors promoted themselves in surveying manuals, advertisements, and audiences with potential patrons, their rhetoric was of science and reason, but their claims were sometimes unreasonably overblown. Institutions whose raison d'être was surveying and mapping acquired their own inertia, continuing to produce surveys and maps and to reproduce themselves through recruitment, training, and the inculcation of map consciousness in those to whom they answered and in the public at large. Self-interest was in one sense entirely reasonable but was not always consonant with Enlightenment rhetoric of harnessing reason to wider human needs.

Land had been exchanged, cultivated, distributed and redistributed, reclaimed, and taxed, and boundaries had been disputed and fixed for centuries with neither measured survey nor mapping. There was nothing about the Enlightenment that made measured surveying and mapping suddenly necessary to these projects, and in some places the Enlightenment came and went leaving land either unmapped or shown on maps that had illustrative but no legal value, such as the impressive English eighteenth- and nineteenth-century enclosure maps (Kain, Chapman, and Oliver 2004). Other graphic media might trump maps in imparting symbolic messages. A prospect of an owner's land or an allegorical representation of a prince's estate might convey a visual message better than a map. If patrons wanted to proclaim their association with science, they might prefer maps to pictures, yet sometimes the maps' measured and reductive nature worked against them. An elevation of a fine house, an oblique view of it amidst its gardens, park, and fields beyond, or an estate portrait might be more telling than a chaste plan map in which the grand house became an outline plan, its expensively modeled park indistinguishable from a mere meadow. Sometimes the static nature of the map was the problem. Humphry Repton sold his landscape remodeling projects to English patrons not with maps but with red books whose successive overlays enabled the client to traverse time to see trees maturing and vistas appropriately framed (Repton 1805) (see fig. 716). Moreover, while patrons' arms or house might appear prominently on the map, they themselves could not, whereas a painting, such as Thomas Gainsborough's portrait *Mr and Mrs Andrews* (ca. 1750, London, National Gallery) could have them in the foreground, masters of all that they and the viewer could survey.

Overall, property survey and boundary marking changed in the Enlightenment from using ritual and physical markers, through systematic but unmeasured survey, to measured survey, and finally to mapped measured survey, and national projects took their place alongside local ad hoc or ad hominem initiatives (Kain and Baigent 1992). While land could be redistributed without maps, wholesale enclosure that swept away precapitalist land tenure practices was often effected with techniques (such as measured survey) and media (such as scale maps with few pictorial elements) that were themselves modern (e.g., Kain, Chapman, and Oliver 2004). However, the trajectory was never simple and rarely uncontested, and pre-Enlightenment practice survived in many areas. Practices such as monumentation, metes and bounds, and estimation were quicker and cheaper than full measured land survey, especially survey with mapping, and so had considerable longevity, but their function often changed. Communal perambulations, for example, were practiced less for their practical point and more for their folkloric value as quaint customs or to fulfil spiritual aims (e.g., to ask for blessing on the land).

While the Enlightenment was predicated on ideas of universality, local particularities still determined whether land in any specific place would be surveyed and mapped, and the story of land survey encompasses failure as well as success. Joseph II's ambitious plans for reform of the feudal system, for example, in which survey and mapping played key roles, fell afoul of aristocratic opposition, lack of money and personnel, and ultimately his death in 1790 (Lego [1968]; Kain and Baigent 1992, 192–95). Moreover, what seemed a straightforwardly good idea in the metropolis might turn out rather differently in the distant field (Scott 1998).

There were several motives for property survey and mapping. Some, such as the levying of tax, were not particular to the Enlightenment, while others, such as the desire for an inventory of a state's resources or the application of science for improvement, were characteristic of it. Further characteristic developments were an increasing emphasis on property survey and mapping to facilitate change, though legal maps continued to be drawn to confirm the status quo, and a move from bespoke (customized) survey for individual projects to the establishment of mapping bodies (the earliest being Sweden's Lantmäteriet, founded 1628) (Baigent 2005a), whose maps could inform a variety of uses.

PURPOSES OF PROPERTY MAPPING Enlightenment princes and the church, like their forebears and successors, frequently relied on taxes and tithes on land and its produce for a good portion of their revenue. Land remained a convenient and appropriate thing to tax. Physiocrats formally argued that land was the source of all value, and their view was influential in France and elsewhere. Political economists such as Thomas Robert Malthus, who, perhaps influenced by physiocratic ideas, considered a nation's population dependent on its food production and hence land; but it was a simple economic fact in most places that land was the source of much value, and even where strictly speaking it was not (in towns and industrial areas), it was still associated with the creation of value (being needed for mines, factories, and workshops) and with the possession of wealth (merchants and manufacturers often invested in land). But ill-apportioned land taxes stifled farmers' enterprise and provoked opposition from the overburdened; tax changes were opposed by those who feared an increase in their contributions; and frequently the ownership, extent, value, and taxable status of land were disputed by those hoping to pay less. The authorities could use survey to discover these things and indeed the very existence of concealed land plots in remote or densely forested areas—maps being particularly useful in providing a complete view (Young 1979; Hoyle 1992b, 212). Comprehensive survey and mapping for taxation fit the Enlightenment concepts of universal knowledge and the end to particularism. Though such tax projects could consolidate the position of the powerful, they might also be linked to ideas of distributive justice derived from Thomas Aquinas (Alimento 2002, 455). Whatever the ideology behind them, Adam Smith argued influentially that accurate survey and mapping were inefficient, since the constant need to resurvey to take account of change demanded "an attention so unsuitable to the nature of government, that it is not likely to be of long continuance, and which, if it is continued, will probably in the long-run occasion much more trouble and vexation than it can possibly bring relief to the contributors" (Smith 1776, 2:437). Whatever their benefits, comprehensive survey and mapping for taxation often became embroiled in highly contested legislation that challenged the traditional exemptions from taxation of aristocratic and church lands or that challenged property professionals' monopolies on practice. In eighteenth-century Cleve, for example, the nobility resisted survey while the peasantry petitioned for it (Ketter 1929); in Castile, the clergy actively resisted Ensenada's cadastre of 1749–56 (Domínguez Ortiz 2002, 450); and in England and Wales, lawyers led resistance to successive schemes for comprehensive survey, mapping, and registration of deeds and titles for reasons that included fears of land taxation (Offer 1981).

During the Enlightenment, property surveys and maps were increasingly used to settle or ward off legal disputes over land ownership, occupation, or use. By a suggestive or at least clear presentation of the situation, they might persuade a court to a favorable decision or dissuade a potential challenger from making a claim. In the same period, public registration systems for land title developed, for example, in attempts to construct a national French cadastre after the revolution (Konvitz 1987, 41–62). Both changes were part of longer-term moves from private justice (seizing land) to state justice (settling land claims in court) and, within the legal system, from oral to written evidence and were linked to the contemporary consolidation of the machinery of state, bourgeois influence, and the legal system and profession in many European countries. The law was the gentry's favored means of defending its land (cf. aristocratic brute force) and was itself a source of wealth, especially where primogeniture kept gentry estates intact but required younger brothers to carve out independent careers. The self-interest of lawyers, who lacked technical understanding but were at home with written documents, might have kept maps subservient in the courts. In England, where the rise of the lawyer in both the legal system and public life generally was remarkable, property maps never acquired legal force, and a system of public registration of land title based on property maps was never established, so surveyors, despite their skills in interpreting maps, did not threaten the monopoly of lawyers (Offer 1981). By contrast, in Norway a royal order of 1719 established a national system of *landmålingskonduktører* (surveyors) who were to arbitrate in and even decide property disputes (Kain and Baigent 1992, 103–8) (fig. 653).

Property surveys reflected Enlightenment ideas that nature was governed by natural laws, rather than divine whim (miracles) or mystic forces (magic); that these natural laws could be discovered by reason applied to empirical data; and that by discovering and then applying these laws through science man could and should bend nature to social and economic ends. Earlier (perhaps especially pre-Reformation) attempts to control nature depended on magic and religion (Thomas 1983)—strategies that rested on the particular qualities of people (conjurors, priests) or places (magic springs or holy wells). Enlightenment science, by contrast, attempted to control nature through the application of universal rather than local principles and on knowledge that was rational and openly available rather than secret or mystical. While medieval maps had often helped readers to discipline themselves intellectually or spiritually, Enlightenment property maps often helped them to discipline nature. The rhetoric of "improvement" proclaimed the superiority of new scientific practices over local, time-honored ones, and the business of "improvement" linked it firmly to capitalism and often to the power of the emergent bourgeoisie. Many agricultural improvements, especially enclosure, were predicated on, or themselves introduced, production for the market, absolute control of land, contract labor, money rent, and an end to common rights. The resultant market economy reduced responsibility to a system of cash payments (which rested on surveyable things such as land and its value), not moral obligations (which were hard or impossible to survey and certainly to map) (Wilmot 1990; Thompson 1991).

A prerequisite for rational improvement of the kind the Enlightenment advocated was good information, and it was argued by many surveyors, and some princes and patrons, that land survey and maps were ideal for inventorying the nation. Joseph II declared of them: "If one is to rule countries well, one must first know them exactly" (quoted in Kain and Baigent 1992, 195), and the Swedish *geometriska jordeböcker* are best understood as an inventory to be used by the Swedish mili-

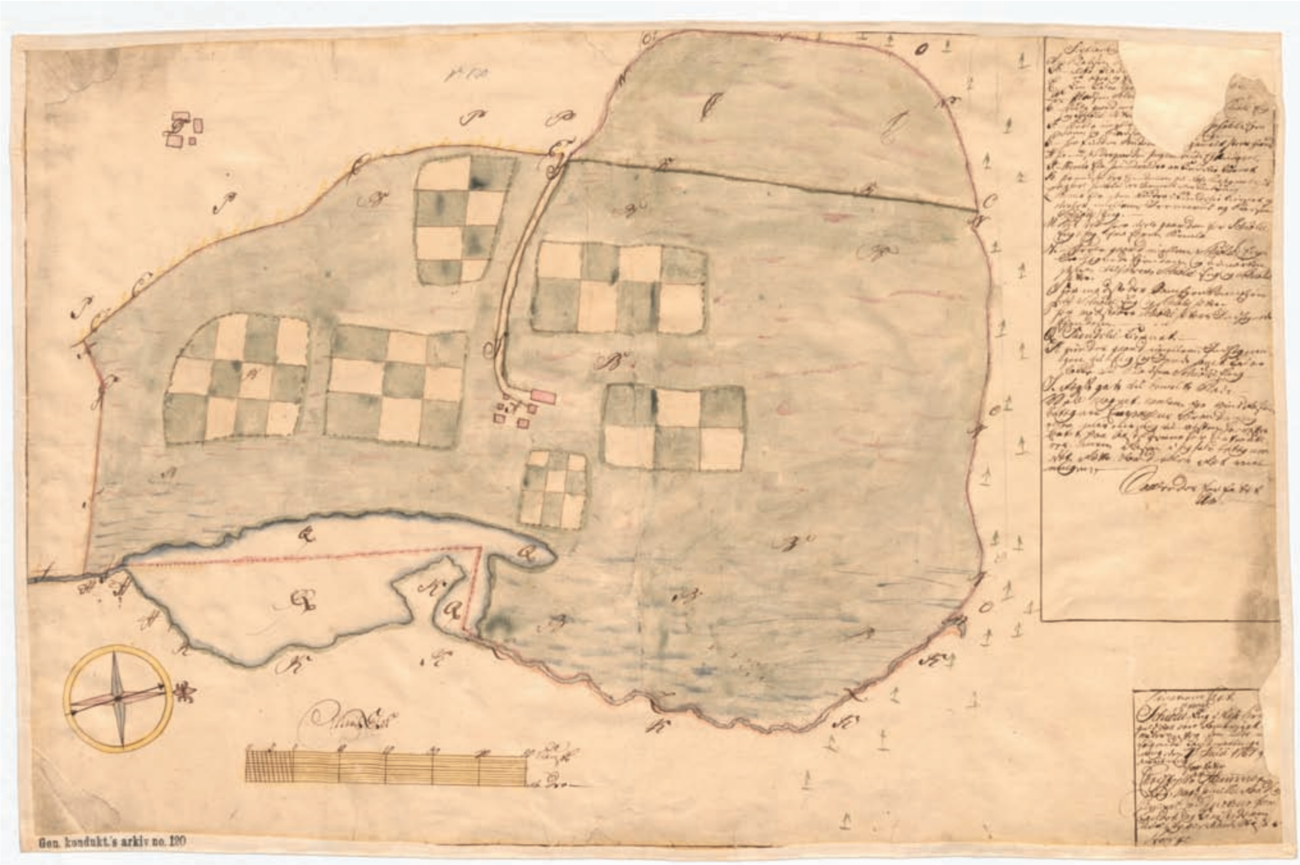

FIG. 653. MANUSCRIPT MAP BY CHRISTOPHER HAMMER OF PROPERTY IN DISPUTE IN ØVRE ROMERIKE, AKERHUS *AMT*, 1764. Hammer was appointed Norway's first *generalkonduktør* (surveyor general) in 1752.

Size of the original: ca. 48 × 74 cm. Image courtesy of Riksarkivet, Oslo (G. kond. 120).

tary state (Baigent 2005a). Comprehensive state surveys were found before the Enlightenment (e.g., the English Domesday Book of 1086), but their use became systematized and normalized during it.

In a further normalization of earlier trends, knowledge gained in the field or experimentally achieved parity with or superiority over that gained in the study or cabinet. Enlightenment property survey demanded the bodily presence of the surveyor in the field to gaze on the landscape, sometimes with the unassisted eye and sometimes with his gaze enhanced. Instruments, such as telescopes, or vantage points, such as church towers, enhanced surveyors' ability to see over space, and sighting instruments linked to those that measured angles enhanced the surveyors' ability to give quantified expression to what they saw and to reproduce it in scale maps or in numbers from which such maps might be produced. However, the field provided only partial knowledge, and it was knowledge gained through cabinet study of antiquarian descriptions, other maps, tax lists, court rolls, and terriers that enabled surveyors to see the past, while instructions from patrons and the literature of improvement enabled them to envision the future.

Pre-Enlightenment survey was as much about listening as about looking. "Survey" had meant rigorous and systematic inquiry and, in addition to studying written records, surveyors were to listen to local people. In earlier times, oral evidence often carried as much authority as written, and in at least some jurisdictions local custom (*lex loci*) could suspend the operation of statute law in any place if that custom could be proved to be locally specific and of ancient exercise. E. P. Thompson (1991) considers the elevation of written over oral evidence that occurred during the Enlightenment to have been a legal device to give freer rein to capitalists, whose schemes for improvement would no longer have to accommodate customary use rights to which the practice, memory, and oral evidence of local people attested. He finds capitalists and lawyers complicit in this, but so were surveyors, who were rising property professionals like lawyers (Offer 1981). The (incomplete) process of downgrading custom and the speech of local people meant that surveyors listened less and looked more, spent more time in the field exercising uniform scientific practices, and less in the cabinet inquiring after local particularities (these were increasingly left to antiquaries and, later, folklorists). Listening to locals was also linguistically problematic: Austrian imperial surveyors struggled to understand Hungarians; French surveyors, Bretons; English surveyors, Welsh and Irish people; and metropolitan surveyors struggled with the languages of their colonized subjects.

Though property maps, like all maps, are perfectly adapted to show variation over space, a single map cannot show variation over time. Property maps thus cannot show seasonal use rights, for example, the right to depasture animals or glean fields at certain seasons, but only place-names that allude to such rights. Thus "Lammas lands" on a map alludes to their use as pasture each year after Lammastide (1 August), but the practice resides in the performance of local people and its representation is in memory or textual descriptions, not on maps.

Contemporary apologies and some later historical analyses dwell on the all-encompassing nature of the surveyors' gaze: but in fact the gaze was always supplemented by inquiry in the cabinet. Moreover, surveyors from all periods might prove blind to some things: the ideology of improvement might prevent them from seeing the plight of cottagers condemned to destitution by enclosure effected by survey, while their patrons' interest might lead them to overlook inconvenient aspects of reality that might undermine a legal case.

Before the Enlightenment, some property surveys (e.g., the "metes" element of metes and bounds) involved measurement, while others involved quantification without measurement (estimation of the extent or value of land [Hoyle 1992b]). The normalization of measurement in the methods and products of property survey epitomized Enlightenment values of regularity, precision, and rationality and the increasing professionalization of surveying. The nature of quantification changed: often the whole area of a village was measured, perhaps triangulated, and plotted before individual plots were surveyed, as happened in the United States, for example, after the U.S. Public Land Survey System replaced the older systems including metes and bounds following the Land Ordinance of 1785 (Kain and Baigent 1992, 265–98). Increased quantification was complemented by the increased, though substantially incomplete, standardization of units of measurement (see e.g., Konvitz 1987, 41, for the link between the French eighteenth-century cadastre and metrification). The preference for national or at least regional units (such as the Rhineland rod) rather than local epitomized the Enlightenment's advocacy of uniformity and universality, and, where implemented, rendered the products of land survey more legible to outsiders, though less legible to local people.

Property survey might be regular or exceptional. Beating the bounds (perambulation) was often an annual ritual, land was often surveyed when it was bought and sold, while surveys of Crown or state lands typically took place at the start of a new reign or regime. A great survey of English Crown lands, with some mapping, took place under the Commonwealth following an act of 1649 (Madge 1968) and the French Revolution gave new impetus to a variety of cartographic initiatives, including cadastral ones (Konvitz 1987).

FROM MAPPING TO MAP Just as surveyors were to survey using their eyes, so were their products to open the land to the gaze of others, an audience that changed during the Enlightenment, as did the nature of the gaze itself and the knowledge on which it was predicated. Pre-Enlightenment survey produced written texts but also memory (daily routines of work and life inscribed boundaries, names, and extent and quality of land plots in the minds of local people); ritual (the yearly perambulation of parishes or plots taught the young to see with the eyes of the old, the wayward with the eyes of the community as a whole); monuments (easily visible and enduring boundary markers such as walls and cornerstones were erected and agreed), and metes and bounds (visually prominent features such as trees, streams, and buildings were designated as bounds). By contrast, Enlightenment property survey was characteristically recorded in written terriers, tax rolls, or maps, especially in colonies where local practice and memory collided with settlement schemes. Such written records changed the nature of the gaze. The empirical method claimed the senses—universal qualifications—to be arbiters of truth, but while science was in some ways open and able to subvert authority, its processes and products also reinforced privilege. Written survey records privileged the gaze of those who could read at all, read official rather than local languages, read statistics, and read maps, over those who could not. They privileged the gaze of the specialist few (professional surveyors, lawyers, estimators, and valuers) over the gaze of the many (those who saw the boundaries in the course of their daily work and the whole parish who performed the perambulation). They privileged the gaze of those who kept the records, in muniment rooms or survey or tax offices, over those who were thereby kept from them. In particular, they enhanced the view of those outside the community compared with that of local residents, and of future people alongside those of the present. While memory, custom, monumentation, and designation of bounds worked for current local people, people distant in space (metropolitan tax authorities or institutions owning scattered estates [Fletcher 1995]) or time (descendants of estate holders) needed written records to see the land and its boundaries. Though written records were vul-

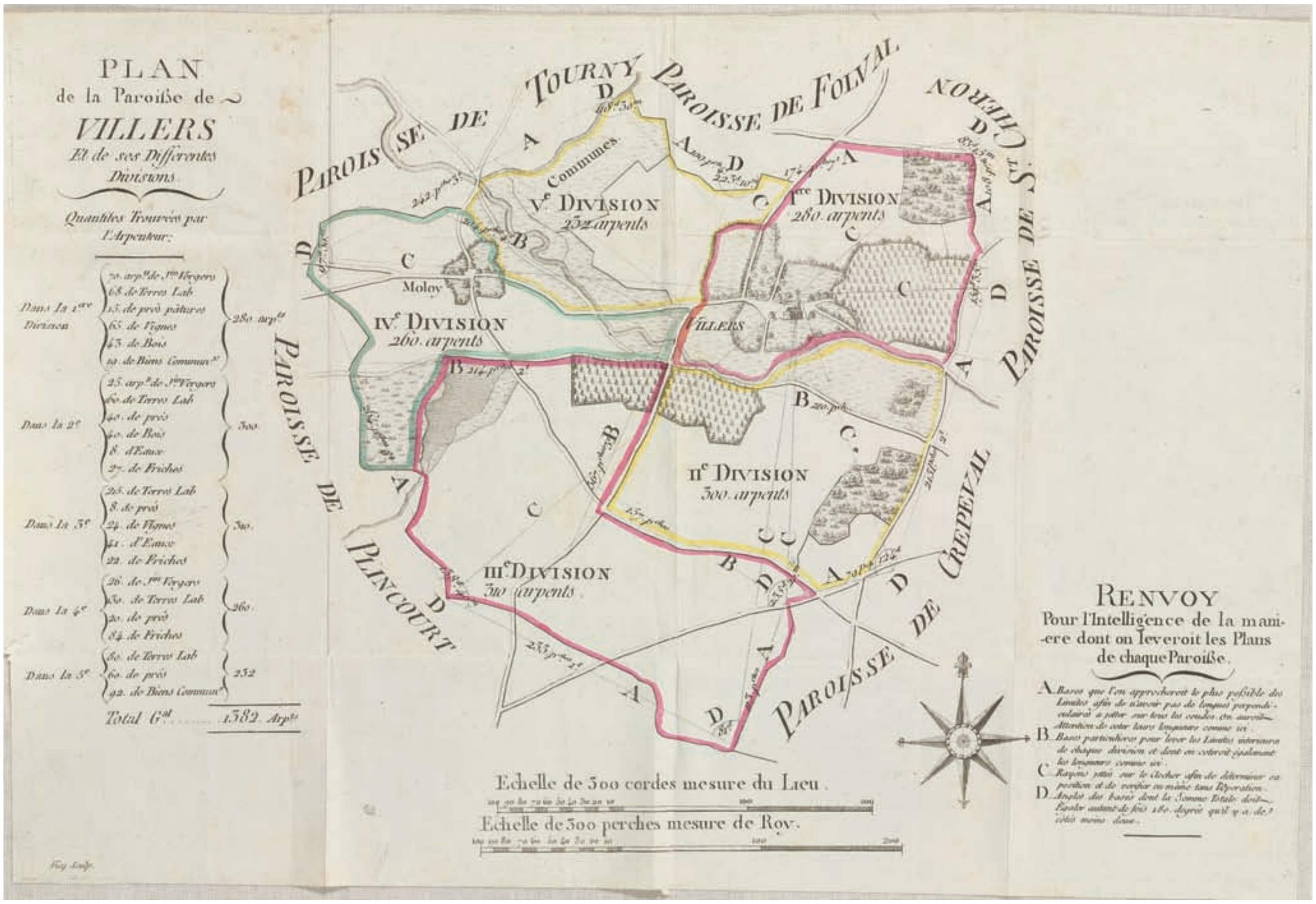

FIG. 654. *PLAN DE LA PAROISSE DE VILLERS ET DE SES DIFFERENTES DIVISIONS*, 1790. A printed example of a model map that could be used to increase uniformity. From Pierre-François Aubry-Dubochet, *Exécution du cadastre général de la France* (Paris: Imprimerie National, 1790), 16–17. Image courtesy of the Bibliothèque nationale de France, Paris.

nerable to wear and tear and loss, they were more permanent than monumentation (where doubt remained over which were the markers or whether they had been moved) or bounds (where designated trees might die or streams change their course), and thus they better enabled landholders' descendants to view the land. Again, these trends did not originate in the Enlightenment, but they were characteristic of it.

There were sometimes several versions of property survey maps: working drafts made in the field (using plane tabling), clean copies produced in the office, elaborately decorated presentation copies, or calculations as a coded copy, comprehensible to few. Printing was, however, rare. Having a smoothly functioning and comprehensive system of property survey records was of considerable collective interest to nations and individuals, but each individual record commanded limited interest, and, because of the large scale of property survey maps, few people were interested in any one map sheet. Print culture did influence property survey, however. Printed survey manuals, advertisements, and trade cards influenced survey practices and advertised survey's benefits; printed tables to be completed by surveyors and model maps, such as figure 654, increased the uniformity of surveys; and property survey maps, such as those of the eighteenth-century Milanese and Corsican cadastres, were reduced to create printed topographical maps (Kain and Baigent 1992, 183, 224).

Property maps typically depict the boundaries of plots, properties, and, where appropriate, political or administrative units and for each land plot, its owner, occupier, use, area, and, in the case of state-sponsored maps, plot registration number or rateable value. (Some of this information may be shown on accompanying documents rather on than the map itself, and this caused problems when previous archival practice separated textual from visual records). Some topographical information, such as the names of fields or settlements, was necessary to the purpose of the map, while other features, such as hills and roads, were depicted for prudential reasons (the avoidance of doubt).

The style and decoration of maps proclaimed the authority of those who commissioned and drew them and of the methods used to draw them. Surveyors used the

FIG. 655. DETAIL FROM FREDERICK YOUNG'S MANUSCRIPT ESTATE MAP, "PLAN OF THE PARISH OF HAWKHURST IN THE COUNTY OF KENT," 1818. Maps were drawn to meet an institution's need to oversee scattered estates, and the continued use of pictorial elements even at the end of the Enlightenment was probably a result of surveyors' personal preference. Young employed a pictorial landscape technique to display forests and copses but used symbols for arable, pastoral, and hop fields.
Size of the entire original: ca. 172 × 161 cm; size of detail: ca. 42 × 90 cm. Image courtesy of the Governing Body of Christ Church, Oxford (Hawkhurst 2 1818).

map proper and its margins, cartouche, and dedication to declare their authority as men of local knowledge but also nationally validated experience, law, and science. They furthered their careers as employees or freelance workers by drawing attention to their names. They advertised their qualifications by including their rank. They curried favor with present and potential patrons by depicting their great house or including fulsome dedications; buttressed claims to authority by including coats of arms; and proclaimed their patrons and themselves men of taste, aesthetic judgement, and sensibility by ensuring their map looked good on the wall. They situated the map, themselves, and their patrons in the international cultures of science and reason (by depicting scale bars, compasses, and themselves with their instruments) and of scholarship and classical authority (by depicting putti, gods, and goddesses). As the domination of science increased during the Enlightenment, scale mapping became nearly ubiquitous and pictorial elements were marginalized. The typical property map became a plan view in a chaste style, partly because its production became increasingly routine, and partly because absence of decoration could be interpreted as proclaiming modernity, reason, and seriousness. Religious symbolism was absent: the church had co-opted the earlier survey method of beating the bounds by linking it to liturgical seasons such as Rogationtide (starting the fifth Sunday after Easter), but it could not give a religious stamp to property maps. The power of church patrons was represented no differently from that of secular ones. No symbolic element was unique to property maps: rather, cartographic norms of color and signs reflect increasing uniformity and converged around Enlightenment modalities of science, modernity, an often-austere classicism, and reason. Nonetheless, unreason flourished, and property mapmakers eclectically adopted representational strategies or included information or decorative elements on their own or their patrons' whims (fig. 655).

Since rational change was a fundamental aspect of the Enlightenment, its property maps may show what is there or what might or should be there. Sometimes pairs of maps, typically before and after enclosure, illustrate the difference, but a single map may show a real landscape or a desideratum that never materialized or whose elegant regularities succumbed to local vagaries of terrain or vested interests. The 1785 *skärskifte* (enclosure) map of the Svanholm estate owned by Rutger Macklean in Skåne, southern Sweden, for example, represented an ideal rarely if ever achieved in reality (see fig. 49).

Property survey records, including maps, might be used in ways that conformed to or were quite different from their creators' expectations. Some, notably the Swedish *geometriska jordeböcker* maps, appear not to have been used at all, though they remained symbolic storehouses of information for the authorities (Baigent 2005a). Most property maps remained in manuscript, lodged in official archives or private muniment rooms, and only rarely were they printed for wide circulation. In the Netherlands, where the book trade was well established, maps of polderlands were printed for circulation among potential buyers and to meet wide public interest in the *hoogheemraadschappen* (water control boards) that administered the polders (Hart 1985; Kain and Baigent 1992, 11–24) (fig. 656). Manuscript maps went through the hands of all or some of engravers, colorists, printers, binders, and sellers before they reached their readers, and at each stage information might be lost, added, or changed. For some projects being up to date was paramount, and working copies of property survey records might be changed to reflect the land's new owner, use, or value. When they were past alteration, such working documents might be carefully archived or destroyed, and this loss makes it difficult to estimate how widespread map use was. Property maps made for display might be superseded when land use changed, estates were broken up or added to, or aesthetic tastes changed. Such maps might be destroyed or find their way with outdated furniture to the servants' quarters or the salesroom where their relationship with the land was lost. Destruction was also true of organizations, such as survey bodies or colonial monopoly companies, as well as private individuals (Zandvliet 1998).

Before the Enlightenment, surveying manuals had been important as apologies for survey and sites where pro-

FIG. 656. MAP OF PUTTEN COMMISSIONED BY THE *HOOGHEEMRAADSCHAP* AND DRAWN IN 1700. To equalize assessment of dike taxes, surveyor Daniel Schillincx was commissioned in 1617 to make a cadastre (written documents and maps). The map shown here was made in 1700 by Bernard I de Roij using the original 1617 survey and reference numbering of Schillincx. A rare printed property map from a country with a buoyant book trade and a highly developed capitalist land market.

fessional struggles between new- and old-style surveyors were played out (Hoyle 1992b, 213–26). As property survey became better established, manuals became less apologetic and more practical aids to survey. In England, William Leybourn's *Compleat Surveyor* of 1653 was the first of a new breed of manual that assumed acceptance of the plane table and lacked the lengthy sections on mathematics and law that had characterized earlier volumes (Bendall 1997, 1:37). It is difficult to know how such manuals were used by the many surveyors who learned their trade by apprenticeship, though they would have had a clearer role in educational establishments. Although land surveying became a more specialist profession it often remained a sideline for teachers, booksellers, land agents, auctioneers, or farmers (Bendall 1997, 1:34–42, 60–63; Kain and Baigent 1992, 23). Military schools (private and state) were increasingly numerous in the Enlightenment, and military practices (such as the use of scale plans) fundamentally influenced civilian surveying, not least as surveyors moved between civilian and military practice as demand dictated. Surveying, like navigation and bookkeeping, was one of the practical skills taught at vocational schools to middle-class boys (rarely girls) for whom a classical education was thought inappropriate (Buisseret 2003, 113–51; Bendall 1997, 1:34–58). It was also taught at universities in the Netherlands—an indication of the high value put on surveying in that country. As public interest in surveying increased, authorities instituted the swearing in of surveyors judged to be both competent and upright (Kain and Baigent 1992, 23–24, 103–8).

The Enlightenment saw an increase in property survey of all types: general survey for a variety of purposes rather than bespoke survey; comprehensive survey, which covered whole territories rather than just selected areas within them; surveys based on triangulation; mapped surveys; surveys instituted by ruling bodies; surveys undertaken by men who were publicly appointed or regulated; and surveys based on measurement. The differing roles and priorities of locals and outsiders are a recurrent theme. Property survey and mapping constitute coherent phenomena since both are predicated on the view that land is to be actively managed and that survey and mapping are effective management tools. The skills needed for land management and survey to some extent overlapped. Though there is very considerable variation in property plans, with poor and marginal countries often producing less sophisticated products than richer and more central ones, ideal property plans existed in the minds of surveyors and on paper. Deviations from the ideal are abundant, however, and counsel against overgeneralization. Enlightenment property maps were part of a modernist vision of grand projects and an end to local particularism: yet everywhere this encyclopedic, rational vision—this seeing like a state (Scott 1998)—had to accommodate whim, vested interests, and local particularities, which often made property survey contentious and always made the surveyor's gaze wishful.

ELIZABETH BAIGENT

SEE ALSO: Cadastral Surveying; Instruments for Angle Measuring; Instruments for Distance Measuring; Modes of Cartographic Practice; Property Map; Taxation and Cartography

BIBLIOGRAPHY

Alimento, Antonella. 2002. "Eighteenth-Century Cadastres, between Tradition and Modernity." In *El Catastro de Ensenada: Magna averiguación fiscal para alivio de los vasallos y mejor conocimiento de los reinos, 1749–1756*, ed. Ignacio Durán Boo and Concepción Camarero Bullón, 453–56. Madrid: Ministerio de Hacienda.

Andrews, J. H. 1985. *Plantation Acres: An Historical Study of the Irish Land Surveyor and His Maps*. Belfast: Ulster Historical Foundation.

Aymans, Gerhard. 1986. "Die preussische Katasteraufnahme im Herzogtum Kleve der Jahre 1731–38." *Erdkunde* 40:14–28.

Baigent, Elizabeth. 2005a. "Monarchs, Ministers, and Maps: The Geometrical Mapping of Early Modern Sweden in International Perspective." In *Nationalutgåva av de äldre geometriska kartorna*, ed. Birgitta Roeck Hansen, 23–60. Stockholm: Kungliga Vitterhets Historie och Antikvitets Akademien.

———. 2005b. "Mapping the Forests and Chases of England and Wales, c. 1530 to c. 1670." In *Forests and Chases of England and Wales, c. 1500–c. 1850: Towards a Survey & Analysis*, ed. John Langton and Graham Jones, 21–28. Oxford: St John's College Research Centre.

Beckett, J. V. 1985. "Land Tax or Excise: The Levying of Taxation in Seventeenth- and Eighteenth-Century England." *English Historical Review* 100:285–308.

Bendall, Sarah. 1997. *Dictionary of Land Surveyors and Local Mapmakers of Great Britain and Ireland, 1530–1850*. 2d ed. 2 vols. Originally comp. Francis W. Steer and ed. Peter Eden. London: British Library.

Brückner, Martin. 2006. *The Geographic Revolution in Early America: Maps, Literacy, and National Identity*. Chapel Hill: For the Omohundro Institute of Early American History and Culture by the University of North Carolina Press.

Buisseret, David. 2003. *The Mapmakers' Quest: Depicting New Worlds in Renaissance Europe*. Oxford: Oxford University Press.

Delano-Smith, Catherine, and Roger J. P. Kain. 1999. *English Maps: A History*. London: British Library.

Domínguez Ortiz, Antonio. 2002. "The Ensenada Cadastre and Its Circumstance." In *El Catastro de Ensenada: Magna averiguación fiscal para alivio de los vasallos y mejor conocimiento de los reinos, 1749–1756*, ed. Ignacio Durán Boo and Concepción Camarero Bullón, 450–53. Madrid: Ministerio de Hacienda.

Durán Boo, Ignacio, and Concepción Camarero Bullón, eds. 2002. *El Catastro de Ensenada: Magna averiguación fiscal para alivio de los vasallos y mejor conocimiento de los reinos, 1749–1756*. All articles are in Spanish and English. Madrid: Ministerio de Hacienda.

Fletcher, David H. 1995. *The Emergence of Estate Maps: Christ Church, Oxford, 1600 to 1840*. Oxford: Clarendon Press.

Gómez Urdáñez, José Luis. 2002. "Ensenada, Economist of the Enlightenment." In *El Catastro de Ensenada: Magna averiguación fiscal para alivio de los vasallos y mejor conocimiento de los reinos, 1749–1756*, ed. Ignacio Durán Boo and Concepción Camarero Bullón, 466–69. Madrid: Ministerio de Hacienda.

Grenacher, Franz. 1960. "Daniel Meyer, ein unbekannter schweizerischer Kartograph und der Kataster seiner Zeit." *Geographica Helvetica* 15:8–16.

Hart, G. 't. 1985. "De kaart van Rijnland van 1647." *Caert-Thresoor* 4:12–15.

Holmsen, Andreas. 1979. *Gård, Skatt og Matrikkel*. Oslo: Universitetsforlaget.

Hoyle, R. W. 1992a. "Introduction: Aspects of the Crown's Estate, c. 1558–1640." In *The Estates of the English Crown, 1558–1640*, ed. R. W. Hoyle, 1–57. Cambridge: Cambridge University Press.

———. 1992b. "'Shearing the Hog': The Reform of the Estates, c. 1598–1640." In *The Estates of the English Crown, 1558–1640*, ed. R. W. Hoyle, 204–62. Cambridge: Cambridge University Press.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Kain, Roger J. P., John Chapman, and Richard Oliver. 2004. *The Enclosure Maps of England and Wales, 1595–1918: A Cartographic Analysis and Electronic Catalogue*. Cambridge: Cambridge University Press.

Ketter, Kurt. 1929. *Der Versuch einer Katasterreform in Cleve unter Friedrich Wilhelm I*. Bonn: Ludwig Röhrscheid.

Konvitz, Josef W. 1987. *Cartography in France, 1660–1848: Science, Engineering, and Statecraft*. Chicago: University of Chicago Press.

Lego, Karl. [1968]. *Geschichte des österreichischen Grundkatasters*. Vienna: Bundesamt für Eich- und Vermessungswesen.

Madge, Sidney J. 1938. *The Domesday of Crown Lands: A Study of the Legislation, Surveys, and Sales of Royal Estates under the Commonwealth*. London: George Routledge & Sons.

Massabò Ricci, Isabella. 1983. "Conoscenza, memoria, gestione della Terra nella rappresentazione catastale." In *Arte e scienza per il disegno del mondo*, ed. Carlo Pirovano, 187–94. Milan: Electa.

Nissen, Kristian. 1937. "Brødrene von Langen og deres virksomhet i Norge, 1737–1747." *Tidsskrift for Skogbruk* 45:379–87.

Offer, Avner. 1981. *Property and Politics, 1870–1914: Landownership, Law, Ideology and Urban Development in England*. Cambridge: Cambridge University Press.

Repton, Humphry. 1805. *Observations on the Theory and Practice of Landscape Gardening*. London: Printed by T. Bensley.

Richeson, A. W. 1966. *English Land Measuring to 1800: Instruments and Practices*. Cambridge: Society for the History of Technology and MIT Press.

Schön, Berthold. 1970. "Die ersten Flurkarten." *Heimatkalender Jahrbuch Kreis Dinslaken* 27:66–72.

Scott, James C. 1998. *Seeing Like a State: How Certain Schemes to Improve the Human Condition Have Failed*. New Haven: Yale University Press.

Smith, Adam. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. 2 vols. London: Printed for W. Strahan and T. Cadell.

Thomas, Keith. 1983. *Man and the Natural World: Changing Attitudes in England, 1500–1800*. London: Allen Lane.

Thompson, E. P. 1991. *Customs in Common*. London: Merlin Press.

Wilmot, Sarah A. H. 1990. *"The Business of Improvement": Agriculture and Scientific Culture in Britain, c. 1770–c. 1870*. [Bristol]: Historical Geography Research Group.

Young, Charles R. 1979. *The Royal Forests of Medieval England*. Leicester: Leicester University Press.

Zandvliet, Kees. 1998. *Mapping for Money: Maps, Plans and Topographic Paintings and Their Role in Dutch Overseas Expansion during the 16th and 17th Centuries*. Amsterdam: Batavian Lion International.

Property Mapping in the Austrian Monarchy. Until 1700, no surveys entailing the composition of large-scale cadastral maps were conducted within the Austrian monarchy. The monarchy's decentralized nature left taxation in the hands of each estate, although emperors did try to impose organized systems of land registration and tax collection in order to maximize their revenues. Ferdinand I (r. 1558–64) had first established a uniform tax system in the 1520s within the Habsburgs' core hereditary territories of Austria and Bohemia. Leopold I (r. 1658–1705) worked to restore the wholesale damage to the system caused by the Thirty Years' War and began the delicate process of restricting the aristocracy's exemption from taxation. Attempts to increase tax revenues through reforming the assessment and collection processes continued on a district-by-district basis throughout the eighteenth century, under Charles VI (r. 1711–40), Maria Theresa (r. 1740–80), and Joseph II (r. 1780–90). But almost all of these reform efforts relied on the preparation or correction of cadastral registers of property owners *without* undertaking cartographic surveys and preparing maps (Kain and Baigent 1992, 180–95).

The remarkable exception to this trend was the Duchy of Milan, one of the territories acquired by the Habsburgs during the War of the Spanish Succession (1701–14). The tax system there was in complete disarray, and potential revenues were diminished by the exemptions enjoyed by the church and nobility. In 1718, Charles VI therefore appointed a committee, the Giunta di Nuovo Censimento Milanese, to establish a new cadastre as the basis for an equitable system of taxation. The Habsburgs' court mathematician, Johann Jakob Marinoni, argued that the complexity of the task required both a detailed survey of all properties and the drawing-up of cadastral maps. Marinoni also recommended that the survey be completed with his improved plane table and with the standard measure of the Milanese trabucco or perch (1 trabucco = ca. 2.6 m). Local surveyors opposed the use of the plane table, preferring to use the more familiar *squadro*, or surveyor's cross (see fig. 678); field tests in 1720 proved that the plane table was more efficient to use and provided greater detail than the *squadro*, and Marinoni's techniques were adopted. Covering 2,387 communes and 19,220 square kilometers, the land survey ran from 1720 to 1723 and faced significant opposition from the local nobility (Kain and Baigent 1992, 181–87; Harris 2003, 40–61). Each commune and its parcels of property was surveyed at a scale of 1:2,000 (fig. 657); the original survey plans were then reduced to neat plans at 1:8,000 (see fig. 648). Today the maps are distributed across multiple archives in Lombardy; for example, the neat version of the survey plan in figure 657 is held not in Milan, with the original survey plans, but in the Archivio di Stato di Pavia (Harris 2003, pl. 15). The second half of the *censimento*, the assessment of the quality and taxable value of each parcel, was not yet complete and was interrupted when France and Spain invaded Lombardy in 1733. An entirely new assessment was undertaken under Maria Theresa in 1749–58, and the new tax system finally came into force in 1760; for this reason, the entire work is often known today as

fig. 657. DETAIL OF GIOVANNI ENRICO ECK'S ORIGINAL MANUSCRIPT MAP OF THE COMMUNE OF BELGIOIOSO, 1722. At 1:2,000, this is one of the thousands of detailed cadastral plans made for the Milanese *censimento* (1720–23). The detail shows part of the town of Belgioioso, in the province of Pavia, and some of the surrounding properties. Each property bears the name of its owner, its calculated area (in square trabucci, or perches), and, in red, the property's index number in the list of the 299 properties delineated on the map.
Size of the entire original: 346 × 142 cm; size of detail: ca. 60 × 96 cm. Image courtesy of the Archivio di Stato, Milan (Signatura 139).

the Catasto Teresiano (Lego [1968], 1–11; Kain and Baigent 1992, 181–87).

The *censimento* stands as the first complete cadastral survey of a province, save for a few remote mountains, yet it was not widely emulated within the Austrian monarchy. Local circumstances led to a cadastral survey of the Tyrol after 1749, as part of Maria Theresa's general taxation reforms (Kretschmer 1974, 208; Kain and Baigent 1992, 191–92). The Duchy of Mantua, initially excluded from the *censimento*, was finally surveyed and an assessment made, beginning in 1785 (Veres 2015, 423). The first cadastral survey of the entire Austrian territory conducted on a scientific basis was initiated only after the Napoleonic Wars (Kretschmer 1974, 208–9; Kain and Baigent 1992, 196–202). Even so, the *censimento* was influential during the eighteenth century. Its maps were compiled into topographical maps of Milan, which meant that the duchy did not have to be included within the Josephinische Landesaufnahme after 1763 (Veres 2015, 405–13). The principle of taxing all property owners alike was influential across northern Italy and in Spain as well as France (Kain and Baigent 1992, 187–90). And, it appealed to Enlightenment *philosophes*. Adam Smith, in his *Wealth of Nations* called the survey for the *censimento* "one of the most accurate that has ever been made" (Smith 1776, 2:435).

In addition to the cadastral work of the state, property maps were commissioned by aristocrats and monasteries. While some were commissioned in the seventeenth century, the practice became common only after 1700 (Kain and Baigent 1992, 176–80). Again, it was Marinoni who produced the most important of these works, in Lower Austria, near Vienna. In the 1710s and 1720s, he compiled the "Atlas deren Hochgrafflichen Hardeggischen Herrschaften." This manuscript atlas comprised twenty-three map sheets covering large portions of southwestern Weinviertel region (Dörflinger 2004, 85). When Count Johann Julius Hardegg became *Oberstjägermeister des Kaisers* (emperor's high lord of the hunt) in 1724 he commissioned Marinoni's second important work—the "Neuer Atlas des kayserl.^{en} Wildban in Österreich unter der Ens," or the so-called hunting atlas of Charles VI. Prepared in 1726–29, the atlas comprises thirty map sheets representing the imperial hunting preserves near Vienna, mostly at a scale of 1:10,800 (see fig. 529). The maps show the zones along the Danube between Vienna to the west and Orth on the Danube to the east as well as the adjoining regions to the north (Marchfeld plain, southern part of Weinviertel hills). The orientation of the individual sheets varies: thus, each sheet features a compass rose to clarify its specific orientation. One particularly remarkable feature of this work is the baroque title cartouche of the overview sheet with its hunting motif decoration (Kain and Baigent 1992, 177). These maps provide a useful basis for research on the ancient course of the Danube, since they disclose precise information on the ground cover and location of individual islands and branches of the Danube at the time of composition (Oberhummer 1933; Dörflinger 2004, 85).

For the Schottenstift (Scottish Abbey), a Benedictine institution and Vienna's oldest monastery, Marinoni produced a map of the community of Breitenlee, which is situated in the Marchfeld plain and is today part of the municipal territory of Vienna (fig. 658). The production of a map seems to have been occasioned by the need to provide new arable land after the devastations of the second Turkish siege of Vienna (1683) and the Kuruc incursions. The extended title reveals that Marinoni's disciples participated in the surveying work as well (Dörflinger 2004, 160–61).

In the course of the eighteenth century, a few thematic cadastral and field maps were compiled, such as the tithe map of the parish of Pulkau in northwestern Weinviertel ("Mappa von dem Pfarr District zu Pulckhau" [1747], ca. 1:12,000), which also contains several entries denoting economically significant assets. Thus, the map shows eight mills and features a few legends mainly referring to vineyards (Dörflinger 2004, 162–63).

Large-scale maps were also produced for sections

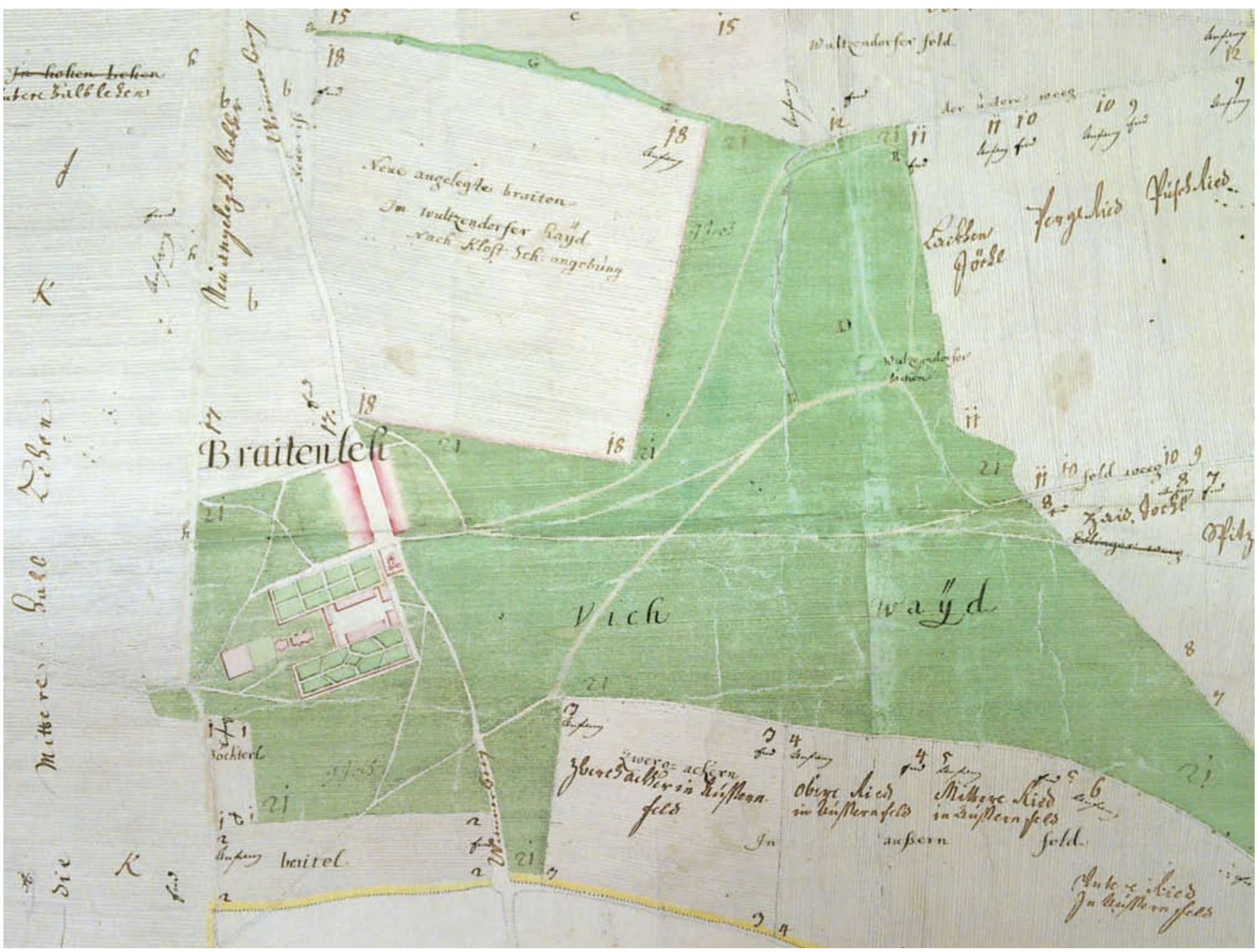

FIG. 658. DETAIL FROM JOHANN JAKOB MARINONI'S "MAPPA ÜBER DIE DEM LÖBL. STIFFT UND CLOSTER SCHOTTEN," 1727. Colored manuscript, ca. 1:5,500. Size of the entire original: 138.5 × 92.5 cm; size of detail: ca. 31 × 42 cm. Image courtesy of the Schottenstift Archiv, Vienna (Plansammlung, Alte Signatur 7).

of Upper Austria, above all by representatives of the Ingenieurschule established in 1708 by the Upper Austrian Estates in Linz. The best-known of these were compiled by the engineers Franz Anton Knittel and Franz Jakob Knittel. In the early 1720s, Franz Anton Knittel surveyed the properties owned by subjects of Lambach Abbey, which resulted in 259 map sheets. In the 1740s, together with his son Franz Jakob, he surveyed the Freistadt holdings of the Harrach family on behalf of Count Friedrich von Harrach. These maps (over 580 sheets) were drawn at various scales (1:3,454, 1:5,428, 1:7,037, and smaller) (Grüll 1952, 56–65). Other eighteenth-century surveys of aristocratic properties were prepared by Wolfgang Josef Schnepf, Anton Perlachner, and Karl Anselm Heiß. In the 1750s, Schnepf mainly surveyed several aristocratic domains such as the villages of Schwertberg, Puchenau, Weinberg, Wartberg, and Hartheim, and also prepared maps on that basis. In later years, this was followed by maps of properties belonging to the abbey of St. Florian and its subjects. For example, Heiß, who succeeded Franz Anton Knittel as the director of the Linz Ingenieurschule, produced maps of vineyards of the abbey of St. Florian as well as maps of manor houses (Grüll 1952, 49–54).

PETRA SVATEK

SEE ALSO: Austrian Monarchy; Marinoni, Johann Jakob; Property Mapping: Italian States

BIBLIOGRAPHY

Dörflinger, Johannes. 2004. "Vom Aufstieg der Militärkartographie bis zum Wiener Kongress (1684 bis 1815)." In *Österreichische Kartographie: Von den Anfängen im 15. Jahrhundert bis zum 21. Jahrhundert*, by Ingrid Kretschmer, Johannes Dörflinger, and Franz Wawrik, ed. Ingrid Kretschmer and Karel Kritz, 75–167. Vienna: Institut für Geographie und Regionalforschung der Universität Wien.

Grüll, Georg. 1952. "Die Ingenieure Knittel im Rahmen der o.-ö. Mappierungen im 17. und 18. Jahrhundert." *Mitteilungen des Oberösterreichischen Landesarchivs* 2:43–76.

Harris, Dianne. 2003. *The Nature of Authority: Villa Culture, Landscape, and Representation in Eighteenth-Century Lombardy*. University Park: Pennsylvania State University Press.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Kretschmer, Ingrid. 1974. "Die Entwicklung der österreichischen Katastralmappen und ihre Bedeutung für die Geographie." *Mitteilungen der Österreichischen Geographischen Gesellschaft* 116:206–18.

Lego, Karl. [1968]. *Geschichte des österreichischen Grundkatasters*. Vienna: Bundesamt für Eich- und Vermessungswesen.

Oberhummer, Eugen. 1933. "Ein Jagdatlas Kaiser Karl VI." *Unsere Heimat: Monatsblatt des Vereines für Landeskunde und Heimatschutz von Niederösterreich und Wien*, n.s. 6:152–59.

Smith, Adam. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. 2 vols. London: Printed for W. Strahan and T. Cadell.

Veres, Madalina Valeria. 2015. "Constructing Imperial Spaces: Habsburg Cartography in the Age of Enlightenment." PhD diss., University of Pittsburgh.

Zeger, Josef. 1992. *Die historische Entwicklung der staatlichen Vermessungsarbeiten (Grundlagenvermessungen) in Österreich*, vol. 1, *Verschiedene Arbeiten vom Altertum bis zum Ersten Weltkrieg*. Vienna: Zeger.

Property Mapping in Denmark and Norway. Socioeconomic differences led officials and landowners to take markedly different approaches to the graphical representation of property on maps in each of the three primary regions of the Danish state: Denmark; the duchies of Slesvig (Schleswig) and Holstein; and Norway. This entry considers each in turn. (There was little property mapping to speak of in the Danish possessions of Iceland, the Faeroe Islands, and Greenland until late in the nineteenth century.)

In Denmark, the centralized and absolutist administration sought to increase tax revenues, but its cadastral mapping was routinely thwarted by a persistent lack of funding and skilled surveyors. The statewide *matrikel* (land register) of 1688, begun under King Christian V, simply measured the length and breadth of each property but featured no maps because of the shortage of surveyors and appropriate equipment for more comprehensive surveys; it did lead to the establishment of the Landmaalingsarkiv in 1693 as a repository for written land records and later for property maps. Two later mapped cadastres focused on the *rytterdistrikter* (cavalry districts) that provided military material to the Crown. In 1753, a particular survey was made of the Crown's heathland at Alheden in Jylland (Jutland) to encourage colonization and to assess taxes, but the production of maps at 1:4,000 was delayed by a lack of equipment. In 1768, the Exchequer initiated a statewide cadastral survey, called the "special survey" to distinguish it from the contemporary Videnskabernes Selskab kort. The two *landinspektører* (surveyor inspectors) and about twelve *landmålere* (surveyors) were supervised by Thomas Bugge and used up-to-date equipment and methods. Survey work began in the Antvorskov (fig. 659) and Vordingborg *rytterdistrikter* in western

(*facing page*)
FIG. 659. EARLY DANISH CADASTRAL MAP. Herman Hegelahr's "Concept-Carte over Hovedgaarden Lÿstager," 1769. This manuscript map at 1:4,000 of Lystager Torp By, Krummerup Sogn, in the *rytterdistrikt* of Antvorskov in western Sjælland, shows a wide range of land use: the strips of open fields, woodlands, heather, bogs, and ponds; in the southwestern corner are peat fields belonging to the Crown (*Kongens piiber*).
Size of the original: 104 × 80 cm. Rigsarkivet, Copenhagen (Matrikeldirektoratet, Rytterdistriktkort, Æ 24–10). Image courtesy of Geodatastyrelsen, Nørresundby.


Concept = Carte.
over
HOVEDGAARDEN LŸSTAGER
beliggende udi
efter
HØVLOVLIG RENTEKAMMERETS
BEFALING
Aar 1769.
optaget af
ESHOLTS
GRÆNDSER
RAVNBIERGS GRÆND.
GIMLINGE.
MØLLE
MOSEN
SER.
TORPES.
LILLE HALD.
S T U B B E
GRÆNDSER.
AGERS GRÆNDSER
GIMLINGE.
S K O V E N
STORE
SOGNS
KONGENS
Lyst.
GRÆND.
P I B E
ENG.
PIIBER
agers.
HALDAGERS
SER
SLETS.
MARKEN
Piiber
MARKEN
TING.
AAE.
MARKEN
GRÆNDSER
IELLINGE.
Giærder
Veje
Tørve
Elle
Tiie
Moser
A. Gamle
B. Nye
Gaardeplads
C. Aae
D. Grøfter med Vand udi
GRÆNDSER
MAALESTOK
hvoraf en halv decimal Tomme er 100 Alen
Foto: 1:20.000
Æ. 24-10
Rytterdistriktskort.

FIG. 660. EARLY PROPERTY PLAN FOR A BOUNDARY DISPUTE. This manuscript map from 1684 of Raundalen's *almenning* (commons) in Voss, east of Bergen, was made as part of legal case brought by the Crown against one Claus Henriksen Miltzow, who had illegally encroached on Crown properties.
Image courtesy of Riksarkivet, Oslo (RK 226 Raundalen almenning Voss [RA/EA-5930/T/T063/T063e/0184]).

Sjælland (Zealand), producing 139 maps at 1:4,000 before lack of funds and a new antireform government stopped the work in 1772 (Kain and Baigent 1992, 77–83, 357n133; Korsgaard 2006, 90–91).

In 1757, a growing movement for agricultural and economic reforms led Frederik V to appoint a land commission to promote the enclosure (*udskiftning)* of the open fields and commons then standard across Denmark. Specific instructions for surveyors were issued in 1777, but few enclosures were attempted until the enclosure acts of 1781 and 1792. The 1781 act made maps compulsory at several of the stages of the enclosure process. Each village was surveyed simply, with iron chains, twenty-five alen (ells) long. A preliminary *udskiftningskort* (enclosure map) of each village, usually showing both the former distribution and the proposed new division of lands, was drawn at 1:4,000. It was then approved in a special meeting of the landowners and government officials. The approved *udskiftningskort* was then copied. One map was for the primary landholder and one for the government. The *udskiftningskort* was usually reused—either in the original or in a copy—as the basic map for the new cadastre and served to guide the division and reallocation of property and to assess taxes based on land value. Most of the *udskiftningskort* were produced before 1810. They are generally large, up to six square meters, and depict property boundaries, buildings, land use, and often the names and the boundaries of the preenclosure fields. Except for the scale, there were no explicit requirements for the maps, so each map bears the personal style of the surveyor. But the 1781 act did establish examinations in mathematics, surveying, and land allocation for aspirants to the jobs of *landinspektør* and *landmåler*, thus assuring some uniformity of process and offering a professional route to work (Kain and Baigent 1992, 83–88, 92; Møller 2004; Korsgaard 2006, 70–77).

The Danish Crown's absolutism did not extend to the Duchies of Slesvig and Holstein, so tax and agricultural reforms occurred more sporadically, taking into account local traditions and privileges. The complexity of local jurisdictions often made it difficult to define precise rights to each piece of land, thus hindering cadastral surveys before enclosure clarified property rights in each

district. The earliest surveys for tax reform were undertaken in 1639–41 in northern Slesvig for the local administrators by Johannes Mejer; Mejer's maps included property boundaries and indications of land use. In seven parishes in the counties of Haderslevhus (Hadersleben) and Tønder (Tondern), Peter Petersen undertook a cadastral survey in 1714–15 on the model of the 1688 Danish *matrikel* and without maps; maps were produced in a continuation of the survey by Samuel Gries in 1716–18, but the survey was very unpopular with the local population, and his maps, at 1:4,000, remained in draft only. A military officer, Christian Ludolf Pape, surveyed church lands on the island of Ærø in 1734, with maps at between 1:1,000 and 1:2,500 and with a mixture of graphical styles and perspectives, but his purpose remains unclear (Kain and Baigent 1992, 92–94).

Enclosure was promoted in Slesvig and Holstein by the local development of a new form of crop rotation (*verkobblung*), but it required the permission of the local *amt* (county) as well as the duchy, landowners, and tenants. Among the early enclosure surveys were those by Pierre Joseph Duplat the Elder of the county of Schwarzenbek between 1743 and 1750, producing twenty-four maps, most on a scale of 1:3,600, that depicted boundaries, forest, and meadow types, and by Johann Bruyn between 1767 and 1799 of 252 parishes in Slesvig and 168 parishes in Holstein with maps at 1:1,800, many of which showed fields and properties before and after enclosure. The ducal administration issued instructions in 1766 and 1776 that required surveying and mapping to be integral parts of the enclosure process, to protect both the state and the landowner. The Slesvig-Holstenske Landkommission, founded in 1768, directed the survey and enclosure of villages in the county of Haderslevhus, whose maps at 1:1,807 were also intended to facilitate crop rotation (Kahlfuß 1969; Kain and Baigent 1992, 94–96).

In Norway, an acute need to raise state income and to ensure an equitable tax burden led to the comprehensive assessment of the *skattmatrikkel* (tax cadastre) beginning in 1647 and completed between 1665 and 1670, together with the establishment of a land commission in the 1660s; this work was revised for the counties of Hordaland and Sogn og Fjordane in 1773 and for

Finnmark in 1775. But maps formed no part of these registers because the object of possession and leases in Norway was not the property itself but the *skyld*, a measure of the produce generated by the property, fixed by custom. Maps of the extent of properties were therefore irrelevant. A 1764 law decreed that the *skyld* must also reflect a physical division of land, yet still no systematic mapping was undertaken for the *matrikkel* (cadastre) until late in the nineteenth century (Kain and Baigent 1992, 98–101). While some private enclosures were made in the eighteenth century and varied greatly (Hovstad 1981), a state-sponsored enclosure movement did not get under way until the 1790s with the work of the Danish-Norwegian Rentekammer, whose comprehensive collection of reports, completed by 1803, informed the enclosure legislation for the 1821 land reallocation act (Kain and Baigent 1992, 108–10).

A final important use of property mapping in Norway was the role of maps in property disputes (fig. 660). A royal order of 1719 empowered "skilled and impartial" surveyors, the *landmålingskonduktører*, to arbitrate and adjudicate property disputes (Engelstad 1981, 30). They were empowered to prepare maps for anyone who needed and could pay for one; in the case of a dispute, the costs were either shared by both parties or assumed by the loser. The government was committed to supplying trained surveyors for this role and paid the salary of the surveyor in each district, a unique provision in Europe of the state supporting a body of surveyors. The *konduktører* (surveyors) were generally not recruited but applied for posts; they represented a range of surveying training from military service to self-taught mathematicians. The *landmålingskonduktør* in 1775 was given the task of parceling out the land in Finnmark, the northernmost part of Norway. The accuracy of these maps reflects the poor quality of land, which was suitable only for grazing. It was not necessary for all boundaries to be precisely measured, but only to have boundary markers recorded by reference to other landmarks (Engelstad 1981, 36; Kain and Baigent 1992, 103–8).

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SEE ALSO: Danish West Indies; Denmark and Norway

BIBLIOGRAPHY

Engelstad, Sigurd. 1981. "Landmålingskonduktørene." In *Våre gamle kart*, ed. Rolf Fladby and Leif T. Andressen, 30–44. Oslo: Universitetsforlaget.

Hovstad, Håkon. 1981. "Hva jordskiftekart kan fortelle." In *Våre gamle kart*, ed. Rolf Fladby and Leif T. Andressen, 19–29. Oslo: Universitetsforlaget.

Kahlfuß, Hans-Jürgen. 1969. *Landesaufnahme und Flurvermessung in den Herzogtümern Schleswig, Holstein und Lauenburg vor 1864*. Neumünster: Karl Wachholtz.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Korsgaard, Peter. 2006. *Kort som kilde—en håndbog om historiske kort og deres anvendelse*. [Copenhagen]: Dansk Historisk Fællesråd, Sammenslutningen af Lokalarkiver.

Møller, Per Grau. 2004. "Udskiftningskort og Original I-kort." *Geoforum Perspektiv* 3, no. 5:14–25.

Property Mapping in France. At the heart of property mapping was the act of surveying. There exists no term in French equivalent to the generic English concept of "survey," which derives from the Latin *supervidere*, then *surveeir* in fourteenth-century French. The French language has a precise word for each of the surveying operations necessary to produce maps at a large or very large scale: *mesurer* (to measure), *arpenter* (to survey surfaces), *toiser* (to survey lengths), *borner* (to mark boundaries), *jalonner* (to mark out), *niveler* (to assess height or depth). This is the vocabulary of geometers and surveyors who delimited land parcels and assessed values for seigniorial rights or rents. The very large-scale documents were *plans-terriers* and cadastres.

Following the Wars of Religion, from the end of the sixteenth century, notable landowners (the king, lay and ecclesiastical seigneurs, communities of inhabitants) consigned to registers the dues owed by tenants and the revenues from their feudal holdings. They sometimes recorded on a plan the land parcels to which rents were attached. Disturbances during the Thirty Years' War (1618–48) reinforced this practice. Some of these *terriers* from the seventeenth century have survived. They allowed individual landowners to represent graphically the boundaries of each of their scattered possessions in relation to those of their neighbors; however, this fragmentary vision of the territory was merely an aide mémoire, without exact planimetry or estimation of slope.

The reign of Louis XIV (1661–1715) introduced a new concept of the state. Playing on his motto "*nec pluribus impar*" and his emblem, the sun, the king embodied the scientific authority of the Académie des sciences and the Paris Observatory. He surrounded himself with competent ministers who attempted to improve the state of the realm in spite of the ruinous wars and famines of his reign. Jean-Baptiste Colbert and Sébastien Le Prestre, marquis de Vauban, ordered inspections by *intendants* and used statistics as a tool for demographic and economic analysis. The acquisition of noble lands by magistrates and the bourgeoisie encouraged the compilation of *terriers*, a practice that spread in the eighteenth century and visibly demonstrated social change within a society where the nobility of the sword still stood at the apex of the social order (Mousnier 1974–80, 1:172–87). A trend developed in France comparable to the enclosures in sixteenth- and seventeenth-century England, in which the rights of private landownership grew so that land was increasingly treated as a commodity (Beauroy 2002, 91–94). The social hierarchy and administrative centralization of the

FIG. 661. DETAIL FROM A MANUSCRIPT *TERRIER FORESTIER*. "Plans des bois dependans dv marquisat de Bantange," from the "Atlas des bois de l'ancien Comté de Louhans, marquisat de Bantange et forêt de la Faye; ainsi que de la terre de St. Germain du Plain," 1697, pl. 11. Especially note the scattering of plots of land and forests, the boundaries of which are defined by place-names and the names of neighboring proprietors.
Size of the entire original: 76 × 107 cm; size of detail: ca. 30.5 × 34.0 cm. © Archives nationales (France) (N/IV/Saône et Loire/1/11).

monarchy in France obliged landowners to reconcile ancestral traditions with innovative economic ideas. A precise visual knowledge of real estate attested the reality of possession of noble lands. Thus, a new owner "living nobly" permitted his descendants to become noble. Geometric plans complemented the *terrier* books. In the same way, revenues from forests, which furnished wood, indispensable to the economy of the period, had to be evaluated with care (fig. 661). It took about thirty years for the ordinance of August 1669, aimed at improving the administration of forests demolished by over exploitation, to produce its effect. Under the Regency (1715–23), several administrations of Eaux et Forêts launched surveying and cartographic operations.

The end of Louis XIV's reign and Regency saw a deep shift in thinking. The austere Jansenist trend, now allied with Parlements, had become political, involving itself in mundane affairs, like the earlier English Puritans, focusing on the rational organization of the city. At the same time, a new lifestyle, based on comfort and utility, was taking root. The pursuit of felicity at any price replaced the quest for salvation. People sang: "Happy is the rule of the Regency / When one does everything except penance!" English empiricism attracted the elites of the salons and whetted an appetite for experiments, the source of all knowledge, according to John Locke. Enthusiasm ran high for Isaac Newton, who based his scientific method on direct observations. The first Masonic lodges were founded in 1724 on the English model; their influential memberships multiplied. The *Encyclopédie, ou, Dictionnaire raisonné des sciences, des arts et des métiers* (1751–72) of Denis Diderot and Jean Le Rond d'Alembert was modeled on the *Cyclopedia; or, An Universal Dictionary of Arts and Sciences* (1728) by Ephraim Chambers.

However, aspirations for economic progress tended to be held back by ancestral traditions, which translated into the search for immediate gain and a reluctance to take true risks. Nevertheless, Regent Philippe d'Orléans, an authentic Enlightenment figure, began to straighten out the dismal economy. Although a banking system based on paper money had failed (John Law's system went bankrupt in 1720), the experiment had paid part of the state's debts. The Regent affirmed the growth of industry and commerce and developed communication routes, thus laying the foundation for the great economic trends of agricultural growth and physiocracy based on the free circulation of goods and the improvement of land. Daniel-Charles Trudaine, *intendant des Finances*, who administered the department of Ponts et Chaussées, created the Bureau des dessinateurs in Paris in 1744. The bureau's mission was to survey and to keep and record plans of the major roads of the realm. In 1745 Trudaine ordered the production of an atlas of all the roads in France including those both "existing and projected." In 1747, a decision of the Conseil du Roi transformed the Bureau des dessinateurs into a school, the future École des Ponts et Chaussées, and its direction was entrusted to Jean-Rodolphe Perronet. Finally, in 1750, Trudaine prepared a reform of the corps des Ponts et Chaussées, which provided the means to train and organize *ingénieurs* capable of carrying out this vast enterprise. The manuscript sheets (more than 4,500) made between about 1740 and 1780 at a scale of 1:8,640, displayed a traditional cartographic style. Despite this rendering, they constituted a homogeneous documentation of the countryside, exceptional in their precise drawing of roads and buildings. The draftsmanship and aesthetics of these maps became the model for numerous contemporary productions (see fig. 630).

While the "Atlas de Trudaine" (as it has come to be called) was being prepared, the *ingénieur géographe* and map editor Georges-Louis Le Rouge emulated descriptions of Chinese gardens by the Scottish architect William Chambers in the 492 plates of his collection of *Nouveaux jardins à la mode* (1775–88). This collection perpetuated "anglomania" and a taste for *chinoiseries* during the Regency, the "golden age" of the Compagnie des Indes reformed by Law in 1719. These printed garden plans modeled the picturesque Anglo-Chinese and English gardens so prized in the nineteenth century (Mosser 1999; Royet et al. 2004). They took pride of place in manuals of cartography, which, in the last third of the eighteenth century, deliberately oriented themselves toward surveying (Bousquet-Bressolier 1999).

If picturesque gardens echoed the lightness and gaiety of a new art of living, the multiplication of *plans-terriers* or their renewal in the second half of the eighteenth century visibly demonstrated the progress of the new agriculture. By fixing property limits, proprietors could administer lands and increase their yield without losing their nobility. The enthusiasm for *plans-terriers* was such that printed works appeared like Charles-Louis Aubry de Saint-Vibert's *Les terriers rendus perpétuels ou mécanisme de leur construction* (1786–87), offering standard models for the presentation of registers and related maps.

Surveyors and feudists competed with former engineers from the Ponts et Chaussées, such as Jean-François Héricé, commissioned in 1750 to prepare an atlas of the forests areas of Bitche (Hemmert 2006). Military *ingénieurs géographes* also participated in property surveying; for example, Pierre Clavaux, officer of the Corsican legion and chief of dragoons of the legion Dauphiné, led important land reclamations in Arcachon bay from 1766 to 1776 on behalf of the François Eymeric de Durfort, marquis de Civrac (Bousquet-Bressolier 1996). Alongside these efforts, a vast project took shape at the highest level of government to completely reorganize taxation from a personal to a property-based system.

In order to reform the tax base on clear fiscal and juridical bases, Louis XV stipulated the creation of a cadastre in an edict of April 1763. Two *intendants*—Anne Robert Jacques Turgot in the Auvergne and Louis Bénigne François de Bertier de Sauvigny in the *généralité* of Paris—ordered geometers, paid by the job, to create plans at 1:8,640 for the parishes within their purview (fig. 662), just as King Vittorio Amedeo II of Sardinia and his son Carlo Emanuele III had done in Piedmont (1698 and 1731) and Savoy (1728 and 1738).

A similar initiative took place in Corsica (conquered in 1768), whose unique status was preserved by the administrative organization established in 1775. An insular nobility had been created, and the island received a territorial assembly governed by a *code corse* that fused local and French royal law. To develop the island's resources, its governor, Louis Charles René, comte de Marbeuf, brought Greek and Lorrainer settlers to the island and ordered a *plan-terrier* richer in geographic, demographic, and economic data than a simple cadastre. It was produced between 1770 and 1795 at a scale of 1:10,800, under the direction of Pierre Testevuide (*Mesure de l'île*, 1997).

These were the only such experiments under the Ancien Régime. However, they bear witness to the impact of the new ideas in political economy that provincial Académies passed on. The physiocrats thought that the wealth of nations rested upon agriculture alone and not the value of goods. Agriculture produced new goods that increased wealth, while industry or commerce, which transformed

FIG. 662. PLAN OF THE INTENDANCY OF THE PARISH OF MAINCY, 1780. One of the cadastral plans ordered by the *intendant* Bertier de Sauvigny near Paris, demonstrating the graphic and technical details employed by the geometers, in this case the area around the chateau of Vaux-le-Vicomte and its park. Land uses are shown by color and texture of line; the cumulative extent of each is given in a table at left. Manuscript on paper.

Size of the original: 65.5 × 65.0 cm. Image courtesy of the Archives départementales de Seine-et-Marne, Melun (1C50/7).

or exchanged natural products, were regarded as sterile, even if they were beneficial for agriculture. The circulation of products along canals and good roads was the lifeblood of the economy. Agricultural land was thus overvalued; every method of cultivation allowing increased yields was examined. Transforming marshes into meadows was imperative, and proprietors invited settlers reputed for agricultural expertise from German states, Holland, and elsewhere. Thus, the land that since time immemorial had allowed one "to live nobly" without losing noble status became the foundation of the wealth of nations (Weulersse 1950, 1959, 1985). In 1789, seventy-three of the electoral assemblies of the Second Estate and fifty-eight of the Third Estate called for a cadastre. The law of 1 December 1790, voted by the Assemblée nationale, replaced the per capita tax with a property tax (*contribution foncière*) based on land and its revenues. Proprietors and tenant farmers had to declare the nature and extent of their holdings. Each municipality was responsible for estimating land productivity and for establishing a register matrix of each section of land in the communal territory. The cartographic plan was not compulsory in this first cadastre. Earlier documents, notably the *terriers*, could serve as working documents. Grievances and tax reductions led to numerous complaints. It became necessary to create an Administration des Contributions directes (1797–98) to handle them.

The Assemblée Constituante examined the proposals set forth in "Réflexions sur la carte et le cadastre de la France" by Perronet's collaborator Gaspard Marie Riche de Prony, *directeur général* of the cadastre: "to measure more than one hundred million parcels or separate properties over an expanse of more than forty thousand lieues carrées; to make for each commune a plan on atlas-size sheets"; to determine for the whole territory the extent of each property and its revenue (*Recueil* 1811, 12). This project was so burdensome and costly that a cadastre by cultivated plots (*masses de cultures*) was adopted by the Consuls on 3 November 1802.

Préfets, *sous-préfets*, and *inspecteurs des contributions* closely supervised the application of the provisions of the cadastre; their work helped decentralize authoritarian power to the *départements*. The adoption of the metric system should have allowed for a division of taxes that was at last egalitarian. In practice, old units of measure remained the only comprehensible points of reference, and the *représentants de la nation* performed miracles of written conversions. A plan was established for two to six communes chosen by lot from each arrondissement, or around 1,800 communes, to be mapped at a scale of 1:5,000 by land use type (ploughed land, meadows, vineyards, woods, marshes, etc.) (fig. 663). For each unit, proprietors communicated the capacity and yield of their parcels. After verification and comparison

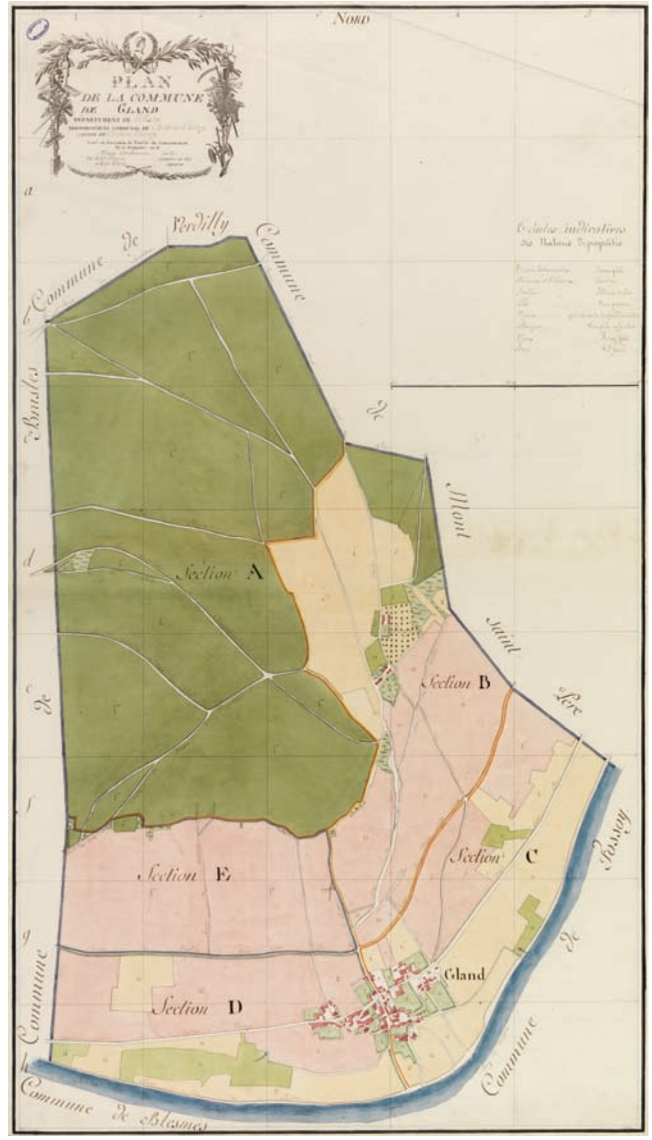

FIG. 663. CADASTRE BY CULTIVATED PLOTS. "Plan de la commune de Gland, département de l'Aisne arrondissement communal de Château-Thierry, canton de Château-Thierry," 1:5,000, surveyed from 12 Brumaire an 11 to 10 Frimaire an 12 (3 November 1802 to 2 December 1803). The cultivated plots, designed and colored, are rendered on a sheet printed with a standard cartouche, which is completed in ink with the name of the commune and appropriate details. The manuscript legend explains the colors used and the cultivation denoted.
Size of the original: 94 × 55 cm. © Archives nationales (France) (F/31/106).

between the total amount declared and that shown on the plan a *coefficient de majoration* was determined, as proprietors always underestimated their holdings. This coefficient was applied to the surfaces declared by the proprietors of the other communes of the arrondissement, but the administration failed to extend the system to all the communes of France. Surviving plans were produced in color on the same model: printed cartouche with the profile of the First Consul, title and legend, date, orientation, metric scale, and grid. The plans represent communes spread randomly throughout 84 of the 102 French *départements* of the period.

This hybrid system provoked numerous complaints from communes and proprietors who felt unjustly assessed, so much so that in 1807, in order to stop the lawsuits, the Emperor Napoleon demanded the production of a quality cadastre by parcel as a complement to the Civil Code. A commission of nine members led by Jean-Baptiste-Joseph Delambre, permanent secretary of the Académie des sciences, fine-tuned a regulation applicable to the twelve divisions of the national territory. This regulation led to the law of 15 September 1807 that launched the parcel-based cadastre. This Napoleonic cadastre was not completed until around 1850. The dramatic development of cities and routes of communication in the nineteenth century quickly showed the limits of cadastral plans. Even if the *matrices* (lists of proprietors) were kept perfectly up to date, the plans were rigid documents that did not take into account rapid change except by frequent revisions that were too costly to make.

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SEE ALSO: France; Revolution, French

BIBLIOGRAPHY

Antoine, Annie. 2000. *Le paysage de l'historien: Archéologie des bocages de l'Ouest de la France à l'époque moderne*. Rennes: Presses Universitaires de Rennes.

Beauroy, Jacques. 2002. "La représentation de la propriété privée de la terre: *Land surveyors* et *Estate maps* en Angleterre de 1570 à 1660." In *Terriers et plans-terriers du XIII^e au XVIII^e siècle*, ed. Ghislain Brunel, Olivier Guyotjeannin, and Jean-Marc Moriceau, 79–101. Rennes: Association d'Histoire des Sociétés Rurales; Paris: École Nationale des Chartes.

Bousquet-Bressolier, Catherine. 1996. "Expériences physiocratiques dans le bassin d'Arcachon, 1750–1776." *Bulletin du Comité Français de Cartographie* 148:66–78.

———. 1999. "Du paysage naturel à l'utopie: Le corps des ingénieurs-géographes et la diffusion d'un savoir théorique sur les cartes." In *Le paysage des cartes: Genèse d'une codification*, ed. Catherine Bousquet-Bressolier, 81–97. Paris: Musée des Plans-Reliefs.

Hemmert, Didier. 2006. "L'atlas topographique du comté de Bitche: Du projet à la réalisation." In *Le Pays de Bitche, il y a 250 ans*, 33–46. Bitche: Société d'Histoire et d'Archéologie de Lorraine, Section de Bitche.

Mesure de l' île: Le plan terrier de la Corse, 1770–1795. 1997. Corte: Musée de la Corse.

Mosser, Monique. 1999. "Hortésie cartographe: De l'écriture classique des parcs français à la calligraphie poétique des jardins anglo-chinois." In *Le paysage des cartes: Genèse d'une codification*, ed. Catherine Bousquet-Bressolier, 99–119. Paris: Musée des Plans-Reliefs.

Mousnier, Roland. 1974–80. *Les institutions de la France sous la monarchie absolue, 1598–1789*. 2 vols. Paris: Presses Universitaires de France.

Recueil méthodique des lois, décrets, réglemens, instructions et décisions sur le cadastre de la France approuvé par le Ministre des Finances. 1811. Paris: Imprimerie Impériale.

Royet, Véronique, et al. 2004. *Georges Louis Le Rouge: Jardins anglo-chinois*. Paris: Bibliothèque Nationale de France/Connaissance et Mémoires.

Weulersse, Georges. 1950. *La physiocratie sous les ministères de Turgot et de Necker (1774–1781)*. Paris: Presses Universitaires de France.

———. 1959. *La physiocratie à la fin du règne de Louis XV (1770–1774)*. Paris: Presses Universitaires de France.

———. 1985. *La physiocratie à l'aube de la Révolution (1781–1792)*. Paris: Éditions de l'École des Hautes Études en Sciences Sociales.

Property Mapping in New France and the French West Indies. Beginning in 1575, the profession of surveyor came to be recognized as a responsibility conferred by the king. The sworn surveyor established the measurements of land. The information he gathered constituted proof in courts of law, but his findings might themselves be contested before these same courts. The office came with fiscal privileges, although it was poorly paid: 100 livres per year in 1702, 500 beginning in 1772; this amount was less than what a typical foreman overseeing laborers earned. The surveyor, a rural officer occupied principally with the mapping of property for landed gentry or nobility, enjoyed neither the competencies nor the prestige of the military engineer. Even if involved in construction or mechanical operations, his contribution was only for the purpose of measuring. The surveyor, moreover, was not responsible for measuring three-dimensional space. Tied to the measurement of land and parcel, he only worked in two dimensions, never preparing topographic plans of a civil or military nature (Touzery 1984, 161–68).

At the end of the seventeenth and the beginning of the eighteenth century, the land surveyor's tools were still rudimentary: a graduated chain or cord, a square, knowledge of the Pythagorean theorem, and a compass, especially important in unfamiliar territory. Ideally, the surveyor would have a rudimentary knowledge of triangulation, as it was taught, for example, in the regularly reissued works of the mathematician Jacques Ozanam, including *Methode de lever les plans et les cartes de terre et de mer* (1693) and *Methode facile pour arpenter ou mesurer toutes sortes de superficies* (1699), or *La Géometrie pratique* by the engineer and mathematician Allain Manesson-Mallet (1702).

Nevertheless, the exercise of the craft usually grew out of practical experience rather than theoretical training in schools, as was the case with engineers. Thus, lacking correct instruction and having difficulty obtaining good books while in the colonies, surveyors too often indicated estimated extractions of square roots, without rigorous calculation. Right angles were also approximate, which led to significant errors when measuring large areas. In France, aiming to reduce such imprecision but lacking properly trained surveyors, the director of the

Paris Observatory, César-François Cassini (III) de Thury, required the on-site verification of the triangulation (*La meridienne de l'Observatoire royal de Paris*, 1744).

In New France and the French West Indies, it fell to the surveyor to measure the land concessions made to colonists as well as the frontiers of the king's holdings. These boundaries were crucial, for example, in Canada, where they divided French holdings from English colonies, or on the island of Saint-Domingue, which was divided into French and Spanish domains. The task was immense. Denis Hébert, who was named surveyor in Martinique in 1679, and Jean Guyon, who occupied that same post in Quebec in 1672, had to determine boundaries between *habitations* (land concessions) and also draw up maps. Hébert had to establish the limits on the ground and give the manuscripts maps to the Conseil de la colonie and the *procureur général*. For this work, Hébert was paid in sugarcane, both by the king (12,000 pounds every year) and by the inhabitants whose lands he measured (50 pounds of sugar for each, 1,000 × 100 pas, 1 pas equal to about 2 feet) (Dessalles 1847–48, 3:387–88; Aix-en-Provence, Archives nationales d'outre-mer [ANOM], col. E219 [personal colonial ancien/Hébert] and col. A24, fol. 81v^{o} [arrêt du Conseil: nomination of Hébert as surveyor]).

The skills of the surveyor were essential for establishing a colonial city, with its division into blocks and parcels surrounded by plantations, cultivated land, and pasturage. As with engineers or doctors, this job required extensive knowledge and precise skills that local practitioners did not always possess, thus exposing them to criticism from government administrators and from colonists (fig. 664).

The territorial division carried out by surveyors gave an appearance to the colonies in the Caribbean islands, Louisiana, and New France that varied from place to place, but is still recognizable. The colonial exploitation of the island of Saint-Domingue rapidly accelerated after the Treaty of Ryswick (1697), thanks to the system of *habitations* that had existed on other French Caribbean islands for a half century. These *habitations* were concessions of arable land made by the royal administration to colonists in return for their commitment to clear and farm them; the *habitations* became the building blocks of colonial society in all French possessions. The majority population of the *habitations* comprised black slaves, who made up the workforce of the Antilles, with the free population only accounting for slightly more than 5 percent in 1789. The *habitations* gave the countryside of Saint-Domingue a remarkable appearance: a regular grid of enclosures and canals, as well as the ordered space of plantations even when soil exhaustion had led to their abandonment (see figs. 110 and 898). The earliest of these networks were located near cities, which were themselves laid out in a regular fashion. Roads in straight lines were lined with orange and other citrus trees forming impenetrable hedgerows. Untamed nature was now present only in the mountain defiles and in the nearly inaccessible forests, the territories of the *nègres marrons* (fugitive slaves) who risked claiming their freedom.

The immense territory of Louisiana led to settlement along waterways, ignoring the Amerindian lands of the interior. The majority of plantations sat along the capricious course of the Mississippi and beside some of its tributaries and bayous. The holder of a concession obtained a certain measure of river frontage and was free to cultivate the land perpendicular to this as far into the interior as he was capable of clearing. For measuring area, the arpent louisianais was used and, as in Canada, amounted to 100 square perches or around 3,418 square meters (ca. 34 ares), corresponding roughly to the measure of the arpent de Paris (Zupko 1978, 5). However, such measures must be used with care: for example, in Saint-Domingue the surveyors used a chain of 36 feet, but sometimes of only 34 feet (in a claim in Léogâne concerning the surveyor De Forges; see below). Varieties in measurement may also be explained in Louisiana by the extent of the concessions, their generally flat relief, and the extensive nature of poor yield crops. In Basse-Louisiane, the majority of these strip farms were located between Plaquemine and Baton Rouge; in Illinois Country, they were found between Sainte-Geneviève and Fort de Chartres. Several large plantations or population centers proceeded from looser divisions around Mobile, Natchitoches, and Natchez. The work of the surveyor became very difficult here because he used the sinuous paths of the rivers as his axes. In the absence of quality surveyors, it was frequently the engineer Ignace-François Broutin who was called upon to carry out surveys in Louisiana (fig. 665).

Around the St. Lawrence and on the coasts of Acadia elongated and aligned parcels bear witness to the rural training of their surveyors. The climate and activities of this colony were quite different from those of Louisiana and did not motivate colonists to organize vast plantations or to rely on slave labor. Moreover, the rural population included large numbers of *coureurs des bois*, fishermen, and trappers, while city populations comprised businessmen and merchants as well as ecclesiastical and military administrators. Farmers and breeders of livestock formed a smaller proportion of the population than in Louisiana or the Caribbean. In this context, the surveyor practiced his trade in rural settings as well as in extensions of the cities, including Quebec and especially Montreal, whose plans required numerous redivisions of parcels. From 1660 to 1670, rectangular fields called *rangs* (long lots) began to emerge in a fairly regular pat-

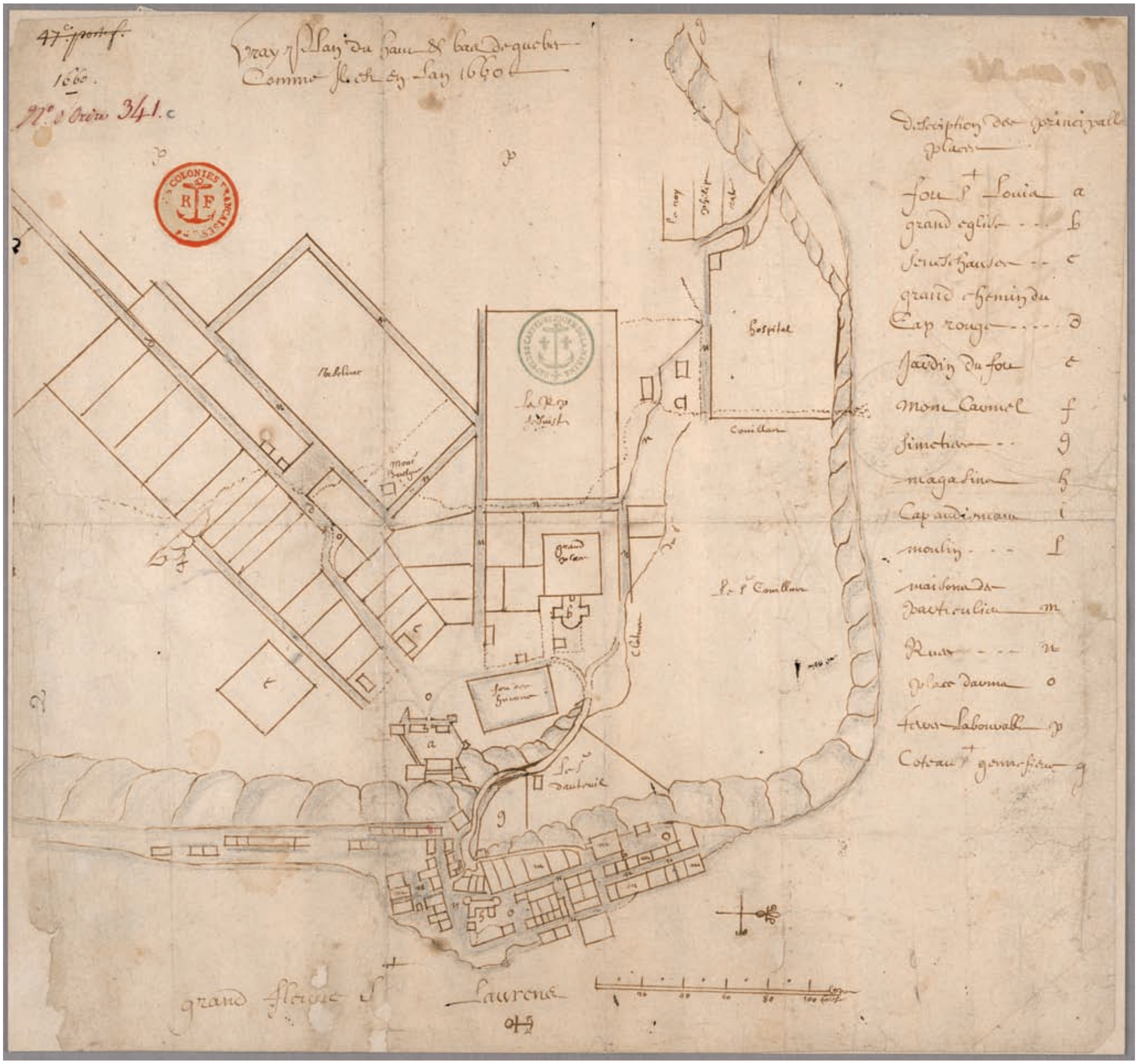

FIG. 664. JEAN BOURDON, "VRAY PLAN DU HAUT ET BAS DE QUEBEC COMME IL EST EN LAN 1660." This manuscript plan exemplifies the desire to plan and arrange the upper city of Quebec, from the end of the 1630s, based on Bourdon's plans. See also figure 895.

Size of the original: 32.0 × 34.5 cm. Image courtesy of the Archives nationales d'outre-mer, Aix-en-Provence (DFC AMSEPT, 341, pièce 4 C).

tern along the St. Lawrence River between Quebec and Montreal. The dimensions of the fields were smaller than those of the great plantations of Louisiana created half a century later: 60–120 arpents (20–41 hectares) instead of 280 (95 hectares) (Harris and Matthews 1987, 115). The relative straightness of the course of the St. Lawrence facilitated surveying. The Chemin du Roy, running parallel to the river, marked the edge of another, deeper series of *rangs*, which extended the colony into the interior.

The division of territory in New France and the Caribbean islands was thus not organized in a homogeneous and regulated fashion, although the king did provide models for concessions, and divisions of parcels in cities did, in principle, follow the plans of the engineers. The strip divisions of Louisiana are mirrored in the Canadian

FIG. 665. "PLAN DES CHAPITOVLAS" (LOUISIANA, CA. 1726). This anonymous manuscript plan was probably prepared by the engineer Ignace-François Broutin. It shows very precisely the organization of the plantations along the river, including the cleared land for the concessions and the long straight line of drainage ditches.
Size of the original: ca. 44 × 113 cm. © Service historique de la Défense, Vincennes (MV/71/68-72).

rangs, elongated strips where buildings occupied a small area serviced by the road. Similar divisions existed in the western provinces of France where a dispersed, rural system, spread out along rivers and roads, contrasted with the fortified towns that Sébastien Le Prestre, marquis de Vauban wanted to establish for defensive purposes. This manner of surveying reflected the individualism of the colonist-farmers and the rural practice of the surveyors.

Colonial surveyors were considered inferior to mathematicians, astronomers, and engineers; their authority was not decisive in administrative or legal affairs. Nor did surveyors remain long in the colonies. The career of the naval officer Jean-Pierre Lassus illustrates the precarious life of the surveyor. Lassus went to Louisiana in 1725 for an exceptional remuneration of 3,000 livres per year. However, the chief engineer Adrien de Pauger and his colleague Broutin repeatedly complained about Lassus's shortcomings in surveying and his lack of zeal for carrying out his responsibilities, finally driving him off to Saint-Domingue (Historic New Orleans Collection 2006, 96) (fig. 666). During his time in Louisiana, Lassus measured the frontage lots of plantations along the Mississippi as ranging from five to fifteen arpents, depending on the wealth of the concessionary and the location of the land. Lassus observed that "those [lots] at the capes of the river lost while those [lots] in the coves gained" (Lassus to the directors of the company, April 1727; ANOM, C13A 10, fol. 285). He emphasized that it was scarcely possible to carry out surveys in these uncharted swamps and woods with only his brother Joseph to assist him. Lassus's brother defended him against criticism, emphasizing the risks "of encountering a thousand dangers as he went up 200 leagues inland on the Mississippi; he had to defend himself at each step from the monstrous reptiles of the terrible river and from the savages who inhabited these distant lands. He at last fulfilled his mission and had the plans and maps brought to the office of the navy" (ANOM, C13A 10, fol. 286). Meanwhile, from 1726, Pauger "asked that the Lassuses be prohibited from meddling and from going out themselves to mark out limits and boundaries, which could only be false and ill-founded" (letter by Pauger, 26 March 1726; ANOM, C13A 9, fol. 366).

The measurements of surveyors were thus frequently at the core of judicial affairs, as much to justify their measurements (e.g., the surveyor David on Guadeloupe in 1726; ANOM, A1, fol. 245) as to draw attention to their errors (e.g., the surveyor Étienne Vianey at Saint-Domingue in 1738 and his colleague Audat in 1775; ANOM, A3, fol. 53 Vianey, A15, fol. 144 Audat). In 1713, the *procureur général* of Léogâne (Saint-Domingue) showed that the chain of the surveyor De Forges was one foot too long. In a curious attempt to achieve an average of false measurements, the chain was reduced by two feet while the surveyor's previous measurements remained valid (18 May 1713, ANOM, A28, fol. 10).

While there were numerous lawsuits on the islands, there seemed to be fewer problems in Canada. This was undoubtedly a result of the size of the concessions and the quality and good supervision of personnel. For example, beginning in 1674 the Conseil de la colonie of

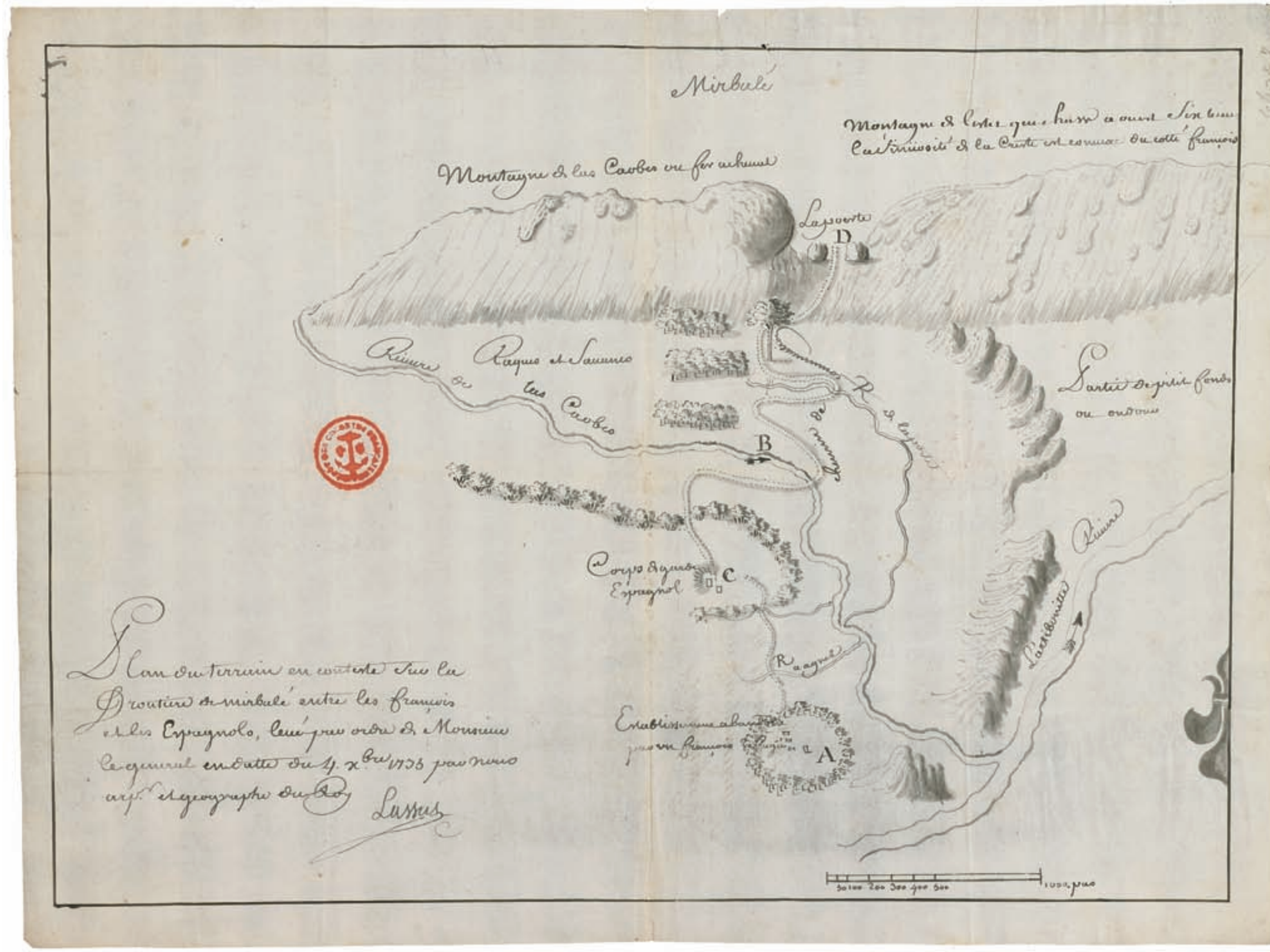

FIG. 666. JEAN-PIERRE LASSUS, "PLAN DU TERRAIN EN CONTESTE SUR LA FRONTIÈRE DE MIRBALÉ ENTRE LES FRANÇAIS ET LES ESPAGNOLS," 1735. Lassus was surveyor successively in Louisiana and Saint-Domingue, then *capitoul* (major) of Toulouse, France. This manuscript map shows his work in drawing the border between the Spanish and French parts of the island.
Size of the original: 33.5 × 45.0 cm. Image courtesy of the Archives nationales d'outre-mer, Aix-en-Provence (FR ANOM/15/DFC pièce 586 C).

Quebec ordered surveyors to submit all their measurement tools and compasses to a mathematician who was ordered to adjust and balance them; if surveyors did not comply, they could lose their jobs. The Conseil also ordered them to establish four boundaries on the square of the lower city in such a way as to establish a base of cardinal directions and to facilitate alignments for urban planning and growth (Roy 1895, 18–19). In the conflict-ridden context of New France, this rigorous operation appears as exceptional as it was necessary.

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SEE ALSO: French West Indies; New France

BIBLIOGRAPHY

Daumas, Maurice. 1953. *Les instruments scientifiques aux XVIIe et XVIIIe siècles*. Paris: Presses Universitaires de France.

Dessalles, Adrien. 1847–48. *Histoire générale des Antilles*. 5 vols. Paris: France, Libraire-éditeur.

Dujardin, Justine. 2008. "Cartographier la Louisiane française au XVIIIe siècle." Thèse diplôme d'archiviste-paléographe, École nationale des chartes, Paris.

Giraud, Marcel. 1991. *A History of French Louisiana: Volume Five, The Company of the Indies, 1723–1731*. Trans. Brian Pearce. Baton Rouge: Louisiana State University Press.

Harris, R. Cole, ed., and Geoffrey J. Matthews, cart. 1987. *Historical Atlas of Canada: Volume I, From the Beginning to 1800*. Toronto: University of Toronto Press.

Historic New Orleans Collection. 2006. *Common Routes: St. Domingue, Louisiana*. New Orleans: The Collection; Paris: Somogy Art Publishers.

Roy, J.-Edmond. 1895. "La cartographie et l'arpentage sous le régime français." *Bulletin des Recherches Historiques* 1:17–20, 34–40, 49–56.

Touzery, Mireille. 1984. "Arpents, arpentage et arpenteurs dans l'élection de Paris à la fin du XVIIIe siècle: Le cadastre de Bertier de Sauvigny (1776–1790)." *Bulletin de la Société de l'Histoire de Paris et de l'Ile-de-France* 110:151–97.

Zupko, Ronald Edward. 1978. *French Weights and Measures before* *the Revolution: A Dictionary of Provincial and Local Units*. Bloomington: Indiana University Press.

Property Mapping in the German States. After the end of the Thirty Years' War (1648), a growing number of estates were surveyed and cartographically depicted in every German region. Estate maps, initially originating mainly from landlords, were continually produced and handed down from the mid-seventeenth century onward. Multiple administrative interests encouraged these mapping endeavors, the main impetus being the documentation of property relations and land use as a basis for generating manorial income and later taxes. Mere verbal description no longer satisfied demand, and graphic representation became the general custom. Maps were prepared because of the advantages they offered as legal protection for landlords and farmers: they documented and established rights of use, tributes, leases, and services. Property mapping could also be seen as an expression of the enlightened concept of rationalized agriculture and the pragmatic economic use of land. Last but not least, the increasing divisions of properties and expansion of agricultural use contributed to growing public interest in mapping individual landholdings (fig. 667).

The political author Veit Ludwig von Seckendorf fueled the establishment of land registers of *Kammergüter* (Cameral Estates) with his book *Teutscher Fürsten Stat* (editions 1656–1737). He praised particular maps (*Particular Abrisse*) of separate lands as well as general maps (*General Taffeln*) of all the *Kammergüter* of the entire country as the reliable basis of information regarding property and other legal relations (1656, 235). Landlords who were also sovereigns were the first to undertake these mapping measures. An upsurge in topographical surveying began in the late seventeenth century at the behest of the sovereigns' *Kammern* (financial administrators). They no longer wanted to establish the leased area in their domains by rough estimate. In

FIG. 667. MANUSCRIPT PARCEL MAP OF DOBERATSWEILER, 1726/27. This map by Martin Schneider shows property in the Teutonic Order's dominion of Achberg.

Size of the original: 53 × 72 cm. Image courtesy of the Landesarchiv Baden-Württemberg, Stuttgart (FAS K Nr. 83/10).

Brandenburg-Prussia, the principle of leasing land based on surveying was encapsulated in a set of regulations. The previous patchy surveying and mapping were subject to numerous provisions in the regulations "for the surveyors" of 1702 and "for surveying fields" of 1704 (Stichling 1954). A typical example, although mainly still on a scale of 1:10,000, is the Magdeburg *Kammeratlas*, "Atlas Cameræ Magdeburgensis," in seventy-three map sheets made between 1702 and 1710 (Fiedler 2012). The nobility, church institutions, and cities with large landholdings followed suit. A characteristic example is the so-called Zehnt-Atlas in sixty-five sheets, prepared by a sworn geometrician for the Bishopric of Xanten in 1697.

The upsurge in cadastral surveying and the establishment of surveying as a profession brought cadastral surveying for tax purposes into reach. Levying direct taxes according to the landholdings of the taxpayer began to take shape in the sixteenth century. Since direct taxes were initially assessed only in exceptional cases, precise assessment and knowledge of property relations, especially in maps, were not yet necessary for assessing and levying taxes. Initial attempts were made to arrive at appropriate proportions of tax assessment by estimating the size of a parcel. The destruction wrought by the Thirty Years' War heightened the sense in the late seventeenth century that fair land tax assessments should be based on an exact register of surveyed land. Since the portion of tax revenue in state income continuously grew in both relative and absolute terms, the time had also come to put state finances on a firm footing. Yet land register surveys were almost exclusively carried out in small- and medium-size states. Tax reforms were implemented in the larger states in the eighteenth century, but they did not go hand in hand with any general surveying.

In numerous territories the survey results were not mapped. The register stemming from the surface calculations was ultimately decisive. For instance, cadastral surveying without mapping took place in the Duchy of Württemberg (1713–36), in the Electorate of Trier (1718–20), in the Duchies of Jülich and Berg (1745–52), and in the County of Lippe-Detmold (1751–78) (Stein 2004, 176–77). As early as 1700, a tax overhaul was ordered in Hesse-Darmstadt under which every taxable property was to be surveyed and appraised. Only the district boundaries were mapped, while the individual properties were merely surveyed to calculate surface area (Rößling 1996).

Nonetheless, a significant number of fiscal land registers with cadastral maps in the strict sense appeared in the eighteenth century. Early cadastral surveys occurred thanks to foreign influences. From 1669 to 1679 in the County of East Friesland, Dutch engineers had already ordered cadastral maps of the dike network of the lower Ems River (20 sheets; ca. 1:8,700) as well as the *Amt* (district) of Esens (8 sheets, ca. 1:8,330) (Stein 2004, 158). From 1692 to 1709 Swedish surveyors mapped Pomerania, which was under the Swedish Crown as of 1648 (Asmus 1996). The maps, encompassing multiple estates, as well as the accompanying descriptions were meant to result in a land register, but this did not happen due to the outbreak of the Great Northern War (1700–1721). Nonetheless, a beautiful compilation of around 1,700 maps on a scale of 1:8,000 to 1:8,300 survives. The approximately forty surviving cadastral maps of the domains of the imperial city of Schwäbisch Hall from 1699–1710, many on the large scale of 1:1,750, can likewise be ascribed to foreign influences, as the surveying was carried out by a Swiss geometrician (Kain and Baigent 1992, 152–53). Cadastral surveying initiated in 1711 in the Orange ancestral homeland of Nassau-Siegen can be ascribed to Dutch influences; when all the work ceased in 1722, cadastral maps on a scale of 1:7,200 and general maps of four administrative authorities (*Ämter*) for nineteen municipalities had been made (Stein 2004, 159). Finally, under the Austrian aegis, the cadastral survey (1719–38) of every taxable cultivated surface of Austrian Swabia was carried out by eight topographical surveyors (Vanotti 1825).

Meanwhile, in addition to these externally driven surveys, numerous internal initiatives took place. The Landgraviate of Hesse-Kassel was among the first German states to have cadastral maps as well as complete property indices and cadastres created in order to tax landholdings. Tax regulation enacted as early as 1680 ordered the survey of entire districts, which began in 1682; yet only ninety-five districts were mapped by the turn of the century due to a shortage of qualified personnel. From 1699, the surveying projects were extended and coordinated centrally by the newly founded Steuerstube (tax authority), initially by six to eight topographical surveyors. The principles of surveying and tax assessment were revisited in the 1730s, and a topographical surveying directive was issued in 1732. With up to thirty topographical surveyors in 1775, the cadastral survey of the state was partially completed by 1791 at the astonishingly large scale of 1:1,271 (Kahlfuß 2001, 15–16; Kain and Baigent 1992, 149–50). Numbering the land parcels ensured that they corresponded to the tax registers, which indicated the taxes to be paid by the landholder.

The fact that the Hessian cadastre maps did not cover nearly all the state's surface until about one hundred years later shows that experience in organizing such a comprehensive enterprise was lacking in the early eighteenth century, and that the large expense of surveys and local opposition to taxation were also obstacles. The Bishopric of Merseburg was among the first territories to introduce a legally binding cadastre based on cadastral maps. The Saxon Elector Friedrich August I, who

FIG. 668. MANUSCRIPT CADASTRAL MAP OF KLEINZSCHOCHER IN THE PRINCE-BISHOPRIC MERSEBURG, 1713, CA. 1:2,200. Size of the original: ca. 53 × 62 cm. Image courtesy of the Stadtarchiv Leipzig (RRA [F] 1294 a).

supervised the underage Maurice Wilhelm, Prince of Saxe-Merseburg, initiated this enormous state project in 1710. Within four years, some thirty-five geometricians surveyed the entire territory of the bishopric under the leadership of the Saxon surveyor general, resulting in two scales of maps in a uniform style: a comprehensive general map for each district and separate map sheets of the subdistricts on a scale of approximately 1:2,200 (fig. 668). A general tax audit was commenced in 1714 in the Thuringian Principality of Saxe-Eisenach. Cartographic surveys, of which only sparse copies have survived, were made to establish a property tax cadastre. This cadastral survey most certainly influenced the neighboring Prince-Bishopric of Fulda, where surveying began pursuant to a directive in 1718 (see fig. 135). Some one hundred districts were mapped by 1739, yet many maps were lost in the Seven Years' War and the fire at Fulda Castle in 1802 (Jestädt 1932).

A similar fate befell the cadastral maps of the Principality of Saxe-Weimar, which perished in the Weimar Castle fire of 1774, except for a few backup copies archived in the cities. The cadastral survey (1726–42) was originally carried out by nearly twenty topographical surveyors on a scale of 1:1,600 (fig. 669) and stands out from its contemporaries in many ways. It began with the *General-Revisions-Instruction* (general audit directive) of 1726, a voluminous regulation in print, containing 337 articles that described in precise detail the complete process of surveying and mapping and the layout and maintenance of land registers and cadastres. In addition to its express purpose of avoiding conflicts among subjects, its intent for the legal protection of landholders was obvious. The technical supervisor, Johann Wilhelm Zollmann, described the process and organizational principles of cadastral surveying in his well-received textbook, *Vollständige Anleitung zur Geodæsie oder practischen Geometrie* (1744) (see fig. 833). The Weimar example explains why skilled supervision of surveying techniques was necessary for there to be satisfactory results from the survey of a territory of this size.

About the same time in 1727, a *General-Steuer-Revision* (general tax audit) was ordered in the Duchy of Saxe-Gotha. A commission on cadastral surveying formed in 1729 followed the example of the work already in progress in Saxe-Weimar and appointed six geometricians. Five large-scale (1:1,400) map series (1730/31) and a few copies (1758) remain of the surveying that continued until 1736. Much greater are the archival holdings in the Prussian Duchy of Cleves, which was surveyed mostly by Prussian engineer-officers (1731–38), resulting in roughly 1,500 surviving cadastral maps on a uniform scale (1:2,041.5) and in a uniform format (Kain and Baigent 1992, 155) (see fig. 774). The central Prussian provinces already issued directives as early as 1720 and 1724 to survey the inner cities and urban farms as well as prepare municipal cadastres, after which at least sixty cities in the Electoral March of Brandenburg, the New March, the Duchy of Magdeburg, and Pomerania prepared cadastres with general maps (1:4,000) and large-scale specialized maps (1:2,000) by 1730 (Hanke 1935). The County of Schaumburg-Lippe ordered a fiscal survey in 1743, but it was never completed except for the two southern districts. Not until 1781–92 were the remaining territories surveyed and mapped on a scale of 1:2,320. The general topographical survey carried out in the Principality of Braunschweig-Wolfenbüttel (1746–84) gave rise to a land register containing district maps of 432 towns on a scale of 1:4,026, which remained in force until 1849 (Pitz 1967, 345–73; Stein 2004, 179–80).

Cadastral surveying in the Nassau Principalities began in 1751 (Stein 2004, 187–88). After Nassau-Usin-

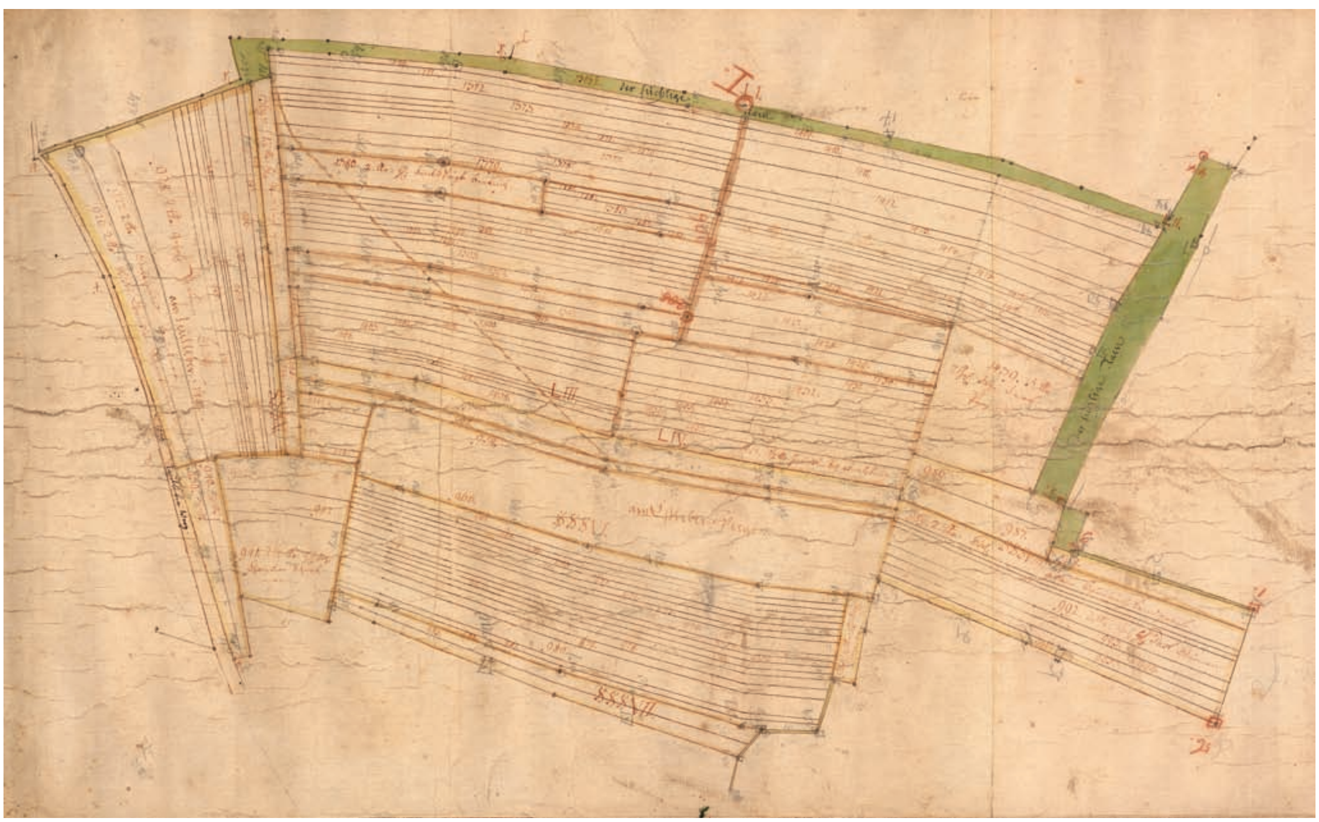

FIG. 669. MANUSCRIPT CADASTRAL MAP OF BUTTSTÄDT IN THE DUCHY OF SAXE-WEIMAR, PROBABLY 1732, CA. 1:1,600.

Image courtesy of the Kreisarchiv Sömmerda (Map Collection Nr. 263).

gen, cadastral surveying of Nassau-Saarbrücken began in 1752. The supervisor of this project had previously been involved in the work in Saxe-Eisenach, Fulda, and Saxe-Gotha. Nassau-Idstein and Orange-Nassau followed in the 1780s. Cadastral surveying began in the Margraviate of Baden-Durlach in 1752, but rapid progress did not occur until after 1774, when a technical surveying supervisor was engaged. Eventually this led to a map on a scale of 1:2,746 in 1801. In the Duchy of Mecklenburg, where the first cadastral surveys solely by surface calculation were done in 1703, cadastral maps (1756–73) were made on a scale of 1:3,840 or 1:4,800 as part of the directorial survey of the property of landed nobility (Greve 1997). A survey based on triangulation networks was begun in the Duchy of Oldenburg in 1782, carried out by only three surveyors who had barely begun when it was abandoned entirely in 1791 in favor of the topographical administrative maps on a scale of 1:20,000 (Fieseler 2013, 241–55). In 1782 in the Principality of Fürstenberg, however, a tax regulation expedited the surveying work that had been under way since 1726. It involved thirty-one geometricians in total until its conclusion in 1796, resulting in cadastral maps at ca. 1:2,350, many of which have survived (Wesely 1995). A cadastral survey was carried out in the Prince-Bishopric of Osnabrück as early as 1718–24, but its results were not mapped due to the high additional costs entailed. From 1784 to 1790, a total of 476 "island maps" (*Inselkarten*)—in which small isolated areas appear to float freely in space (as in figs. 677 and 680)—on a scale of 1:3,840 were surveyed pursuant to a directive (Fieseler 2013, 206–26). The cadastral survey of the imperial city of Frankfurt was undertaken in 1787 under a municipal resolution. Besides fiscal considerations, the land registers and delineations (*Gewannrisse*) on a scale of 1:1,250 served as a land register and had to be updated by the municipal or state geometrician when new parceling occurred. The series of cadastral surveys of the eighteenth century ended finally in the Principality of Saxe-Altenburg, where 531 land registers on a scale of 1:2,092 were created (1795–1816) (Roubitschek 1958).

As cadastral surveying grew, it was recognized that, in addition to tax collection, maps could serve to improve agriculture. For instance, the general topographical survey in the Principality of Braunschweig-Wolfenbüttel from 1755 simultaneously achieved the objective of merging fragmented landholdings and dividing up jointly held land among interested parties (Pitz 1967, 352). From the mid-eighteenth century, more and more ordinances were enacted to divide mutually held land in the interest of agricultural management in several states, such as in the Kingdom of Prussia (1763) and the Electorate of Hannover (1768), based on which many subdivisions and mapping projects ensued. Large surveying and mapping projects to consolidate lands came about in the then-Danish Duchies of Schleswig and Holstein in the context of agricultural reform after the respective ordinances came into force in 1766 and 1771 following the example of laws enacted in Denmark.

As the growth of commerce put progressively higher demands on the profitability of forests for lumber, construction, fire, charcoal, and other uses, forest managers were accordingly compelled to rationalize forest organization, to which well-planned, large-scale forest surveys significantly contributed. By 1680, mapping of the Württemberg forest had begun on 280 maps at ca. 1:8,256. The forest survey begun in 1745 in Braunschweig-Wolfenbüttel was already based on the principles of sustainable forestry (Pitz 1967, 300–324).

The increasing improvement of surveying practice created the conditions to fulfill the high demands for managing various challenges. State enterprises undertook further attempts at mapping on a large scale, which required a careful assessment of complex spatial planning, from the early eighteenth century onward. In Brandenburg-Prussia in particular, maps for soil enrichment and colonial settlements served as a basis for clearing and developing territories that were chiefly unsettled and unusable for agriculture due to floods.

Despite the commonalities of purposes, these property maps and cadastral surveys have a personal graphic style that is preserved in the numerous surviving maps. It was not until the nineteenth century that these individual styles disappeared, making way for a purely technical design methodology.

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SEE ALSO: German States

BIBLIOGRAPHY

Asmus, Ivo. 1996. "Die geometrische Landesvermessung von Schwedisch-Pommern, 1692–1709." *Baltische Studien* 82:79–98.

Fiedler, Friedrich August. 2012. *Atlas Cameræ Magdeburgensis [1722]*. Facsimile reprint. Halle: Mitteldeutscher Verlag.

Fieseler, Christian. 2013. *Der vermessene Staat: Kartographie und die Kartierung nordwestdeutscher Territorien im 18. Jahrhundert*. Hannover: Verlag Hahnsche Buchhandlung.

Greve, Dieter. 1997. *Ruthen, Hufen und Erben: Vermessung und Kataster in Mecklenburg*. Schwerin: cw Verlagsgruppe.

Hanke, Max. 1935. *Geschichte der amtlichen Kartographie Brandenburg-Preussens bis zum Ausgang der Friderizianischen Zeit*. Ed. Hermann Degner. Stuttgart: J. Engelhorns Nachf.

Jestädt, Aloys. 1932. "Zur Agrargeschichte des Fuldaer Landes im achtzehneten Jahrhundert." *Fuldaer Geschichtsblätter* 25:1–12, 37–48, 59–64, 72–80.

Kahlfuß, Hans-Jürgen. 2001. *Geschichte der amtlichen Kartographie der Herrschaft Schmalkalden*. Kassel: Verein für hessische Geschichte und Landeskunde.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Kötzschke, Rudolf. 1953. *Ländliche Siedlung und Agrarwesen in Sachsen*. Ed. Herbert Helbig. Remagen: Verlag der Bundesanstalt für Landeskunde.

Pitz, Ernst. 1967. *Landeskulturtechnik, Markscheide- und Vermessungswesen im Herzogtum Braunschweig bis zum Ende des 18. Jahrhunderts*. Göttingen: Vandenhoeck & Ruprecht.

Rößling, Karlheinz. 1996. *Die Geschichte des Katasters in Hessen-Darmstadt*. Wiesbaden: DVW Hessen.

Roubitschek, Walter. 1958. "Die Altenburger Landesvermessung und die von ihr abgeleiteten Kartenwerke." *Wissenschaftliche Zeitschrift der Martin-Luther-Universität Halle-Wittenberg*, Math.-Nat. Reihe 7:277–308.

Seckendorf, Veit Ludwig von. 1656. *Teutscher Fürsten Stat*. Frankfurt.

Stein, Wolfgang Hans. 2004. "Die Kataster- und Matrikelbestände der Grundsteuer in den deutschen Territorialstaaten des Alten Reichs in der frühen Neuzeit." *Archivalische Zeitschrift* 86:151–97.

———. 2007. "L'État de finance et les 'familles' de cadastre en Allemagne à l'époque moderne." In *De l'estime au cadastre en Europe: L'époque moderne*, ed. Mireille Touzery, 81–116. Paris: Comité pour l'Histoire Économique et Financière de la France.

Stichling, Paul. 1954. *Die preußischen Feldmesser-Regelements*. Braunschweig: Oeding.

Vanotti, Johann Nepomuk. 1825. "Steuerwesen in den schwäbisch-vorderöstereichischen Landen." *Württembergische Jahrbücher für vaterländische Geschichte, Geographie, Statistik und Topographie*, 398–407.

Wesely, Daniel. 1995. *Steuerreform und Katasterkartographie im Fürstentum Fürstenberg im 18. Jahrhundert*. Frankfurt am Main: Peter Lang.

Zollmann, Johann Wilhelm. 1744. *Vollständige Anleitung zur Geodæsie oder practischen Geometrie*. Halle: Renger.

Property Mapping in Great Britain. The making of large-scale local maps of property started in England and Ireland in the sixteenth century and by the mid-seventeenth century had become well established. Measuring and quantifying land was both a cause and a consequence of the emerging Tudor capitalist society, in which ownership of a definable piece of land became paramount, and also reflected a Renaissance interest in practical mathematics. Property mapping and surveyors met with suspicion at the turn of the sixteenth and into the seventeenth century, and authors of contemporary surveying manuals went to considerable lengths to defend the skills they were advocating and to press for properly trained practitioners using techniques based on trigonometry and angle measurement, no doubt partly to increase sales. By the time of Charles II's Restoration in 1660, property mapping was sufficiently common for such propaganda to have died out. It had become a mathematical science, and practitioners had to have some knowledge of geometry. The instruments they used hardly changed between 1650 and 1800; in England, they depended on a plane table with a compass for measuring bearings, a chain for measuring distances, and a measuring wheel for roads. Irish surveyors preferred to use a circumferentor, or surveying compass, to measure angles. The theodolite remained a rare and expensive instrument into the nineteenth century. In 1800 as in 1650, surveyors still relied on assistants to carry the chain and to show them the land and its boundaries (fig. 670).

Property mapping was one of the social and economic changes of the 1650s and Restoration periods, with their rising prosperity and increasing interest in science, mathematics, and cartography. Improvement schemes involved surveyors; Jonas Moore, for instance, was at the center of the project to drain the fens in the 1650s as surveyor to the Bedford Level Corporation. He knew the mapmaker Ralph Greatorex, who had wide-ranging scientific interests and was well connected with early members of the Royal Society. They collaborated in surveying a part of London in 1666 that had been devastated by the fire that September. The fire stimulated mapmaking, as plans of the affected areas had to be drawn up and new plots of land laid out (Willmoth 1993, 136–37). The experience and publicity enjoyed by these surveyors affected the direction of their later careers; William Leybourn, for example, who started out as a printer of mathematical books, was one of those employed to survey the City after the fire, and was subsequently employed to map properties (Bendall 1997, 2:317–18).

Property mapping could be stimulated by political and military activities. The politics of the Commonwealth and Restoration periods, for example, encouraged property mapping in certain cases, particularly in Ireland. There the Down Survey of 1655–59 to map forfeited lands as part of the plantation process, and the later Trustees' Survey of 1700–1703, contributed to a substantial increase in the number of skilled mapmakers (Andrews 1985). After having worked on plantation surveys, these men often turned to private estate surveying.

Military activities used large-scale maps, and this influence also spread into civilian mapmaking, most especially when army officers such as John Peter Desmaretz made estate maps in England in the early eighteenth century. Later in the century, the 1745 Jacobite Rebellion in Scotland resulted in substantial military mapmaking. William Roy, joined later by colleagues, surveyed Scotland in 1747–55 to provide adequate maps for building roads and forts. As a consequence of the 1752 Annexing Act, commissioners were authorized to have the forfeited estates surveyed and mapped to visualize the type of land and the possibilities for improving it. Extensive peacetime military mapping ceased as rumors of war in Europe and North America caused engineers to be transferred to tasks seen to be more urgent.

Property mapping increasingly became used as a tool of estate management. Especially from the last quarter of the eighteenth century, English institutional landowners employed surveyors. Thus, the colleges in Oxford and Cambridge started routinely to use maps for estate management from the 1770s onward, especially in connection with the renewal of leases. In the 1790s,

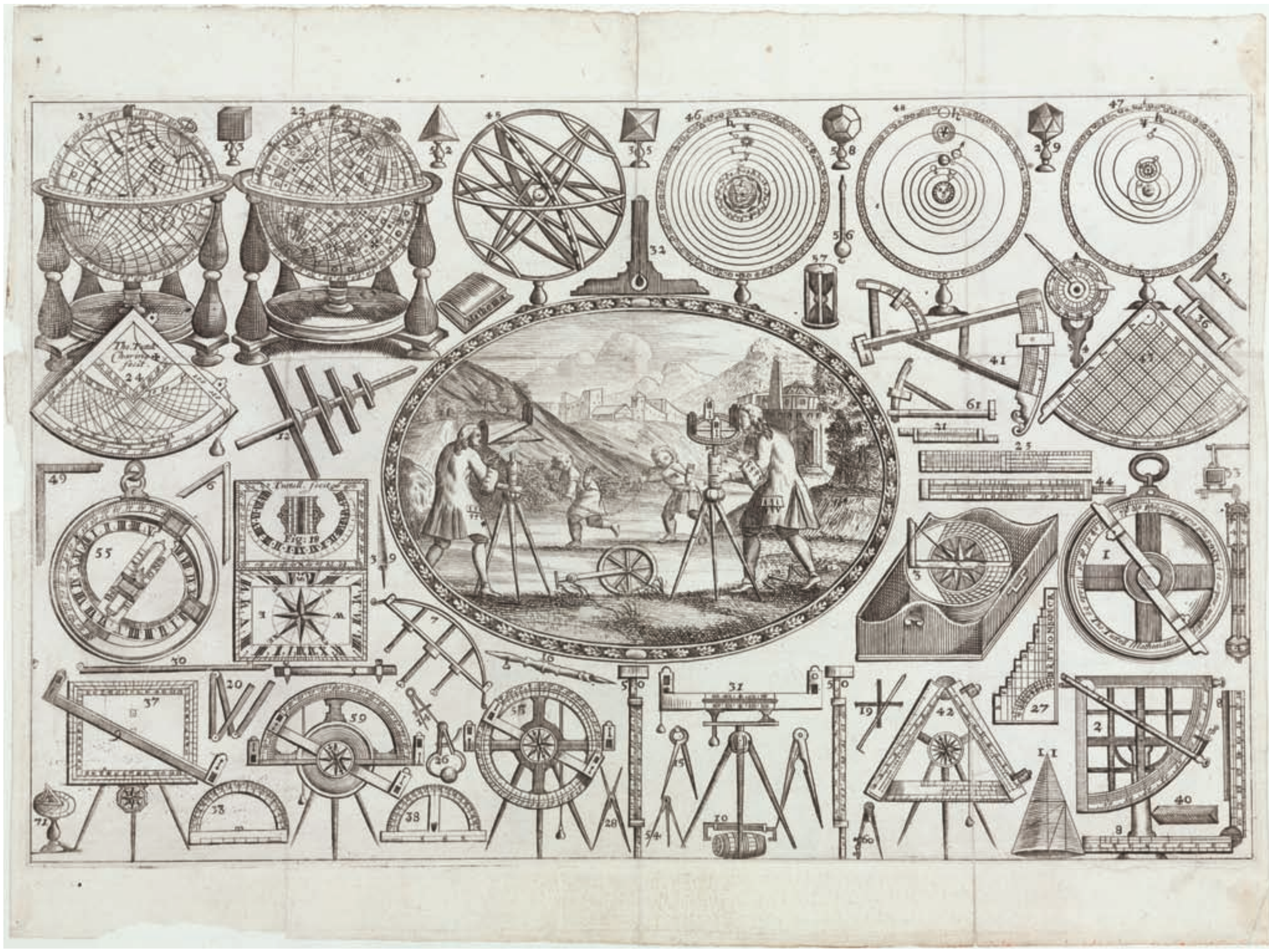

FIG. 670. TRADE CARD BY THOMAS TUTTELL, CHARING CROSS, CA. 1700. Tuttell was mathematical instrument-maker and (later) hydrographer to the king, and his trade card shows surveyors using a plane table on the left, a theodolite on the right, and a perambulator (for measuring roads) lying between them, as well as two children carrying a chain.
Size of the original: 19 × 29 cm. Image courtesy of the Science Museum/Science & Society Picture Library, London.

for example, Merton College in Oxford commissioned several replacement maps of its estates, while in Cambridge, the surveyor Joseph Freeman worked for at least eight colleges between the 1760s and his death in 1799 (Bendall 1992). As Welsh landlords started programs of consolidation, agricultural improvement, and better estate management in the second half of the eighteenth century, many estates were surveyed and mapped. In Scotland, however, demand for estate surveyors was decreasing by the 1770s as agriculture was hampered by poorly developed markets and the American Revolutionary War.

Surveyors produced an increasingly wide variety of maps. For example, urban areas were gradually starting to employ mapmakers; Glasgow was one of the first British provincial cities to employ an official surveyor, James Barry, in 1773 (Moore 1996, 2). Other surveyors too produced maps of towns even if they were not officially commissioned to do so; one example is John Chapman who mapped Newmarket in 1768 (Lewis 1991). From the 1720s and especially from the 1760s, maps increasingly were produced as part of the local process of the enclosure (inclosure) of open fields. At the same time, enclosure by Parliamentary Act became the normal way of proceeding and involved the appointment of commissioners who appointed the surveyor. In some cases, an enclosure commissioner carried out the survey himself, but usually a different person marked out the land and made the map. Surveying for enclosure became a major occupation for men such as William Cullingworth of Daventry, who surveyed for twenty-three enclosures in Northamptonshire between 1764 and 1780. Sometimes he worked by himself, but he collaborated with others on several occasions, and sometimes repeatedly (he and George King worked together on seven different enclosures) (Bendall 1997). Some enclosure surveyors followed the enclosure process across the country, and some went on to become commissioners in later surveys (fig. 671).

From the 1760s onward, industrialization accelerated, which had an impact on property mapping. Surveyors became involved in the construction of canals, improvement of harbors, and land drainage and reclamation. Men such as the canal surveyor John Longbottom joined the Society of Civil Engineers, which had been founded in 1771. The younger John Grundy was also a member; he and his father were employed in navigation and drainage work as well as estate surveying. Similarly, Thomas Yeoman, who surveyed enclosures, estates, and turnpikes, was also a drainage engineer, manager of a cotton mill, and a mechanic for agricultural machinery.

As teachers, lecturers, and members of learned societies, these men were interested in practical mathematics. They thus continued the ideas of the late seventeenth and early eighteenth centuries, when many surveyors described themselves as philomaths, or lovers of learning, especially mathematics. Some demonstrated this by the decoration on their maps; others sold maps, instruments, and books; and many taught. Andrew Pellin ran a mathematical school in Whitehaven, Cumberland, in 1697, using his skills as a surveyor to earn additional income. The need for mathematicians was so acute in the early eighteenth century that from 1713 on, teachers of mathematics, navigation, and mechanical arts were excused from subscribing to the Thirty-nine Articles of Religion of the Anglican Church. Nonconformists took advantage of this opportunity and they, among others, opened private academies that concentrated on practical subjects, including surveying. For example, members of

FIG. 671. DETAIL FROM "HENLOW IN THE COUNTY OF BEDFORD," BY JOHN GOODMAN MAXWELL, CA. 1798. The cartouche of this enclosure map shows the surveyors in the process of their work. Watercolor on parchment. Size of the entire original: 61 × 66 cm; size of detail: 15 × 20 cm. Image courtesy of the Bedfordshire Archives, Bedford (MA5).

FIG. 672. "A MAP OF THE FARM CALLED ARNOLDS IN THE PARISHES OF STAPELFORTH ABBY AND LAMBOUN IN THE COUNTY OF ESSEX," CA. 1790. This anonymous sampler demonstrates the extent to which both cartography and estate plans had become part of a common vocabulary of young women's education. Not only does the sampler demonstrate a high standard of needlework in its variety of stitches and techniques, it also exhibits an understanding of the attributes of the estate plan with the naming of individual fields and the precise measurement of their areas. Embroidered woolen canvas with colored silks and chenille thread.

Size of the original: ca. 64 × 54 cm. Image courtesy of the Victoria and Albert Museum, London (T.65-1954).

the Fairbank family of Sheffield were notable Quaker surveyors and had a school there. Their school, which had forty pupils, was relatively large; so too was Thomas Hogben's village school at Smarden in Kent in the mid-eighteenth century, which also had about forty attending at the end of the century. In at least one instance, education in surveying also extended to female students (fig. 672). Very few mapmakers are known to have taught at schools that followed a traditional classical curriculum and aimed to prepare pupils for university. The balance between teaching and surveying varied from person to person: Isaac Lenny preferred to confine his surveying activities to the school holidays while for Edward Laurence, who described himself as a teacher of mathematics in Northampton, surveying and cartography seemed to take priority (Bendall 1992).

As property mapping became more prevalent, it became easier to acquire the necessary skills. School textbooks now included sections on surveying, and apprenticeships were common, with sons and other young relatives assisting their fathers and more senior family members and learning from them. The length of such training varied; seven years was typical in the early eighteenth century. In 1805, William Stephenson describes a three-year apprenticeship from the age of eighteen (Stephenson 1805, iii), while to join the Land Surveyors' Club in 1834 it was necessary to have served a four-year apprenticeship or to have been with one's father until the age of twenty-four (Thompson 1968, 96).

Surveyors often made their livings by combining several different activities. While some were also teachers, writers, publishers, and enclosure commissioners, others, especially later in the eighteenth century, increasingly acted as land agents, stewards, and valuers. The Duchy of Cornwall, for example, employed William Simpson to visit its manors, survey them, and call extraordinary meetings of the manorial courts, while Joseph Freeman was agent for Jesus College Cambridge's estate in Tempsford (Bedfordshire) in 1785. Many land agents who started businesses in the eighteenth century continued into the nineteenth, such as the Teal family of Leeds, which was employed by Trinity College Cambridge as agent to its northern estates in the eighteenth and nineteenth centuries, and Alexander Watford of Cambridge, whose son Alexander II succeeded him in the early nineteenth century and developed a large business. Other surveyors became involved in other types of work related to the land: the landscape gardener Lancelot ("Capability") Brown, for instance, also made maps, as did his assistants and apprentices; the Driver family in London ran a nursery as well as a surveying business; and the cartographer Alexander Aberdeen was a gardener.

Between 1650 and 1800, property mapping changed considerably. Many more learned people practiced the art. They were employed on a wider variety of projects and consequently drew a wider range of maps. They became increasingly involved in other aspects of land agency. This was, as J. B. Harley (1972, 24) described it, the "golden age of the local land surveyor."

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SEE ALSO: Great Britain; Irish Plantation Surveys

BIBLIOGRAPHY

Andrews, J. H. 1985. *Plantation Acres: An Historical Study of the Irish Land Surveyor and His Maps*. Belfast: Ulster Historical Foundation.

Bendall, Sarah. 1992. *Maps, Land and Society: A History, with a Carto-Bibliography of Cambridgeshire Estate Maps, c. 1600–1836*. Cambridge: Cambridge University Press.

———. 1997. *Dictionary of Land Surveyors and Local Map-Makers of Great Britain and Ireland, 1530–1850*. 2d ed. 2 vols. Originally comp. Francis W. Steer et al. and ed. Peter Eden. London: British Library.

———. 2000. "Merton College and the Mapping of Its Estates, 1601–1836." *Oxoniensia* 65:79–110.

Harley, J. B. 1972. *Maps for the Local Historian: A Guide to the British Sources*. London: National Council of Social Service for the Standing Conference for Local History.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Kain, Roger J. P., John Chapman, and Richard Oliver. 2004. *The Enclosure Maps of England and Wales, 1595–1918: A Cartographic Analysis and Electronic Catalogue*. Cambridge: Cambridge University Press.

Lewis, C. P. 1991. "John Chapman's Maps of Newmarket." *Proceedings of the Cambridge Antiquarian Society* 80:68–78.

Moore, John N. 1996. *The Maps of Glasgow: A History and Cartobibliography to 1865*. Glasgow: Glasgow University Library.

Stephenson, William. 1805. *The System of Land Surveying at Present Adoped by Surveyors and Commissioners in Old and New Inclosures*. London: Symonds.

Thompson, F. M. L. 1968. *Chartered Surveyors: The Growth of a Profession*. London: Routledge & Kegan Paul.

Willmoth, Frances. 1993. *Sir Jonas Moore: Practical Mathematics and Restoration Science*. Woodbridge: Boydell Press.

Property Mapping in British America. Within Britain's North American colonies, real property was an essential component of economic exploitation and development. Land was readily available, especially because there was little regard for Native American ownership. Consequently, property mapping was a necessary component of official and private life in British America, starting with the earliest settlements in the early 1600s. The English Crown had initially delegated land granting and subdivision to commercial companies, influential proprietors with royal connections, or corporate groups with religious or ethnic affiliations. As they established settlements, these groups advocated compact, nucleated properties to counteract what was to them untamed wilderness threatened by both Native American and Spanish aggression. However, these ideal planned communities quickly disintegrated and individual landownership became the norm. The practices for granting, subdivid-

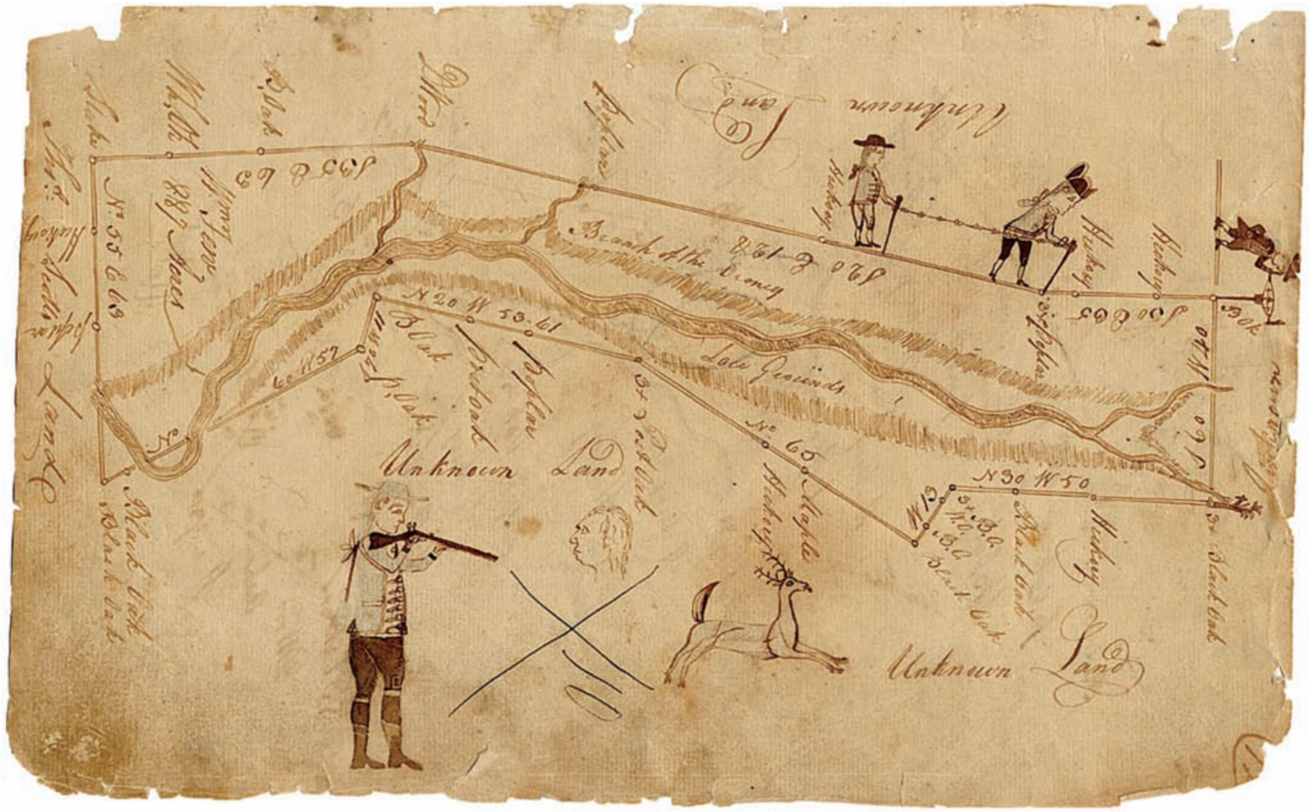

FIG. 673. ANONYMOUS AND UNTITLED PLAN OF LAND GRANTED TO WILLIAM FEW IN FRANKLIN COUNTY, GEORGIA, 1784. Manuscript, ink on paper, 1:15,840. This image is notable for its depiction of a surveyor (sighting through a circumferentor) and chainmen (wielding the chain). Size of the original: 18.5 × 32.0 cm. Headright and Lottery Loose Plat File, Survey Records, Surveyor General, RG 3-3-26, Georgia Archives.

ing, and surveying property were still rather inchoate in the mid-seventeenth century, but they would evolve in complexity, systemization, and technological sophistication throughout the eighteenth century. Although each colony developed its own peculiar system of allotting and surveying land, there were commonalities among many of the colonies. The importance of property mapping to the history of the colonies has given rise to a substantial and varied literature, although good summaries exist (Kain and Baigent 1992, 265–88; Price 1995).

Indiscriminate surveys first appeared in the Chesapeake Bay colonies of Virginia and Maryland and spread to the other South Atlantic colonies as well as many of the Middle Atlantic colonies. Such surveys were based on individual choice, with grantees selecting land before it was surveyed and patented. There was no planning or regularity in regard to size, shape, or location of individual land parcels. Based on the amount of land allotted to an individual, settlers would locate the desired site, initially at prime locations, and a surveyor would delimit the boundaries, often using a river course in combination with a number of surveyed lines, identified by metes and bounds descriptions (see fig. 136). The resulting surveys created a patchwork of irregular polygons, most with more than four sides (Price 1995, 89–172; Hughes 1979) (fig. 673).

By contrast, relatively compact and regularly shaped "towns" (also known as townships) were first employed in Massachusetts but quickly spread to the other New England colonies and initially to several of the Middle Atlantic colonies. Each town, generally larger than thirty square miles (78 km²), was granted or sold to a group, initially religious in affiliation but later commercially motivated. The corporation then divided the town's lands approximately equally among the group members (usually individual families). Property creation and disposal within towns was therefore planned and individual parcels of land displayed some geometrical regularity (fig. 674). Initially, attempts were made to give each member equal shares of various land types,

FIG. 674. JOSHUA FISHER, "A PLATT OF LAND IN DORCHESTER WOODS NEAR DEDHAM," CA. 1670. Manuscript, ink on paper, 1:9,500. This plat illustrates the subdivision of five hundred acres of common land in Dorchester, Massachusetts, into sixty long lots for proprietary shareholders about 1670. The town, founded in 1630, is located just south of Boston, which annexed the area in 1870.

Size of the original: 41.5 × 34 cm. Image courtesy of the Trustees of the Boston Public Library/Rare Books (Ms. V. Ch. M2.3, p. 191).

but eventually single-family farms of contiguous landholdings became more popular (Benes 1981, 36–43; Price 1995, 29–86; Wood 1997).

These opposing systems were not uniform in their respective areas, and as settlement moved inland from the Atlantic seaboard to northern and western frontiers, more comprehensive, systematic, and geometric surveys were introduced. Variations did occur, such as in New York's Hudson River Valley, where the Dutch were the first colonists. Here large, irregularly shaped landholdings known as manors were the predominant method of granting lands. Large tracts of land were also granted to favored colonial officials or royal associates in other colonies, such as Virginia's Northern Neck Propriety. Such large landholdings were further subdivided and sold as smaller plots of land to individual families. When the British gained control of the Canadian Maritime Provinces as a result of their victory over the French in the Seven Years' War (1756–63), British surveyors instituted comprehensive rectangular cadastral systems (consisting of counties, parishes, and townships) on Prince Edward Island (see fig. 26) and the southern portion of Cape Breton Island (see fig. 374). During the last two decades of the eighteenth century, following the American Revolution, individual states or land companies subdivided large tracts of land using a variety of informal rectangular survey patterns. Such patterns appeared in northern Maine, New Hampshire, Vermont, western New York, northwestern Pennsylvania, and western Georgia (Allen 2011; Hornsby 2011).

A variety of written and cartographic documents were prepared to record initial land grants as well as subsequent land transactions (Pearce 2004). These documents include the initial grant or warrant specifying why and how much land was granted, a patent or deed recording the location and bounds of the survey, and frequently a survey plat (i.e., a large-scale plan) showing the boundaries of the parcel of land. Some of the earliest surveys performed in the seventeenth century were based on estimated angles by eye and distances by pacing, but during the eighteenth century, surveys were more precisely determined by using rudimentary instruments, such as a compass, or circumferentor, and a surveyor's chain. Unfortunately, only a limited number of these cartographic records have survived. It is likely that survey plats were not prepared for many land transactions, and those that were made were typically preserved in only one or two manuscript copies. Most of those copies were retained by the owner and have disappeared, but those retained by the surveyor or recorded in the county court records have often survived.

Some of the best archives of land surveying plats are found among the papers of individual surveyors or in the records of county courts. One example is the cartographic legacy of George Washington, first president of the United States. As a teenager he trained in Virginia with the Fairfax County surveyor and subsequently surveyed land for the Fairfax family within their Northern Neck Proprietary. Besides plats of his own properties at Mount Vernon (fig. 675) and land speculation activities in western Virginia along the Kanawha River, there is documentary evidence that he prepared approximately 200 plats for others but less than 75 of these have survived. Many of these are very simple metes and bounds surveys showing only the boundaries of the tract of land and one or two prominent physical landmarks (Redmond 1998). Another example is the work of William Godsoe and his grandson John, who served as surveyors in Kittery, Maine, from the end of the seventeenth century to the middle of the eighteenth century. More than 110 of their surveys have survived, often recopied in county or town records. In general, their plats are more elaborately decorated than Washington's. They were often ornamented with elaborate compass roses and pictorial symbols representing witness trees, which marked the corners and angles of boundaries, or nearby houses (Candee 1982; Benes 1981, 84–87).

In addition, a number of mid-scale maps were published in London from the late seventeenth century through the eighteenth century that delineated the subdivision of large land grants or depicted the boundaries of larger landholdings or comprehensive cadastral schemes within an individual colony. These range from Thomas Holme's map showing the initial rural land grants in the vicinity of Philadelphia (fig. 676) to mid-eighteenth-century maps of individual colonies, including William Gerard De Brahm's *A Map of South Carolina and a Part of Georgia* (1757); Samuel Holland's *A Plan of the Island of S^{t}. John* (Prince Edward Island) (1765); and Claude Joseph Sauthier's *A Chorographical Map of the Province of New-York* (1779), to maps of several Caribbean islands depicting the boundaries of sugar plantations, including St. Christopher (Saint Kitts), Antigua, Barbados, and Grenada, which appeared in atlases like Thomas Jefferys's *A General Topography of North America and the West Indies* (1768) and his *The West-India Atlas* (1775). Maps were also published of large proprietary land grants to show their extent and bounds, such as John Warner's *A Survey of the Northern Neck of Virginia* (first published ca. 1747) or of large land grants subdivided by land companies in the last two decades of the eighteenth century in upstate New York, including the New Military Tract as depicted in Simeon De Witt's *1st Sheet of De Witt's State-Map of New-York* (1792) or the Genesee Tract delineated in *A Map of the Genesee Lands in the County of Ontario*

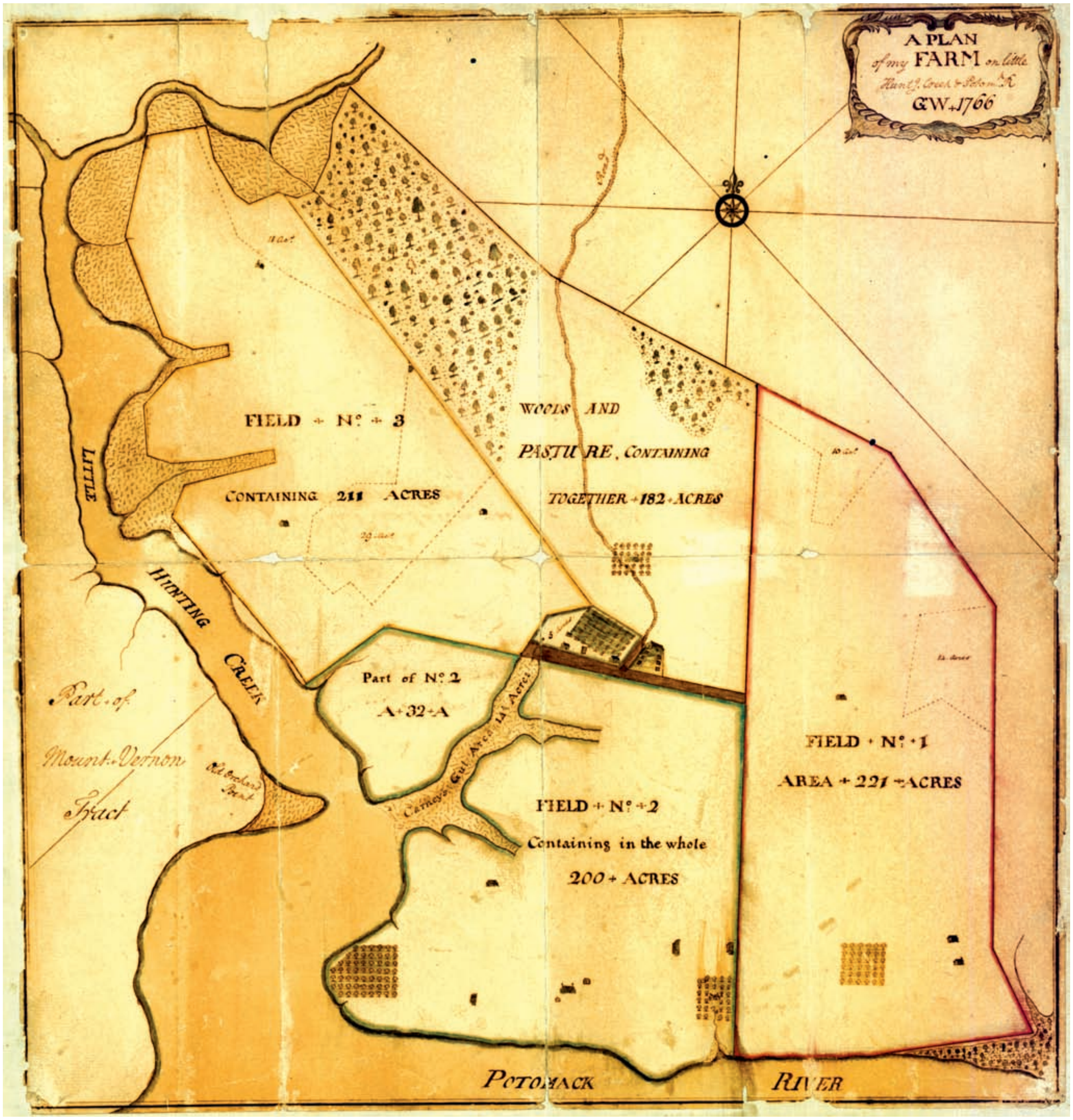

FIG. 675. GEORGE WASHINGTON, "A PLAN OF MY FARM ON LITTLE HUNTG. CREEK & POTOM[K]. R," 1766. Manuscript, pen and ink and watercolor, scale not given. A rare example of an estate plan from Britain's North American colonies, this manuscript drawing depicts Washington's landholdings at his Mount Vernon plantation near Alexandria, Virginia.

Size of the original: 46 × 44 cm. Image courtesy of the Geography and Map Division, Library of Congress, Washington, D.C. (G3882.M7 1766.W3 Vault).

FIG. 676. THOMAS HOLME, *A MAP OF THE IMPROVED PART OF THE PROVINCE OF PENNSILVANIA IN AMERICA* (LONDON, [1705?]). Originally published in 1687, this subsequent edition continues to show how the land was subdivided into counties, townships, and individual landholdings in southeastern Pennsylvania in the vicinity of Philadelphia. Copper engraving on six sheets, ca. 1:63,360.
Size of the original: 80 × 141 cm. Image courtesy of the Geography and Map Division, Library of Congress, Washington, D.C. (G3820 1687.H5 Vault).

and State of New York (1790). While many of the maps showing the subdivision of large grants were prepared to promote land sales, the mid-eighteenth-century maps of individual colonies were most likely prepared to assist with the collection of quit rents (Allen 2011).

Estate plans, which depict the internal layout of large agricultural units, were very common in England during the seventeenth and eighteenth centuries, but they are rarely found among the land records of the thirteen British colonies in North America. Several examples derive from Washington's surveys of his home plantation of Mouth Vernon, including manuscript plats prepared in 1766 and 1799, as well as a map published in 1801, shortly after his death. However, estate plans such as these were common in the British colonies in the West Indies, particularly Jamaica. The National Archives of Jamaica holds an especially large archive of one thousand estate plans, sixty of which date before 1800 (Higman 1988).

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SEE ALSO: British America

BIBLIOGRAPHY

Allen, David Yehling. 2011. *The Mapping of New York State: A Study in the History of Cartography*. Online publication.

Benes, Peter. 1981. *New England Prospect: A Loan Exhibition of Maps at the Currier Gallery of Art, Manchester, New Hampshire*. Boston: Boston University for the Dublin Seminar for New England Folklife.

Candee, Richard M. 1982. "Land Surveys of William and John Godsoe of Kittery, Maine: 1689–1769." In *New England Prospect: Maps, Place Names, and the Historical Landscape*, ed. Peter Benes, 9–46. Boston: Boston University.

Higman, B. W. 1988. *Jamaica Surveyed: Plantation Maps and Plans of the Eighteenth and Nineteenth Centuries*. Kingston: Institute of Jamaica Publications.

Hornsby, Stephen J. 2011. *Surveyors of Empire: Samuel Holland, J. F. W. Des Barres, and the Making of "The Atlantic Neptune."* Montreal and Kingston: McGill-Queen's University Press.

Hughes, Sarah S. 1979. *Surveyors and Statesmen: Land Measuring in Colonial Virginia*. Richmond: Virginia Surveyors Foundation and Virginia Association of Surveyors.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Pearce, Margaret W. 2004. "Encroachment by Word, Axis, and Tree: Mapping Techniques from the Colonization of New England." *Cartographic Perspectives* 48:24–38.

Price, Edward T. 1995. *Dividing the Land: Early American Beginnings of Our Private Property Mosaic*. Chicago: University of Chicago Press.
Redmond, Edward. 1998. *George Washington: Surveyor and Mapmaker*. Washington, D.C.: Geography and Map Division, Library of Congress. Online publication.
Wood, Joseph S. 1997. *The New England Village*. Baltimore: Johns Hopkins University Press.

Property Mapping in the Italian States. While the general practice of property mapping embraced a variety of activities, the discipline would adopt an increasingly territorial focus during the course of the eighteenth century. This trend, which had begun as far back as the sixteenth century, culminated during the eighteenth century with the production of cartographic works that used on-site measurements of terrain as standard practice. In effect, the production of such works became an integral phase in the work of land surveyors, resulting in the creation of numerous geometric maps—at large or very large scale—that were commissioned either by private individuals or by public administrations at both a state and local level. And though perhaps intended to meet various needs, these works were essentially inspired by territorial issues involving the measurement of landed property—for example, the definition of landed estates, the identification of rights over natural resources, or the resolution of disputes regarding boundaries.

Generally, such maps were produced in manuscript form and are now scattered among many different institutions—a fact that makes it very difficult to prepare any exhaustive catalog or inventory. However, we do know that in both quantitative and qualitative terms the most significant such works were *cabrei* (hybrid documents, a combination of pictorial depiction and geometrical survey) and cadastres.

Some *cabrei* were being produced in the Italian states as early as the seventeenth century, but the bulk were produced in the eighteenth century, around the same time as the cadastres under discussion here. In effect, before the state became concerned with the measurement of terrain, it was private landowners who commissioned such surveying. The results were put together in the form of a *cabreo*, which contained all the various documents relating to the definition, measurement, and description of landed property. Increasingly common as an integral feature of these *cabrei*, cartographic works offered a scaled depiction of an estate in either a single overall map or, more usually, in a series of individual maps that gave a geometrical rendition of the various parcels of land that made up that estate; these latter maps of part of the whole estate might sometimes be bound together to form an atlas. In order to confer on them the desired juridical status, such cartographic works were drawn on the franked paper used for legal documents and authenticated by a notary who had been present during the surveying (Sereno 2002b) (fig. 677).

Fiscal reform exerted a crucial influence on the changing practices of property mapping, although the time frame and manner of that reform varied widely depending on the political, institutional, administrative, and financial circumstances of individual states. Nevertheless, whatever its rate of change, reform led to the creation of modern cadastres, the slow process of "gestation" during the eighteenth century achieving full maturity during the course of the nineteenth century. Recent juridical and historical analysis of these cadastres shows how their creation embodied models for the foundation and implementation of fiscal evaluation, while also revealing the channels through which intellectual ideas circulated in eighteenth-century Europe (Alimento 2008; Contini and Martelli 2007; Mannori 2001, 1–166). Similar claims might be applied to the cartographic praxis associated with cadastral land surveying. Until now, analysis of these practices within Italy has focused to varying degrees on the methods and techniques employed in the various cadastres within individual Italian states, tending to place emphasis on local characteristics and features. However, in light of theoretical studies in the history of cartography, which have argued for more specific study of the role that cadastral maps have played in the circulation of ideas, the creation of figurative models, and the professionalization of surveyors and their techniques, it will be useful to stress the points of contact between these various components.

Over the course of the eighteenth century, a combination of circumstances nurtured innovations in cadastral mapping. On the one hand, various technical factors, especially developments in geometrical-mathematical sciences, enriched property mapping; on the other hand, political factors resulting from a desire to redistribute fiscal burdens (in part due to the urgent need to raise funds as a result of the War of the Spanish Succession) created more demand for cadastral surveys in the context of fiscal reform.

The clear starting point of this process emerged in the Duchies of Milan and Savoy, where cadastres were produced with geometrical maps, unanimously considered the prototypes of the modern cadastre (Kain and Baigent 1992, 181–92, 213–17). The project for the Milanese *censimento*, also known as the Catasto Teresiano after Empress Maria Theresa, who restarted the work in 1749, was launched in an edict of 7 September 1718. The edict was stimulated by contemporary debates in Vienna that led to the creation of a cadastre in Silesia and a reform of the Bohemian cadastre. Another influence emanated from Vittorio Amedeo II's Piedmont,

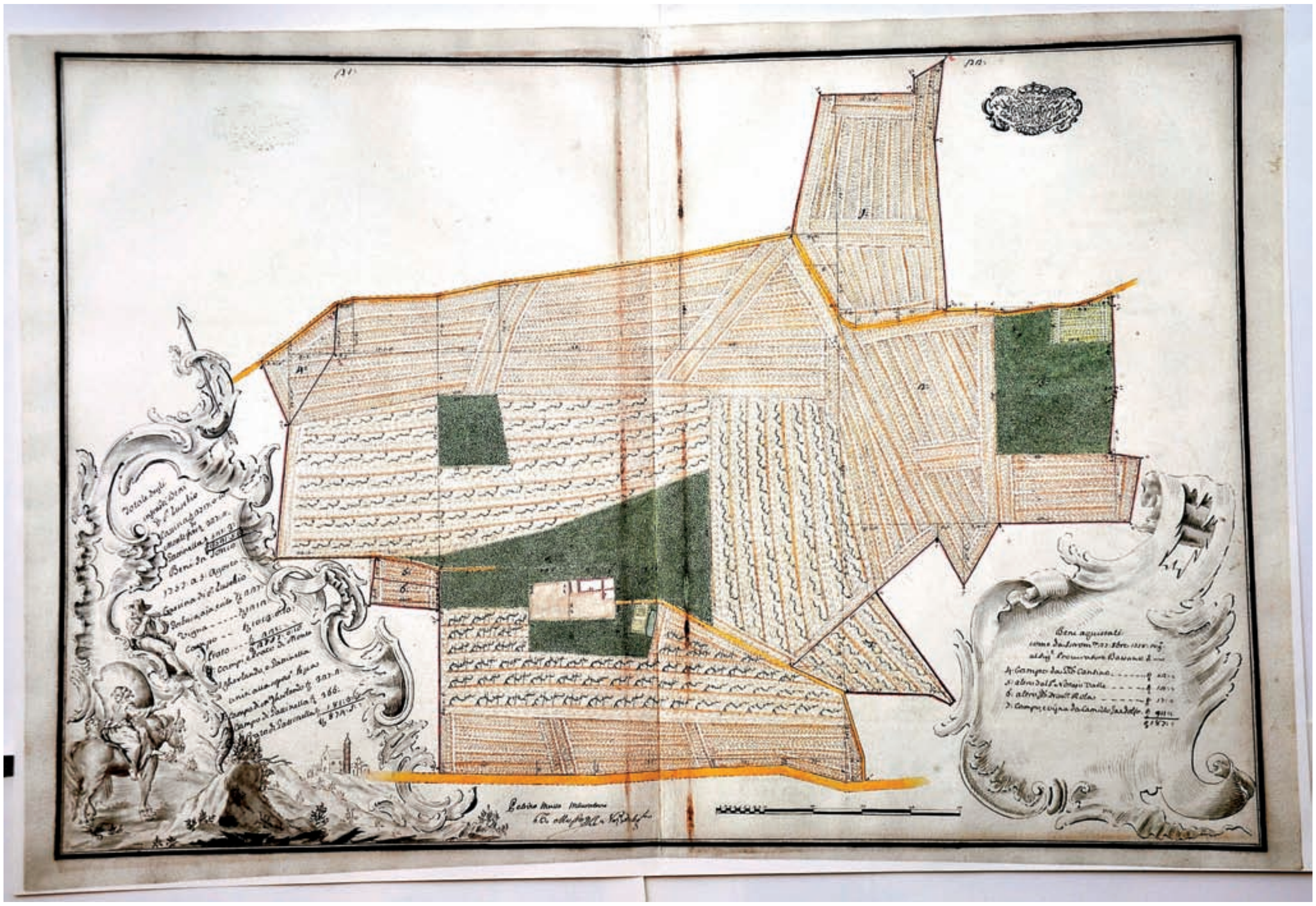

FIG. 677. MAP OF THE FARM, VINEYARDS, FIELDS, AND MEADOW, BY PETRINO MUSSO, 1756–59. Cadastral plan of the area around Tonco in the *cabreo* of the archdeaconal prebend of the cathedral of Asti. The official notarial mark is at top right. Manuscript; scale 50 [trabucchi] = 15.8 cm (ca. 1:975). Size of the original: 50 × 76 cm. Image courtesy of Editris Duemila SNC, Turin (Sala documenti Antichi, Cabrei, Archivio Storico del Comune di Asti).

where a *perequazione generale* had been initiated. (A *perequazione* is the measurement of territory without the creation of maps.) Covering all state territory, including the church and feudal lands that were exempt from taxation, this Piedmont project involved the assessment of all areas producing the same crops; however, it did not result in the measurement of individual parcels of land nor in the production of cartographic depictions.

The chronology of various works is significant both with regard to the spread of a precise type of fiscal model and to the diffusion of technical expertise and professionalization of surveyors. In Milan, the work might be defined as a unified operation that took place in two stages: the cartographic survey and initial assessment from 1722 to 1733 and the complete reassessment from 1749 to 1758. In Piedmont, the first phase of the *perequazione* was followed by operations relating to the creation of a land-register cadastre accompanied by maps of the Duchy of Savoy (1728–38). These latter efforts actually began before the completion of work on the general assessment of Piedmont. Taking place about the time of the pause between the first and second stages of the Milan *censimento*, the Savoy cadastre involved a significant number of land surveyors who had worked for the Duchy of Milan.

In both Savoy and the Duchy of Milan, the creation of the cadastres was a highly centralized enterprise. However, within Piedmont, after the *perequazione* had established the fiscal responsibility of each community, the government delegated the authority to individual communities to share the fiscal burden among nonexempt landowners. Thus, at various times from 1739 onward, each individual community, depending on the state of existing cadastres, could decide to prepare its own cadastre. Under the authorization of the provincial *intendente* and the direct supervision of his delegate, a community would commission a land surveyor (or *misuratore*) for the task; he would undertake on-site measurements, aided by a number of locally recruited assistants, *indicanti* or *trabuccanti* (guides or rodmen) (Archivio di Stato di Torino, Azienda Generale Finanze, Catasto Antico del Piemonte). Thus, two different models of organization were adopted in the creation of the first cadastres. In Milan, as in Savoy, work was centrally organized from the top, resulting in the relatively rapid creation of the cadastres. On the other hand, in Piedmont the division of labor between individual communities resulted in great variations in the rhythm of work. Indeed, from 1730 until the end of the century, the cadastral coverage of the region remained uneven, with gaps and shortcomings (Ricci and Carassi 1980).

However, despite these initial differences, a number of connections between these states emerged as knowledge and technical expertise circulated. It is true that some Italian states continued throughout the century to rely solely on the information provided by the estate owners themselves. However, the Milanese *censimento* began the circulation of qualified experts within Italy who developed technical models and practices to measure terrain and render the data accumulated through on-site surveying.

In fact, the particular innovation of geometrical cadastres for individual parcels of property developed from the extensive surveying of agrarian land and the resulting graphic depiction of the data. On-site measurement of each parcel—the cultivated unit—resulted in a map drawn at a scale of ca. 1:1,500 to 1:2,000. The terrain of a specific community was rendered as a series of numbered parcels of land, each parcel being defined by ownership and crop use, as shown in the map of the commune of Belgioioso by Giovanni Enrico Eck (1722) (see fig. 657).

As for the instruments and techniques used, the early work of measurement resulted in the need for the systematic surveying of ample tracts of territory and thus encouraged experimentation with new instruments for property mapping. A key role here was played by Johann Jakob Marinoni, a mathematician at the Viennese court, who was called to Milan to coordinate the technical aspects of the *censimento*. In order to establish general procedures for property mapping, he stipulated that measurements should be made using the *tavoletta Pretoriana* (plane table) instead of the *squadro agrimensorio* (surveyor's cross) that was then being used locally. The *tavoletta* expedited both the surveying procedures and the graphic representation of data because it was possible to mark the points surveyed directly onto a sheet of paper. Despite initial opposition from local land surveyors, who were more accustomed to traditional goniometric devices, eventually several hundred technicians were trained to use the *tavoletta* and worked on cadastres and surveying projects throughout Italy: the most fully studied cases are those of Giovanni Battista Nolli, active in Milan, Savoy, and Rome; Andrea Chiesa, active around Perugia; and Giovanni Cantoni, in Bologna (Guarducci 2009). Still, the situation sometimes gave rise to conflicts between the land surveyors who used the new techniques and those who relied on the traditional instruments of the *squadro*, compasses, chain, diopter (surveyor's circle), and rulers. And while the *tavoletta* was adopted in work on the Milan *censimento*, the instructions handed down in Piedmont were more flexible: the *tavoletta* was to be used only for large straight-edged parcels of land, while smaller irregular plots were surveyed using the *squadro*, which in fact provided greater accuracy in such situations (fig. 678).

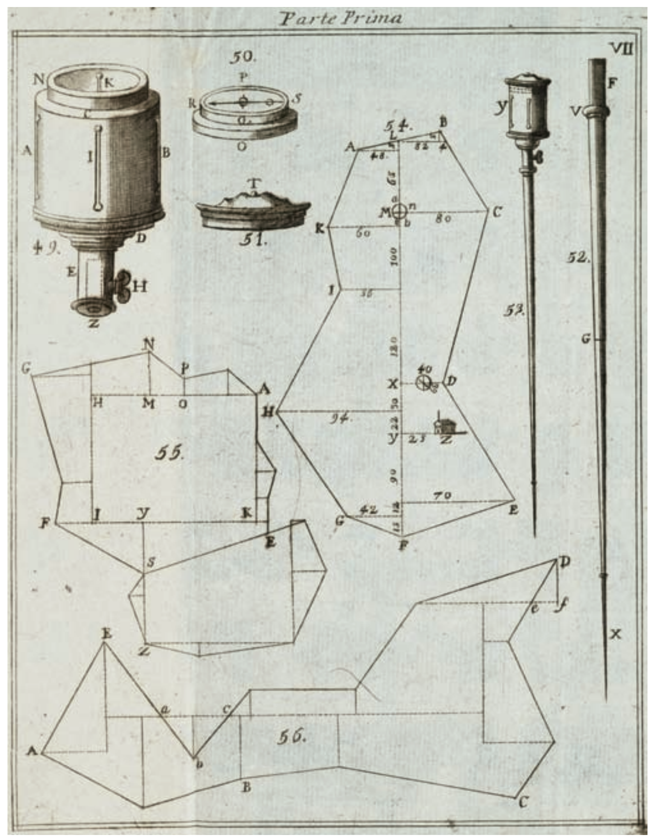

FIG. 678. THE *SQUADRO* AND ITS USE. The *squadro agrimensorio* was an enclosed form of the simple surveyor's cross: the orthogonal lines of sight are defined by vertical slits in a short cylinder (A, B, I, and K in fig. 49). A small compass (fig. 50) could be included, but only for general orientation, below the cap (fig. 51). Setting the *squadro* on a staff (figs. 52–53), the surveyor laid out straight lines, and perpendiculars thereto, across a field or other open property; if the lengths of each line were then measured, the field could be plotted out and its area calculated (figs. 54–56). From Giuseppe Antonio Alberti, *Istruzioni pratiche per l'ingegnero civile* (Venice: Appresso Pietro Savioni, 1782), pt. 1, pl. VII.
Image courtesy of the Library of Congress, Washington, D.C.

Another decisive feature in the creation of modern cadastres was that independent experts using innovative techniques and instruments worked under the direct supervision of local or state administrations; this supervision guaranteed that private interests could not exert pressure during the identification, measurement, and classification of land parcels. Furthermore, the widespread use of land surveyors not only generated the production of cartography but also resulted in a gradual change in the way individuals entered the profession. With increasing frequency, professionals were trained not only through a period of on-site apprenticeship but also through some course of study. Drawing on manuals inspired by sixteenth-century treatises on geometry, such academic study also provided the theoretical grounding for the cartographic rendering of data gleaned from the operations of surveying and measurement. In the Sabaudian states, Milan, and the Kingdom of Naples, this phenomenon has already been studied; however, it has yet to be examined in detail in other parts of the peninsula. Research suggests that there was a gradual move away from skills and expertise derived solely from empirical on-site training toward a greater focus on theoretical-scientific knowledge, often assessed through an examination (Palmucci 2002).

The work in Milan and the Sabaudian states inspired a growing debate about land surveying throughout Europe. In the 1760s, a second phase in the creation of Italian cadastres followed, which achieved rather unequal results. The work in Milan encouraged similar projects in the other Italian satellites under Habsburg rule: Mantua (in 1775–78), Modena (in 1785 for the plains and in 1826 for the mountains), and the Trento region. The Trento-Tyrolean cadastre was created in response to edicts issued first by Charles VI and then by Maria Theresa, which were echoed in directives for large-scale property-mapping operations in the Milan region. The cadastre took the entire century to produce, finally completed in 1784 by resorting to a procedure that heavily compromised the end product: the inclusion of measurements based on declarations by landowners themselves, who were required not only to list the property they owned and used but also, at their own expense, to provide for its measurement. This inevitably generated very rough-and-ready results and also failed to lead to the production of maps based on the data (Bonazza 2005; Guarducci 2009, 33–52).

Other geometrically based property mapping projects produced only partially realized results in the following century. In the Papal States, some important early experiments, such as the geometric cadastre of Perugia by Andrea Chiesa between 1727 and 1734, were followed by other projects (under Pius VI in 1777, then under Pius VII at the beginning of nineteenth century and ending under Gregory XVI in the 1830s); other projects included those in the Bologna Legation (under Cardinal Ignazio Gaetano Boncompagni Ludovisi in 1780); in the Duchies of Parma and Piacenza in 1765, where attempts were made to recruit the same personnel who had worked in Piedmont and Lombardy; and in the Grand Duchy of Tuscany, where—having set aside the failed projects of the eighteenth century—a new cadastre project was ordered in 1817 and became operative in 1835. Elsewhere, totally descriptive rather than geometrical cadastres were drawn up: in the Kingdom of Naples in 1741–51 (known as the Catasto onciario) and in Sicily in 1781–86 (as part of the so-called Caracciolo reforms).

Such cadastres may not have been prepared on a geometrical basis or involved direct on-site surveying; they may have failed to generate maps and depended too much on measurements declared by the property owners themselves. However, they did provide an important means for acquiring knowledge regarding territory and terrain. Admittedly, that knowledge was far from definitive, for it not only suffered from resistance to such projects by certain sections of society, it was also adversely affected by the technical requirements of surveying terrain and giving a geometrically based graphic rendering of the data acquired. Nevertheless, even when the land-surveying operations did not result in the creation of extensive maps—as they had in Lombardy and Savoyard Piedmont—the procedures indirectly generated a substantial amount of cartographic work, which is now to be found in local and national archives.

PAOLA PRESSENDA

SEE ALSO: Italian States; Marinoni, Johann Jakob; Property Mapping: Austrian Monarchy

BIBLIOGRAPHY

Alimento, Antonella. 2002. “Los catastros del siglo XVIII, entre tradición y modernidad.” *CT: Catastro* 46:17–26.

———. 2008. *Finanze e amministrazione: Un'inchiesta francese sui catasti nell'Italia del Settecento* (1763–1764). 2 vols. Florence: Leo S. Olschki.

Bonazza, Marcello. 2005. “Catasto e conoscenza del territorio: Innovazioni tecnologiche e scelte di governo nell'esperienza del teresiano trentino-tirolese.” In *Le radici dell'autonomia: Conoscenza del territorio e intervento pubblico in Trentino secc. XVIII–XX*, ed. Luigi Blanco, 25–50. Milan: FrancoAngeli.

Le cadastre sarde de 1730 en Savoie. 1980. Chambéry: Musée Savoyisien.

Capra, Carlo. 2002. “El nuevo censo del Estado de Milán.” *CT: Catastro* 46:37–46.

Contini, Alessandra, and Francesco Martelli. 2007. “Catasto, fiscalità e lotta politica nella Toscana nel XVIII secolo.” *Annali di Storia di Firenze* 2:151–83.

Guarducci, Anna. 2009. *L'utopia del catasto nella Toscana di Pietro Leopoldo: La questione dell'estimo geometrico-particellare nella seconda metà del Settecento*. Florence: All'Insegna del Giglio.

Guichonnet, Paul. 1955. "Le cadastre savoyard de 1738 et son utilisation pour les recherches d'histoire et de géographie sociales." *Revue de Géographie Alpine* 43:255–98.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Mannori, Luca, ed. 2001. *Kataster und moderner Staat in Italien, Spanien und Frankreich (18. Jh.) = Cadastre et état moderne en Italie, Espagne, et France (18e s.) = Cadastre and Modern State in Italy, Spain and France (18th c.)*. Baden-Baden: Nomos.

Palmucci, Laura. 2002. "La formazione del cartografo nello stato assoluto: I cartografi-agrimensori." In *Rappresentare uno stato: Carte e cartografi degli stati sabaudi dal XVI al XVIII secolo*, ed. Rinaldo Comba and Paola Sereno, 1:49–60. Turin: Allemandi.

Ricci, Isabella, and Marco Carassi. 1980. "I catasti piemontesi del XVIII e XIX secolo da strumento di politica fiscale a documento per la conoscenza del territorio." In *Cultura figurativa e architettonica negli Stati del Re di Sardegna, 1773–1861*, ed. Enrico Castelnuovo and Marco Rosci, 3 vols., 3:1189–221. Turin: Palazzo Reale.

Sereno, Paola. 1981. "Paesaggio agrario, agrimensura e geometrizzazione dello spazio: La Perequazione Generale del Piemonte e la formazione del 'Catasto Antico.'" In *Fonti per lo studio del paesaggio agrario: Atti del 3. Convegno di Storia Urbanistica, Lucca, 3–5 Ottobre, 1979*, ed. Roberta Martinelli and Lucia Nuti, 284–96. Lucca: Ciscu.

———. 2002a. "'Far riconoscer per misura giudiciale': La formazione dei cabrei e delle mappe cabreistiche." In *Il libro delle mappe dell'Arcidiacono Riperti: Un cabreo astigiano del Settecento*, ed. Paola Sereno, 19–41. Asti: Provincia di Asti.

———. 2002b. "Rappresentazioni della proprietà fondiaria: I cabrei e la cartografia cabreistica." In *Rappresentare uno stato: Carte e cartografi degli stati sabaudi dal XVI al XVIII secolo*, 2 vols., ed. Rinaldo Comba and Paola Sereno, 1:143–61. Turin: Allemandi.

Touzery, Mireille, ed. 2007. *De l'estime au cadastre en Europe, l'époque moderne*. Paris: Comité pour l'Histoire Économique et Financière de la France.

Zangheri, Renato. 1980. *Catasti e storia della proprietà terriera*. Turin: Einaudi.

Zaninelli, Sergio. 1963. *Il nuovo censo dello stato di Milano dall'editto del 1718 al 1733*. Milan: Vita e Pensiero.

Property Mapping in the Netherlands. In the Low Countries, property maps are regularly referred to as "precadastral maps." This indicates that these maps were made before the introduction of the national cadastre, established in the Netherlands in 1832. However, property maps were regularly produced earlier (Koeman and Van Egmond 2007, 1253–56). Property administration (including legal conflicts, border issues, and water management) presented some of the earliest occasions for map use in the Netherlands. Polder authorities, which had employed surveyors since late medieval times, were well aware of the usefulness of surveying and mapping (Kain and Baigent 1992, 18). Mapping for property purposes grew in the middle of the sixteenth century and soon became a common practice. In general, two types of property maps in the Netherlands are distinguishable. First, there were maps that indicated the landed property of a single landowner. Usually, these properties consisted of scattered plots of land. Second, there were property maps of complete administrative jurisdictions. In type and function this second group corresponded most closely to the later cadastral maps (Donkersloot-de Vrij 1981, 38). Terms for these subtypes of property maps are (private) estate maps and cadastral maps, respectively (Delano-Smith and Kain 1999, 112–13). For both types, but more often for the scattered properties of individual landowners, *kaartboeken* (map books or estate atlases) were compiled, usually with registers for land accounting and administration of the properties (Koeman and Van Egmond 2007, 1255).

Based on the type of landowner, estate maps in the Netherlands can be characterized as either institutional or private. Landowning institutions, such as abbeys, monasteries, chapters, churches, hospitals, and orphanages, often had an ecclesiastical foundation. However, it should be noted that most estate maps in the Northern Netherlands were drawn after the confiscation of Roman Catholic properties in the 1570s and 1580s. In general, the nonmonastic churches kept their properties for the upkeep of church functions and the relief of poverty. After the dissolution of the monasteries, ownership shifted to provincial governments, with income from the properties being used to finance relief for the poor, health care, and other public facilities (Kain and Baigent 1992, 25). The new owners demanded mapped surveys of the landed properties. For example, in 1581 the States of Holland decided to use former abbey properties (largely plots of land) for the maintenance of the newly established university in Leiden. Most of the estate maps of these properties were made shortly after they became available for the university and later when plots of land were about to be sold. In this case, the comprehensive atlas of the properties functioned as a kind of auction catalog. Elsewhere, most clearly in both the province and city of Groningen, local and regional governments managed the former ecclesiastical properties more directly. While the government took over tithes of the monasteries, tithe maps did not always have a cadastral character, and sometimes only the outlines of *tiendblokken* (tithe blocks) were indicated on these maps.

Estate maps of private properties were commissioned by the nobility, regents, and merchants. There are several noble estate atlases of the eastern part of the province of Gelderland. One of the most striking examples is the estate atlas of Middachten Castle, produced by Barend Elshof in 1729 (fig. 679). Another more recent development was the mapping of farmsteads for business planning. A large number of farm map books from the eighteenth and nineteenth centuries have survived, especially in the province of Zeeland, with the oldest

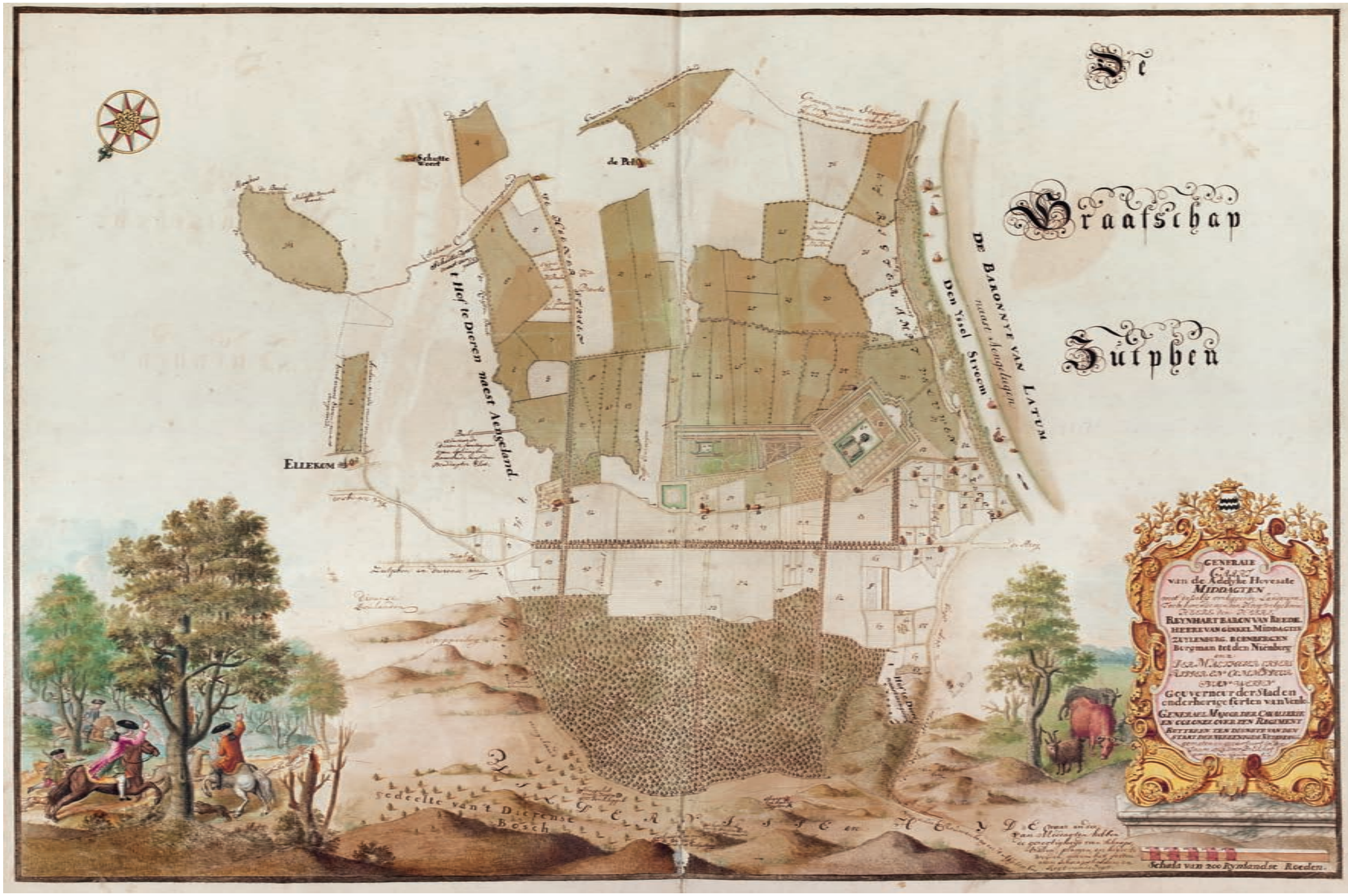

FIG. 679. BAREND ELSHOF, "GENERALE CAART VAN DE ADELYKE HOVESATE MIDDAGTEN," 1729. Pen drawing and watercolor on paper, ca. 1:5,700. The overview map in the estate atlas of Middachten Castle; there are eight individual maps devoted to separate parcels. Size of the original: ca. 63 × 93 cm. Image courtesy of the Archives of Estate Middachten, De Steeg.

known example dating to 1765 (De Klerk and Storms 2004).

In contrast to the Northern Netherlands, the growth of estate map production in the Catholic Southern Netherlands took place a century later, in the middle of the seventeenth century. An important impetus for the mapping of ecclesiastical properties was the reorganization of the Premonstratensian or Norbertine order. In 1644, all Norbertine abbeys in Brabant were advised by Rome to survey and map their landed properties. Subsequently, a great number of abbeys, monasteries, and other institutions commissioned surveyors to make maps and atlases of their properties (Vanhove 1986, 122–23).

The most detailed surveys by *waterschappen* (water management boards), polder authorities, and local governments, although made primarily for other purposes, could also serve as cadastral maps. Most of these remained in manuscript, but cadastral maps were occasionally printed for larger *waterschappen* and polders. Maps of newly established polders and areas of land reclamation (*droogmakerijen*) were used for the planning, allocation, and selling of plots of land (Kain and Baigent 1992, 19–20). Good examples include the map books of the cultivated lands of Sappemeer (1680–1732) by Jannes Tideman and of Pekela (1702) by Jannes's son Arnoldus Tideman. Auction or allocation maps were also produced for urban expansion, especially in the cities in the county of Holland. The city that grew the fastest produced the most maps: between 1568 and 1769 over three hundred map sheets of the expansion plans of Amsterdam have survived (Hameleers and Schmitz 1996, 45–47).

Some *waterschappen* compiled cadastral overview maps of their territory in which every single plot of land was indicated. In these cases, the maps functioned for land tax administration. Landowners had to pay taxes to the polder boards for dike maintenance and other water management purposes. The larger multisheet wall maps, embellished with coats of arms, allegorical decorations, and sometimes even poems, had the rhetorical function to express the power and status of the polder authorities (Kain and Baigent 1992, 12). Between 1695 and 1701, surveyor Heyman van Dijck compiled a series of maps of all the polders within the *waterschap* of Voorne. This led to the publication of the *Voorne: Caart-boeck* in 1701, the only printed precadastral property atlas in the Low Countries (see fig. 772). Universiteitsbibliotheek Leiden owns a unique copy of this atlas, in which proofs of all the maps, corrected by the responsible polder secretaries, are bound together. All the indicated alterations were corrected on the copperplates before publication (Storms 2007). Usually printed *waterschap* or polder maps were reissued several times over long periods. A good example is the polder map of Eemland by Dirk Brekensz. van Groenouw that was first published in 1666 (fig. 680). Six editions of this map were published until 1824, although only the representative coats of arms of the board members were updated (Hameleers 2011, 119–21).

The administration and eventual mapping of immovable property differed from place to place (Kain and Baigent 1992, 29). Especially in Flanders, Zeeland, and the western parts of Brabant, textual *landboeken* (land books) had been compiled since the late Middle Ages. Later it became common to add maps to these written cadastral accounts. These kinds of cadastral registers are known by various names: the term *landbook* is commonly used in Flanders, other local terms are *ommeloper*, *overloper*, and *everingboek* in Zeeland, and *cijnsregister* in Brabant. *Landboeken* generally consist of a series of *hoekkaarten* or *wijkkaarten* (district maps) in a logical geographical order. After each district map the registers listed cadastral information about the plots of land in tabular form. Sometimes these *landboeken* contained a general overview map of the whole jurisdiction. Often these overview maps were separate from the book. The most extensive precadastres within the Netherlands are the overview maps and registers with *hoekkaarten* of the seignories in the margraviate of Bergen op Zoom, surveyed by Henri Adan and his son Johannes Baptiste Adan in the second half of the eighteenth century (Storms 2008, 48–53) (fig. 681). Henri's brother Petrus Josephus Adan was the first generation of the Adan family who worked for the marquis of Bergen op Zoom. He produced a general map and a *landboek* of the barony of IJsselstein in 1740. A document of specifications and conditions of this survey has survived in which client and surveyor agreed in detail how the barony should be mapped (Storms 2008, 68–69, 80–81). In the Prussian Duchy of Cleves, an even more extensive survey was carried out between 1731 and 1738. This Cleves cadastre includes some places that are now part of the Netherlands, for instance Gennep, Huissen, and Zevenaar.

For centuries, land administration to enable taxation was organized on the provincial, regional, and urban levels. In general, these early cadastres were based on estimation, not on surveying. The first attempt toward a systematic cadastre was taken by the Council of States of the Netherlands in the Meijerij van 's-Hertogenbosch in 1791. In 1795, a year after this survey was finished, the French occupied the Netherlands and the survey remained unused (Kain and Baigent 1992, 32). During this period a systematic general survey and mapping of all plots of land was started. This Hollandse cadastre led to a series of

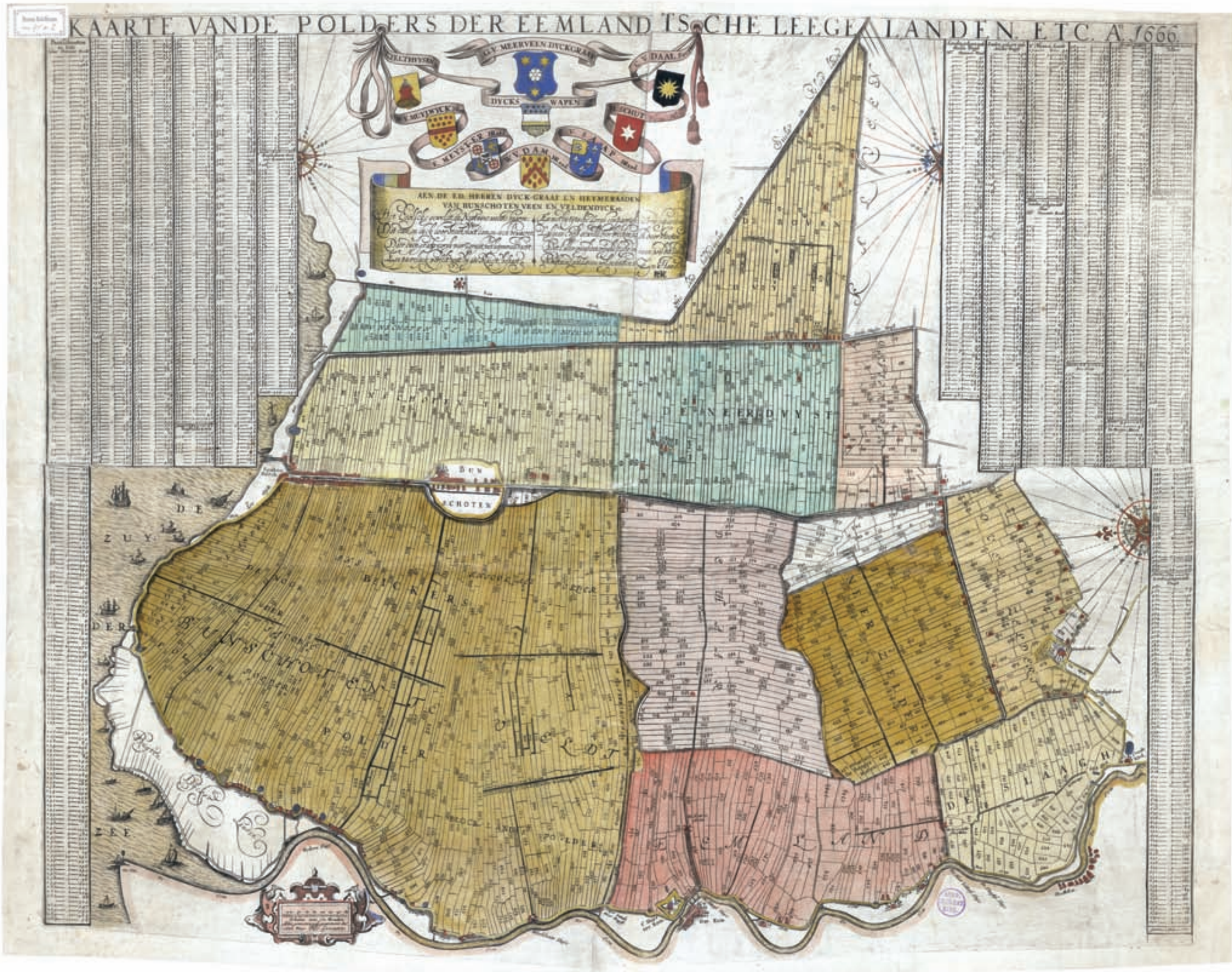

FIG. 680. DIRK BREKENSZ. VAN GROENOUW, *KAARTE VANDE POLDERS DER EEMLANDTSCHE LEEGE LANDEN*, 1666. Engraving, colored, ca. 1:12,000. Each parcel is numbered and keyed to the table, which gives the area in square rods and *dammets* (from *dagmaat*, or "day measure," the amount of land that could be mowed in a day).
Size of the original: 80 × 96 cm. Image courtesy of the Universiteitsbibliotheek Leiden (COLLBN Port 41 N 2).

maatboeken (measurement books), *aanwijzende tafels* (allotment tables), and *verpondingskaarten* (cadastral maps). Because the French disapproved of the results, work was stopped until 1811 when surveys were begun that would lead to the establishment of the national cadastre in 1832 (Keverling Buisman and Muller 1979, 9). In the Southern Netherlands, a uniform cadastre was completed in 1835, in Luxembourg in 1843, and in the Duchy of Limburg in 1844 (Kain and Baigent 1992, 38, 44).

MARTIJN STORMS

SEE ALSO: Netherlands, Republic of the United; Netherlands, Southern; Taxation and Cartography

BIBLIOGRAPHY

Delano-Smith, Catherine, and Roger J. P. Kain. 1999. *English Maps: A History*. London: British Library.

Donkersloot-de Vrij, Marijke. 1981. *Topografische kaarten van Nederland vóór 1750: Handgetekende en gedrukte kaarten, aanwezig in de Nederlandse rijksarchieven*. Groningen: Wolters-Noordhoff; Bouma's Boekhuis.

Hameleers, Marc. 2011. "De *Kaarte van de Polders der Eemlandtsche Leege Landen etc*. van Dirk Brekensz. van Groenouw: De populairste polderkaart van Eemland, 1666–1824." *Flehite: Historisch Jaarboek voor Amersfoort en Omstreken* 12:114–127.

Hameleers, Marc, and Erik Schmitz. 1996. "Amsterdamse uitgiftekaarten, 1586–1769: Basis van de stedelijke verkaveling." *Jaarboek van het genootshap Amstelodamum* 88:45–64.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in* *the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Keverling Buisman, F., and E. Muller. 1979. "*Kadaster-gids": Gids voor de raadpleging van hypothecaire en kadastrale archieven uit de 19e en de eerste helft van de 20e eeuw*. The Hague: Rijksarchiefdienst.

Klerk, Aad de, and Martijn Storms. 2004. "Zeeuwse bedrijfskaartboekjes in particulier bezit: Een vergeten vorm van cultureel erfgoed." *Caert-Thresoor* 23:29–35.

Koeman, Cornelis, and Marco van Egmond. 2007. "Surveying and Official Mapping in the Low Countries, 1500–ca. 1670." In *HC* 3: 1246–95.

Storms, Martijn. 2007. "Het aangeraakte kaartboek: De geannoteerde drukproef van het kaartboek van Voorne." In *Aangeraakt: Boeken in contact met hun lezers*, ed. Kasper van Ommen, Arnoud Vrolijk, and Geert Warnar, 135–41. Leiden: Scaliger Instituut; Universiteitsbibliotheek Leiden.

———. 2008. *Drie generaties Adan: West-Brabantse landmeters in de 18e en 19e eeuw*. 't Goy-Houten: HES & De Graaf.

Vanhove, Luk. 1986. "De kaartboeken van de Abdij van Park-Heverlee." In *Oude kaarten en plattegronden: Bronnen voor de historische geografie van de Zuidelijke Nederlanden (16de–18de eeuw), Handelingen van de studiedag 20 sept. 1985 = Cartes et plans anciens: Sources pour la géographie historique des Pay-Bays méridionaux (XVIe–XVIIIe siècles), Actes de la journée d'étude du 20 sept. 1985*, ed. H. van der Haegen, F. Daelemans, and E. van Ermen, 121–61. Brussels: Archives et Bibliothèques de Belgique; Archief- en Bibliotheekwezen in België.

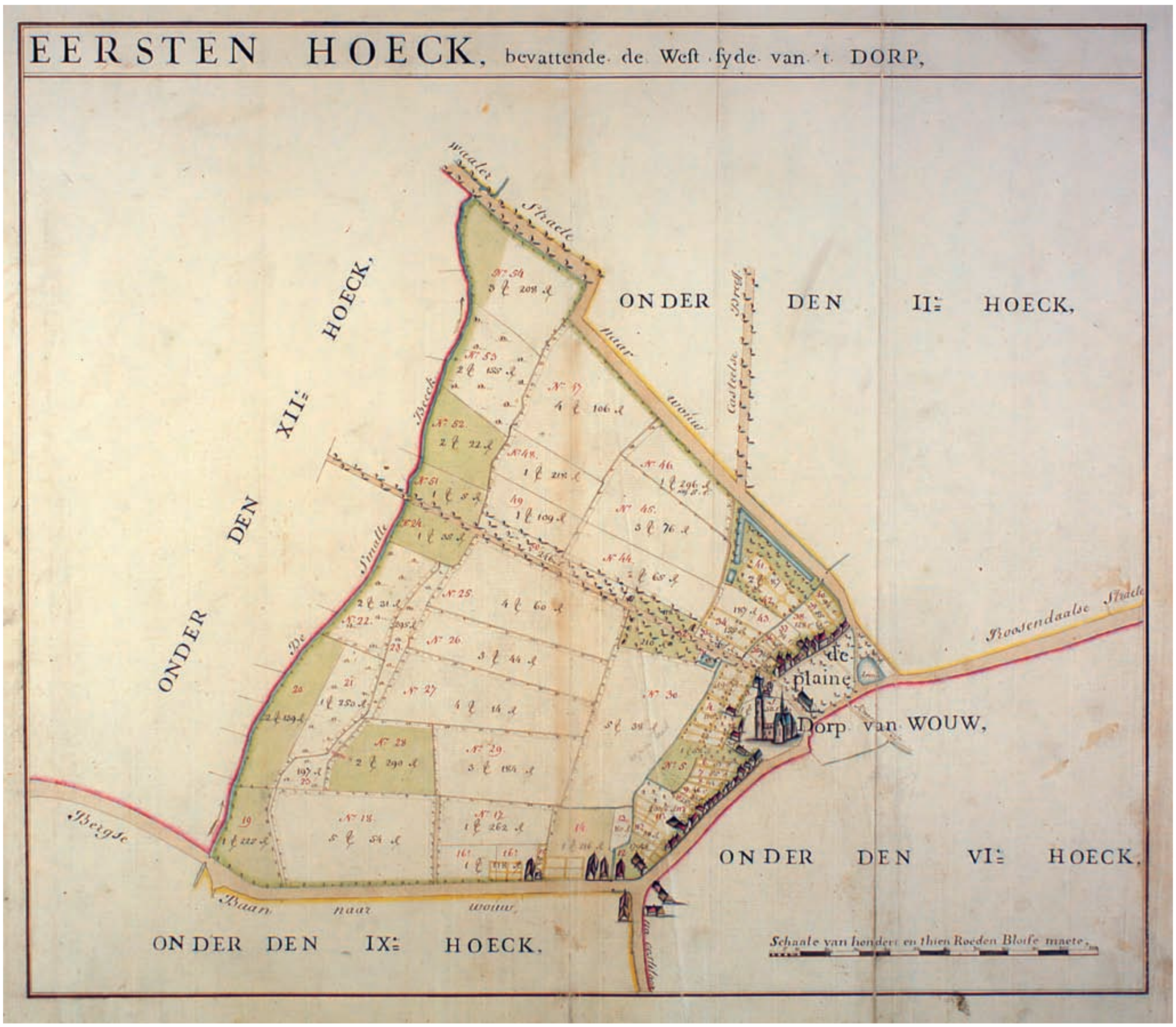

FIG. 681. JOHANNES BAPTISTE ADAN, "EERSTEN HOECK, BEVATTENDE DE WEST SYDE VAN 'T DORP [WOUW]," 1783–84. Manuscript on paper, ink and watercolor, ca. 1:2,600. Henri Adan, his son Johannes Baptiste, and grandson Henricus all lived in the village of Wouw, east of the town of Bergen op Zoom.
Size of original 48.0 × 57.5 cm. Image courtesy of West-Brabants Archief, Oudenbosch (nr. 1063).

Property Mapping in the Ottoman Empire. As a rule derived from the bureaucratic and centralized structure of the Ottoman Empire, all the lands available for cultivation were in the possession of the state. Although this property concept was grounded in Islamic principles, it represented a very Ottoman practice. To administer state lands, the Ottoman government used the *timār* system that assigned certain state revenues to individuals in exchange for military and administrative services. In fact, all the lands in the empire were divided into four groups. First was the *mīrī arāżī*, in which the *proprietas nuda* (simple property, i.e., title alone) belonged to the state, but the right of possession was given to individuals under certain conditions, and they were not allowed to transfer the lands to other persons. The Ottoman administration sought to maintain this category as the standard. Such land could, however, be rented to a farmer, a practice known as *ṭāpū*, and could be inherited by his descendants on the condition that cultivation of the land would never cease, that all taxes would be paid, and the attendant obligations would be completely fulfilled. In the seventeenth and eighteenth centuries, the *ṭāpū* turned into hereditary tenancy. Furthermore, the *muḳāṭaʿalı arāżī* (which ensured the use of land in conformity with a tenancy contract) and places such as pastures, forests, and threshing fields that were reserved for common use also fell into the *mīrī arāżī* category. The second category of land that prevailed in the empire was the *mülk arāżī*: lands acquired by a royal grant, by reclamation of waste land, or by a legal sales contract. The *vaḳıf arāżī* was the third category and comprised the lands converted into endowed charities from private properties. The last category was the *mevāt arāżī*, which encompassed all the vacant and unclaimed areas such as waste lands, untouched forests, deserts, and marshlands.

The political entities that preceded the Ottoman Empire performed population and land surveys in the same geographical region. For Ottoman bureaucracy, the main purpose of property surveying was to determine the amount of all possible sources of revenue in a given region. The results of land surveys were recorded in registers called *taḥrīr defteri*s (*ḳuyūd-ı ḫāḳānī* or *defter-i ḫāḳānī*) that had to be, at least in principle, renewed every thirty to forty years. Among these registers, the detailed cadastral survey registers (*mufaṣṣal taḥrīr defteri*) recorded statistical data related to, in geographical sequence, the wards and surrounding villages of the central town and other settlements of the region. These registers also classified and labeled population groups according to their tax liabilities.

The principal concern of the Ottoman Empire, as for all preindustrial economies, was to maintain strict control over agricultural lands and to assure continuous agrarian production. To achieve this goal, the Ottoman administration organized rural society with what is now known as the *çift-ḫāne* system, the peasant family farm. Except for the military class and persons assigned to formal tasks by the central government, all subjects who were under tax obligations, whether Muslim or non-Muslim, were defined as *reʿāyā* (sing. *raʿıyye*). The *çift-ḫāne* system required that agricultural lands be divided into single-peasant farm units, ensuring the cultivation of land by the peasant household. In this type of production, the taxes collected from the peasants in kind were handed over to the cavalry units, *timārlı sipāhī*, which assumed administrative duties in rural areas.

Land surveys were accomplished on behalf of the imperial council, the *Dīvān-ı hümāyūn*. The central government appointed a qualified surveyor (*taḥrīr emīni*) with a reputation of being just and honest, who was chosen from the members of military class (*ʿaskerī*) or *ʿulemā*. The surveyor held a special diploma (*nişān*) that ordered the local officials and scribes to assist him in his task. The surveyor investigated all the settlements in the region one by one and recorded the pastures, shelters, meadows, wood lots, and forests in the register. He also put down in the register the estimated amount of annual tax to be paid for agricultural products like wheat and barley. The registers containing the results of the surveys were then considered as the main books on the status of state lands. The entries in the registers could also be given to relevant persons in the form of single documents (*tezkire* and *berāt*). Although regions were of different sizes, the surveying of any given region could be completed in approximately one year.

Taḥrīr registers fixed the legal status of land and people and determined tax liabilities that were regarded as valid until the completion of a subsequent survey. The same practice was applied in the case of *vaḳıf* lands (*evḳāf taḥrīr defteri*). Since the demise of the ruling sultan revoked all kinds of documents issued by his government, it was expected that land surveys would follow the accession of each sultan to the throne. But examples reveal that necessity determined the moment for the central administration to undertake a land survey.

Ottoman land surveys cannot be thought of as cadastral surveys in the modern sense. Rather, they very much resemble the Domesday books in Britain and, by the same token, do not include maps indicating exact locations. Ottoman surveying practice was functional and focused on particular and immediate goals; the administration ruled out an entirely systematic cadastral survey, which was indeed impracticable for the era given the technological constraints. On the contrary, the Ottoman administration sought to calculate the number of peasant households that controlled single or partial farm units. In this way it was possible to estimate roughly quantities of land and population and the consequent tax revenues. The surviving survey registers from the Ottoman period encompass the core areas of the empire, i.e., the Balkans, Asia Minor, and the islands in the eastern Mediterranean; Hungary, Slovakia, and Podolia in the northwest; Georgia and Tabrīz in the east; Syria, Palestine, and Iraq in the south. There were some exceptions where no surveying could be done because of the compromises between the central administration and the large tribes that settled in those regions. In addition to survey registers (*mufaṣṣal* [detailed] or *icmāl/mücmel* [summary]), it is possible to find direct or indirect spatial data related to Ottoman lands preserved in some other register types. Among these are the *piyāde taḥrīr* registers including the land measures of farm units and *rūznāmçe* registers containing the imperial orders that conducted the granting—*timār*s and *ze'āmet*s. For the sixteenth century, the Ottoman survey registers constitute an almost full series; in later centuries, the Ottoman administration undertook land surveys only for Crete and Kamianets-Podilskyi, which had been conquered in the seventeenth century, and for Morea and Tabrīz, after they had been reincorporated in the early eighteenth century. It is apparent that the figures in the eighteenth-century registers were copied from those registers completed in the sixteenth century for the same regions. The entire body of the cadastral survey registers is now housed in the Başbakanlık Osmanlı Arşivi, Istanbul, and the Tapu ve Kadastro Genel Müdürlüğü Arşivleri, Ankara.

Ottoman survey registers recorded, as a basic principle, the *ṣancāḳ* (administrative district); this core area formed the main component for the register and reflected the principal administrative partition within the empire. According to the prevailing established custom of keeping the survey register, the *mezraʿa* (arable field; a field under cultivation but with no permanent settlement), farm, summer pasture, winter pasture, and *ḳom* (inn) were bound to a village (*nāḥiye*), which represented the smallest administrative unit in this administrative theory. *Ṣancāḳ* comprised a couple of *ḳażā*s (subdistricts) coming together. In some survey registers, the boundaries of the villages were recorded by their relationship to some natural features such as mountains, hills, and rivers.

On the basis of the crop tax revenues and land denomination recorded in the detailed survey registers, it is possible to draw some conclusions about the size of land plots and the methods of measuring them. In determining how much land was available for cultivation, the Ottoman administration used traditional surveying and calculation practices. In the main, the lands cultivated by peasant families were divided into three categories: *çift*, *nīm-çift* (half *çift*) and *zemīn* (smaller than a half *çift*). The *çift* designated the *çiftlik* (farm), a defined amount of land that could be plowed by a yoke of oxen. This rather imprecise method of measurement depended on the quality of the land; a farm unit was 60 to 80 *dönüms* (an area ca. 900 square miles) in highly fertile lands, 100 *dönüms* in average places, and 100 to 150 dönüms in those areas that were considered relatively unproductive. The *çiftlik* formed a family farm unit that was managed by peasant households. In survey books, the cultivated lands were followed by the records of other agricultural areas, for example, on which vineyards were established and hazel and walnut trees were planted. As was the case in fixing the tax amounts, the surveyor determined the amount of land available to cultivation on the basis of the conditions in the preceding three years. To modern minds the regional differences in measurement units still pose a great challenge for anyone who wants to estimate the actual amount and value of products.

When surveying a piece of land, the Ottoman surveyor used the pace as his basic measure of length. In land measurements, forty average square paces constituted a customary ʿörfī dönüm whereas forty square cubits equaled an Islamic şerʿī dönüm. Nevertheless, dönüm scales showed differences from one region to another; for instance, it was thirty-five square cubits in Istanbul. In modern terms, a standard dönüm corresponds to ca. 920 square meters.

The section of a grain field that could be plowed by a team of oxen in a single day was called evlek/evleg. When this measure was applied to vineyards and orchards, it represented an area of 0.25 dönüm, or ca. 255 square meters. A widely used unit of land measurement, the ziraʿ-i miʿmārī, was equivalent to ca. 0.57 square meters. Another unit of measurement, used for vineyards, paddies, and gardens, was the erlik, which demarcated a defined measure of land that could be cultivated by a single farmer. Numerically, it expressed an area of 2.5 dönüms or an amount of land that would be cultivated by 50 oḳḳa of rice seeds (1 oḳḳa = ca. 1.3 kg). Similarly, a müdlük was the amount of land that would receive one müd of seeds (ca. 513 kg); or one-sixth, one-ninth, or one-twelfth of a farm, depending upon the fertility of the soil. Yet, the cerīb used in land and field surveying equaled ca. 2800 square meters.

Although cultivated lands usually had fixed borders, the Ottoman administration sought to place landmarks in deserted and uncultivated areas only if a land dispute arose. By the same token, the Ottoman bureaucracy issued many documents involving the detailed boundary descriptions of *nāḥiye*s, *mezraʿa*s, and upland meadows that were in dispute and sometimes other papers that verified the actual borders. Thus, the boundary descriptions of villages and lands that fell within the boundaries of *vaḳıf* were notably recorded into survey books and deeds of trust. In some cases, it is obvious that the meadows, farms, and areas where the sultan gathered his hunting party were surrounded by border stones (*ʿalāmet ṭāşı*). However, elaborate and precise surveys were made for valuable grounds like vineyards or for cases in which there were serious disagreements on the actual status of the borders. In order to solve land disputes, the local *ḳāḍī* (judge) surveyed the area in question with a standard rope and issued a formal diploma that contained all the relevant details.

The fields, paddies, and orchards that lay in the vicinity of a town were mostly the private property of town inhabitants who at the same time worked the soil. Aside from the *dönüm*, the amount of land that was contained by these properties could be stated in terms of the quantity of seed, in this case a *kile/keyl* of seeds, which differed greatly from one region to the other. The regional differences in local *kile* sizes would cause difficulties in establishing the size of the land; this was also the case for the unit of *ırgadlık*, which marked a defined size of ground a laborer (*ırgad*) could work in a single day. Private lands situated in or around a town were described in relation to their physical surroundings and dwellings on all four sides. These kinds of descriptions, recorded in the court registers, rarely included the dimensions of land in *dönüms* as well.

The Celālī revolts of the seventeenth century created unstable conditions in the Ottoman countryside, followed by mass emigration of peasants to better-protected areas. By this time, in Anatolia, tens of thousands of peasants were on the move, seeking a place where they could benefit from tax immunity. However, in the seventeenth and eighteenth centuries, the impact of social instability also led to the establishment of large estates, particularly in western Anatolia, northern Greece, Bulgaria, and southern Serbia. For this reason, traditional cadastral surveying proved inefficient and was replaced by a system in which a fixed sum was collected by the person representing the state treasury. With the prominence of tax farming in the Ottoman Empire, the central administration shifted its attention from land tax to taxes per capita. Therefore, the data from the seventeenth and eighteenth centuries pertaining to surveying practices are almost entirely restricted to descriptions appearing on legal documents that confirm the transfer of rights of use or the sale of certain lands that had in time converted into private properties contrary to established Ottoman practice.

In 1777, the Ottoman government created a land regulation that modified the administrative status of *timārlı sipāhī*, who benefited from the tax revenues collected from the rural population. The Ottoman state then attempted for the last time to make an overall survey of the empire, and in 1791 it took additional measures to consolidate the contemporary system. Despite all efforts, however, the *timār* system and its closely associated land surveying practice collapsed, along with the inevitable decline of the cavalry within the military order. In 1847, with the foundation of the Ḫazīne-i ḫāṣṣa, Ottoman land administration began to rest on relatively modern principles, and the Ottoman central government continued to keep land and population survey registers, although in limited areas, until the collapse of the empire. At present, the *taḥrīr* records remain to serve as a source of prime importance in solving the land and boundary disputes both in Turkey and surrounding countries. They remain a written record of the land, expressed in words and numbers, without the addition of further graphic representation.

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

BIBLIOGRAPHY

Afyoncu, Erhan. 2003. "Türkiye'de Tahrir defterlerine dayalı olarak hazırlanmış çalışmalar hakkında bazı görüşler." *Türkiye Araştırmaları Literatür Dergisi* 1, no. 1:267–86.

Barkan, Ömer Lûtfi. 1940–41. "Türkiye'de İmparatorluk devirlerinin büyük nüfus ve arazi tahrirleri ve Hâkana mahsus istatistik defterleri (I)." *İstanbul Üniversitesi İktisat Fakültesi Mecmuası*, 2:20–59, 214–47.

Emecen, Feridun M. 1996. "Mufassaldan icmâle." *Osmanlı Araştırmaları = Journal of Ottoman Studies* 16:37–44.

Faroqhi, Suraiya N. 1994. *Osmanlı'da kentler ve kentliler: Kent mekanında ticaret, zanaat ve gıda üretimi, 1550–1650*. 2d ed. Trans. Neyyir Kalaycıoğlu. Esp. 297–325. Istanbul: Tarih Vakfı Yurt Yayınları.

Gümüşçü, Osman. 2006. *Tarihi coğrafya: Kavramlar-tarihçe-kaynaklar-mekan-metod*. Esp. 317–53. Istanbul: Yeditepe Yayınevi.

İnalcık, Halil. 2000. *Osmanlı İmparatorluğu'nun ekonomik ve sosyal tarihi*. Vol. 1 (1300–1600). Ed. Halil İnalcık and Donald Quataert. Trans. Halil Berktay. Esp. 175–84. Istanbul: Eren Yayıncılık.

İslamoğlu-İnan, Huricihan. 1991. *Osmanlı İmparatorluğu'nda devlet ve köylü*. Esp. 32–77. Istanbul: İletişim Yayınları.

Lowry, Heath W. 1992. "The Ottoman *Tahrîr Defterleri* as a Source for Social and Economic History: Pitfalls and Limitations." In *Studies in* Defterology*: Ottoman Society in the Fifteenth and Sixteenth Centuries*, 3–18. Istanbul: Isis Press.

Öz, Mehmet. 2000. "Tahrir defterlerindeki sayısal veriler." In *Osmanlı Devleti'nde bilgi ve istatistik = Data and Statistics in the Ottoman Empire*, ed. Halil İnalcık and Şevket Pamuk, 15–32. Ankara: T.C. Başbakanlık Devlet İstatistik Enstitüsü.

Özel, Oktay. 2000. "Avarız ve Cizye defterleri." In *Osmanlı Devleti'nde Bilgi ve İstatistik = Data and Statistics in the Ottoman Empire*, ed. Halil İnalcık and Şevket Pamuk, 33–50. Ankara: T.C. Başbakanlık Devlet İstatistik Enstitüsü.

Property Mapping in Poland. The origins of property mapping in Poland lie in the 1557 agrarian reforms of King Sigismund II Augustus. Up to the end of the seventeenth century, textual descriptions of lands, borders, and properties were more common than property maps. Textual descriptions were sometimes accompanied by primitive maps inspired by landscape painting, which used pictorial symbols drawn in horizontal perspective.

Most of them were still anonymous. Eventually property maps, with symbols drawn in plan, began to be required in judicial processes and, by the end of the eighteenth century, had superseded textual descriptions (Gołaski 1969, 102–17; Stoksik 2013, 28, 152–53). Such a situation needed qualified and registered surveyors.

In 1630, the Academia Rakowska published a textbook of surveying, *Institutionum mathematicarum libri II*, by Joachim Stegmann the Elder, a theologian, mathematician, and rector of the academy (Sawicki 1968, 160–61). In this book, Stegmann describes decimals and logarithms, following the work of John Napier and Johannes Kepler in their theories of geometry, and describes instruments such as the plane table and pantograph for the first time in the Polish-Lithuanian Commonwealth. At the Jagiellonian University, a chair in practical geometry was established in 1631 and conferred the title of *geometra przysięgły* (registered surveyor) until 1780. The first holder of the chair was the celebrated mathematician Jan Brożek, whose *Gæodesia distantiarvm sine instrumento, & polybii locvs obscv. geometricè explicatus* (1610) included practical examples of land measurements. Brożek was highly critical of some earlier surveyors in Poland, citing as an example "the stupidity of surveyors measuring the land in Podlachia [i.e., Podlasie] [who] dragged the measuring rope through holes drilled in house walls" (quoted in Sawicki 1968, 102).

Stanisław Solski, Jesuit, mathematician, architect, and chaplain to King Jan III Sobieski, published in Kraków the surveying textbook *Geometra Polski: To iest navka rysowania, podziałv, przemięniania, y rozmierzania liniy, angułow, figur, y brył pełnych* (1683) and dedicated it to the king, who had provided financial support (Sawicki 1968, 248–51). Solski chose to write his book in Polish in the hope that it would be possible to develop local talent instead of hiring expensive Dutch surveyors. In the section on practical geometry, he described the construction of surveying instruments to facilitate fabricating them in the country, such as a pedometer for distance measuring and a plane table. Using the plane table, he described the method of intersection and fixing the points of a triangulation grid (Sawicki 1968, 252–83).

At the Jagiellonian University, some ninety people were granted the title of registered surveyor, half of them between 1750 and 1780 (Stoksik 2013, 115–18, 122–24). One such was Jan Nepomucen Majewski, who became a registered surveyor in 1776, was granted the privilege of king's surveyor in 1777, and was made a captain in the army (Stoksik 2013, 183–85); he produced maps of a number of villages in the vicinity of Kraków (fig. 682). With the establishment of the commission on national education, Komisja Edukacji Narodowej, in 1773, the university underwent a thorough reform along Enlightenment lines under the leadership of Hugo Kołłątaj and became known as the Szkoła Główna Koronna (Stoksik 2013, 104–5). As such, it continued to grant surveyor's patents, forty-four of them between 1780 and 1804 (Stoksik 2013).

Large-scale topographic maps frequently included property borders. Such maps were made by most surveyors; two prominent examples are Józef Naronowicz-Naroński and Samuel Suchodolec. In 1658 the Sejm (parliament) voted through an edict obliging the adherents of the Minor Reformed Church of Poland (Ecclesias Minor) to convert to Roman Catholicism or face exile. As a result, the families of Naronowicz-Naroński and Suchodolec were exiled to the Duchy of Prussia. A student of Stegmann, Naronowicz-Naroński was a noted surveyor, having worked in that capacity since 1644 on the Radziwiłł estate in Biržai. There he surveyed and drew a number of large-scale (ca. 1:50,000 or ca. 1:100,000) maps (Szeliga 1997, 15–16). He used the skills and knowledge he gained to write *Księgi nauk matematycznych* (1654–59), of which the part dealing with surveying instruments for mapping has recently been reprinted (Naronowicz-Naroński 2002). In the Duchy of Prussia, Naronowicz-Naroński was engaged by the Elector of Brandenburg Friedrich Wilhelm and prepared geometric surveys and maps of Prussian *starostwa* (counties) at the scale 1:100,000 and *komornictwa* (communities) at the scale 1:50,000 (Szeliga 1997, 18–23).

The other exile, Samuel Suchodolec, spent the years 1683–1713 (after 1701 with the assistance of his son Jan Władysław Suchodolec) performing geometric surveying and cartography in the Duchy of Prussia. They completed fourteen topographic maps of *starostwa* and *komornictwa* in Upper Prussia, which were drawn on by Jan Władysław for his thirty-sheet manuscript map of Prussia at the scale 1:100,000, "XXIX, Vergrösserte Sectiones der General-Carte von dem Königreich-Preüssen wie daselbe in 4 folgende Districte abgetheilet als: Samland Natangen Oberland und Littauen" (1730; Berlin, Staatsbibliothek, Kart. N 9487/3). In 1744, Jan Władysław also wrote a book on the measuring units used in land surveying, published as *Gegründete Nachricht von denen indem Königreich Preussen befindlichen Lange- und Feld-maassen* (1772) (Szeliga 2004, 35–45, 101–4).

Throughout this period, serfdom was the rule in Poland, and almost all the land belonged either to the Crown, the church, or a relatively small number of noble families. This trifold distinction can be seen, for instance, in three maps made ca. 1760 by Franciszek Florian Czaki: a twelve-sheet manuscript map of the lower Vistula (1:180,000), a map of Volhynia (1:263,000), and a map of Spiš (1:167,000) (Strzelecki 2013, 28).

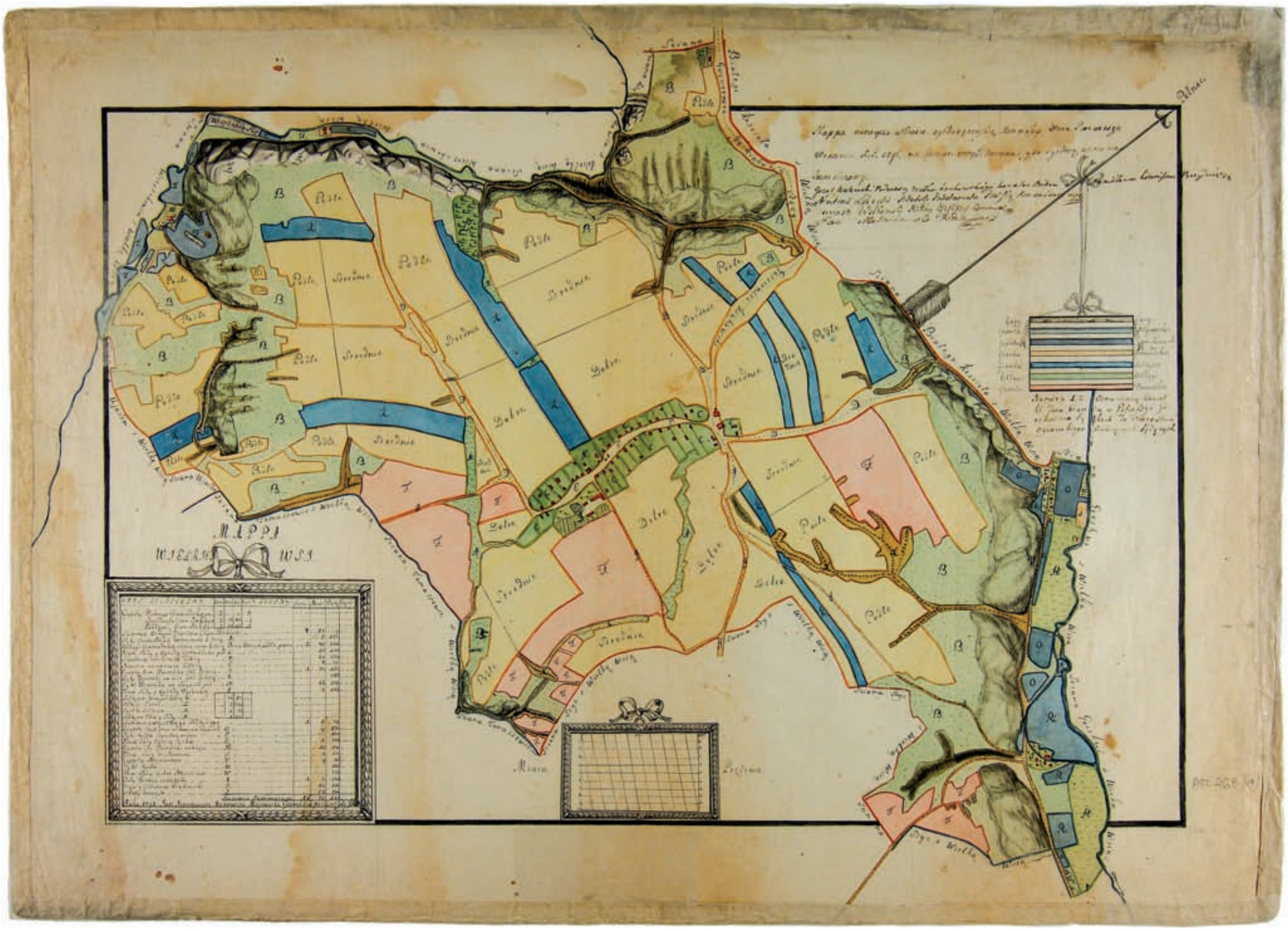

FIG. 682. JAN NEPOMUCEN MAJEWSKI, "MAPPA WIELKIEJ WSI," 1791. In this map of the village of Wielka Wieś, grey = mountains, hills; dark green = millers' lands; dark blue = disputed lands; yellow = villagers' lands; and pink = manorial lands. The villagers' lands are further classified as to quality—good, average, and poor. The table at lower left provides the areas of different parcels using the traditional Polish units: łan chełmiński, morga, and pręt kwadratowy. Manuscript, pen and watercolors on paper; ca. 1:6,000.
Size of the original: 43.0 × 64.5 cm. Image courtesy of the Archiwum Narodowe w Krakowie (ASZ 263).

The Volhynia map, a three-sheet map published anonymously by Georges-Louis Le Rouge in Paris in 1769 as part of his series *Cartes des troubles de l'est*, is the only survivor of number of maps of voivodeships that Czaki is known to have made. The fact that it distinguished Crown, church, and noble properties suggests that this may have been a standard feature of Czaki's voivodeship maps. Meanwhile, Czaki's map of the Warsaw area (1:70,000) shows field patterns.

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SEE ALSO: Poland

BIBLIOGRAPHY

Gołaski, Janusz. 1969. *Kształtowanie się mapy wsi w Polsce do końca XVIII w: Studia nad genezą wielkoskalowej informacji kartograficznej*. Wrocław: Zakład Narodowy Imienia Ossolińskich, Wydawnictwo Polskiej Akademii Nauk.

Naronowicz-Naroński, Józef. 2002. *Kartografia: O delineacyjach miejsc różnych i czynieniu map geographice*. Białystok: Ośrodek Badań Historii Wojskowej, Muzeum Wojska w Białymstoku.

Sawicki, Kazimierz. 1968. *Pięć wieków geodezji polskiej: Szkice historyczne od XV do XIX wieku*. 3d ed. Warsaw: Państwowe Przedsiębiorstwo Wydawnictw Kartograficznych.

Stoksik, Janina Mirosława. 2013. *Geometrzy małopolscy do końca XVIII wieku: Z dziejów geodezji i kartografii wielkoskalowej w Polsce*. Kraków: Archiwum Narodowe w Krakowie.

Strzelecki, Krzysztof. 2013. "18th Century Vistula River Geography in View of Franciszek Florian Czaki's Maps." *Quaestiones Geographicae* 32, no.1:27–32.

Szeliga, Jan. 1997. *Rękopiśmienne mapy Prus Książęcych Józefa Naronowicza-Narońskiego z drugiej połowy XVII wieku*. Warsaw: Biblioteka Narodowa.

———. 2004. *Działalność kartograficzna Samuela i Jana Władysława Suchodolców w Prusach w XVII i XVIII wieku*. Warsaw: Biblioteka Narodowa.

Property Mapping in Portugal. In eighteenth-century Portugal, detailed large-scale surveys of land and property emerged not from concerted policies but in response to specific problems on the local and regional levels and to the requirements for the management of local resources. Surveys for mineral and nonmineral exploration, inventories of agricultural land and resources, boundaries around hunting grounds, and projects to channel rivers in flat and fertile regions exemplify land-surveying activities in Portugal during this period (Dias and Instituto 2010). Most were conducted under the control of the central government, but some were ordered by companies such as the Companhia Geral da Agricultura das Vinhas do Alto Douro, established in 1756 by Sebastião José de Carvalho e Melo, marquês de Pombal, to protect Porto's wine. Most surveys were executed by military engineers, including some contracted from other countries such as José Auffdiener, a German national in the French army who came to Portugal in 1789 to work on the Douro roads.

Winter flooding and subsequent damage to the Tagus River's extended marginal plains required frequent and multiple interventions to the large, asymmetrical valley. The fertility of the nearby terrain as well as changes in the streambed and navigability of the river itself were serious issues. Around 1770, the central government ordered the survey of the Tagus Basin. English military engineer William Elsden, who had arrived in Portugal by 1760, surveyed the downstream segment of the basin (fig. 683). The *Mappa do Tejo desde a villa de Tancos ate a Villa Franca de Xira*, derived from Elsden's survey with corrections by Portuguese engineers in 1784–85, was included in the Academia Real das Sciências de Lisboa's *Memorias Economicas* (Cabral 1790).

Other hydraulic needs stimulated detailed land surveys, including several attempts to open the sandbar at Aveiro on the Atlantic coast. The southerly growth of a sand spit had pulled the city's sandbar south, impeding movement of water between the internal lagoon and the sea and putting economic interests and local health

FIG. 683. "MAPPA TOPOGRAFICO DE PARTE DO TEJO E SEUS CAMPOS COMPREHENDIDO ENTRE SANTAREM E VILLA NOVA DA RAINHA TIRADA NO ANNO DE 1770." This manuscript map, ca. 1:100,000, is part of a series of identical images of the Tagus River surveyed by William Elsden. It is probably a later copy because the interventions planned in 1784–85 by Isidoro Paulo Pereira and Manuel Caetano de Sousa are marked with letters that are explained in a known manuscript report.

Size of the original: 27 × 39 cm. Image courtesy of Portugal/Gabinete de Estudos Arqueológicos da Engenharia Militar/Direção de Infraestruturas do Exército, Lisbon (3526/III-3-31-43).

at risk. Various teams worked on this problem during the second half of the eighteenth century and produced numerous documents proposing resolutions to the problem (Mendes 1972–74; 1974). Some projects proposed a new sandbar; others encouraged the repair of the existing bar. Pombal assembled two teams, one of which included Frenchmen François Hiacinte de Polchet and Louis d'Alincourt, who created the "Carte particulière des environs d'Aveiro" (1759), which represented the region's resources in detail, including the position of the Aveiro sandbar. After the death of King José I and the downfall of Pombal, a new team under the direction of Elsden issued several maps and reports, but Elsden's death (ca. 1778) prevented their work from yielding lasting results. The Italian hydraulic engineer Giovanni Iseppi led a new team, but his release from service in 1781 and misunderstandings among team members only further delayed a solution to the problem. Finally, in 1808 an agreement for a new sandbar in front of the city resulted in a project led by Frenchman Reinaldo Oudinot and completed by his son-in-law Luís Gomes de Carvalho. The sandbar still stands in approximately the same position.

The exploitation of pine forests for economic purposes required several surveys. Pine trees planted to protect coastal sand dunes along a broad swath of the littoral in the center of Portugal lent their name to the area, commonly referred to as the Pinhal de Leiria. For the "Mappa dos pinhaes" (1769), Elsden directed the survey, which was performed by Maximiliano José da Serra, and ordered the delineation of the territories belonging to the king, to the University of Coimbra, and to the municipality of Leiria. In addition to locating various resources, such as a glass factory in Marinha Grande, a new factory for pitch, and a coal pit, the map provided textual explanations of the economy of the region.

In the 1770s, the southern coast of Portugal attracted several detailed surveying projects, including military surveys undertaken by José de Sande Vasconcelos, an engineer active in the Algarve during this period. His numerous surveys minutely detailed salt beds, uncultivated marshlands as well as cultivated terrain, and showed patterns of landownership (Brabo 2006).

Though numerous, these surveys were not carried out in an organized fashion; it was only at the end of the eighteenth century that such mapping projects were undertaken in a more concerted manner according to broadly accepted principles. The first cadastral survey was ordered in 1801, at which time each district (*comarca*) was called upon to name an astronomer responsible for executing a general small-scale map as well as other larger-scale maps of their regions (Sá 1801). Each map would show the configuration of the various properties, rural as well as urban, and include dimensions and boundary lines. But the measures suggested by this legal order—the earliest testament to a Portuguese cadastral survey—appear not to have been carried out; the geodetic work begun in 1790 was suspended in 1804, probably because of the political crises of the early nineteenth century.

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SEE ALSO: Portugal

BIBLIOGRAPHY

Brabo, F. A. D. 2006. "José de Sande Vasconcelos: Engenheiro militar e cartógrafo no Algarve nos finais do séc. XVIII." In *Manoel de Azevedo Fortes (1660–1749): Cartografia, cultura e urbanismo*, ed. Mário Gonçalvas Fernandes, 73–98. Porto: GEDES (Gabinete de Estudos de Desenvolvimento e Ordenamento do Território), Departamento de Geografia da Faculdade de Letras da Universidade do Porto.

Cabral, Estevão Dias. 1790. "Memoria sobre os damnos causados pelo Téjo nas suas ribanceiras." In *Memorias economicas da Academia Real das Sciencias de Lisboa, para o adiantamento da agricultura, das artes, e da industria em Portugal, e suas conquistas*, 2:155–97. Lisbon: Na Officina da Mesma Academia.

Dias, Maria Helena, and Instituto Geográfico do Exército. 2010. *Cursos e percursos para o mar oceano . . . : Intervenções nos rios portugueses e representações da cartografia militar*. Lisbon: Instituto Geográfico do Exército.

Mendes, H. Gabriel. 1972–74. "Cartografia e engenharia pombalinas da ria e barra de Aveiro." *Boletim do Arquivo Histórico Militar* 42:9–80, 43:7–143.

———. 1974. "Cartografia e engenharia da ria e barra de Aveiro no último quartel do século XVIII." *Arquivo do Distrito de Aveiro* 40:184–220, 241–70.

Sá, José Antonio de. 1801. *Instrucções geraes para se formar o cadastro, ou o mappa arithmetico-politico do Reino*. Lisbon: Regia Officina Typografica.

Property Mapping in Portuguese America. Over the course of the eighteenth century, several interrelated processes affected large-scale mapmaking in Portuguese America: massive population growth; migratory movement toward the interior, impelled in part by the discovery of gold and precious stones; and the need to define its boundaries with Spanish America, not to mention its own internal administrative and ecclesiastical divisions. A more solid cartographic basis was thus necessary in order to reconnoiter and control the rapidly expanding geographical space.

The creation of new towns and villages demanded urban planning. The exemplary Luís de Albuquerque de Melo Pereira e Cáceres, who governed the captaincy of Mato Grosso and Cuiabá at Brazil's western interior from 1772 to 1789, sought to promote the region's population growth and to consolidate the Crown's territorial aspirations in this region. Responsible for the creation, implementation, and expansion of various urban settlements, he requested that plans be prepared to define and organize each city's grid layout, buildings, and settlement pattern. The anonymous "Plano de Villa Bella da Santissima Trindade" (1789) (Garcia 2002, 174–75) shows the transformation and evolution of a single town from its foundation until the moment of the map's creation. The map points out future settlement activities by distinguishing between properties already built and those to be constructed. Wishing to control urban space, the Crown also began to request population maps that listed inhabitants based on their distribution by domicile. Though largely textual, these documents were frequently accompanied by maps. The census carried out in 1774 by the *intendente dos diamantes*, João da Rocha Dantas e Mendonça, exemplifies this. The documentation he sent to Portugal included a small album containing a plan of the valley of Tejuco in Minas Gerais that illustrated in detail the location of urban properties, profiles of buildings, and neighboring gardens (Costa et al. 2004, 126). The "Mapa da cidade Mariana" (ca. 1796–1801), a city from the same captaincy that was also the seat of the Mariana bishopric, demonstrates the varied forms of urban occupation. A rectilinear and uniform portion at the map's center represents an older settlement under greater administrative control, complete with large two-storied homes. The hills at the map's periphery reveal an urban settlement that is less ordered and somewhat irregular. The perspective plan of the city of Bahia, made by the military engineer Carlos Julião in 1779, shows the fortresses that protected the city and includes representations of the people who circulated in the city's streets (Reis Filho 2000, 39, 316).

But urban organization was not the only concern of the authorities. Along the roads and rivers that served as routes toward the continent's interior, plantations developed that served both as landmarks for travelers and as places of rest and replenishment. These plantations also provided crucial supplies for the local population. The concession of land grants (*sesmarias*) was the privilege of the monarchy and demanded planning. In the map of the upper Rio Claro basin (fig. 684), for instance, not only are the river and its tributaries shown, but also the village of Pitangueiras and local plantations (Garcia 2002, 238–39). The map of the captaincy of Bahia, showing the region between the Rio de S. Francisco, the Rio Verde Grande, and the Rio Gavião (ca. 1758) shows one section of the backcountry route (*caminho do sertão*) connecting Bahia to Minas Gerais, a route replete with meticulously displayed plantations. The map also shows "twelve places from which saltpeter was extracted," both an essential element for gunpowder and a key ingredient in the diet of cattle continually passing along this road (Costa 2005, 76).

In Portuguese America administrative written documents granted land in rural areas (*cartas de sesmarias*). These documents declared the size of the property (*sesmaria*) and its main borders, constituting verbal maps. In one example of this kind of document, from the Minas Gerais captaincy in 1718, Salvador Fernandes Furtado received three small farms along the Peixe River, bordered on one side by the Carmo River and on the other by Tomé Pereira's land. But usually the land was not properly measured or demarcated, unless there were disputes between neighbors. In such disputes, maps could be drawn by the landlords in order to prove their claim. Although this kind of conflict seems to have been very common, very few property maps produced in this context survived in local archives, such as in São João del Rei village. Two of these property maps were made in 1778 during a conflict between neighbors Inácio José de Alvarenga Peixoto and Gaspar Vaz da Cunha; Cunha accused Peixoto of enlarging his Boa Vista farm by taking Cunha's lands. Each map shows what the opponent believed his land rights were (Pinto 2014, 399–400).

The expulsion of the Jesuits in 1759 transferred management of indigenous populations to the Crown, requiring the establishment and supervision of new villages. The "Planta da povoação dos indios do lugar de Lamego, cita na vezinhança do Forte de Bragança, da capitania de Matto Grosso" (1769), created by José Matias de Oliveira, shows the rectangular structure destined for the new indigenous settlements (Garcia 2002, 195).

Mineral exploration also required large-scale maps, which would allow the distant observer to know, delimit, or dispel doubts about the ownership of productive lands. Shortly after the discovery of diamonds in Minas Gerais in 1734, for example, authorities decided to restrict the size of the so-called Diamond District (*Demarcação* or *Distrito Diamantina*). The first map demarcating the diamond-producing region is attributed to the military engineer Raphael Pires Pardinho, ca. 1734. A royal decree issued in 1770 by Sebastião José de Carvalho e Melo, marquês de Pombal, José I's minister plenipotentiary, gave the monarchy a monopoly over the trade in diamonds, which in turn stimulated the production of several detailed maps made by local authorities providing information about the exploitation of the mines (Costa et al. 2004, 208–15). Mato Grosso was another region that needed more detailed maps of its goldmines, as can be seen in the "Mapa q. comprehende varios rios com seus Letr.os e lavras de oiro com n.os" (ca. 1780s) (Garcia 2002, 310–11). The use of maps as tools to distribute and control goldmines can also be seen in the "Mapa de medição de oito légoas de terras que se medio a Domingos Francisco de Araujo" (1781) near the town of Vila Bela in Goiás (Garcia 2002, 448–49).

At the close of the eighteenth century, naturalists became involved in the search for natural resources in the name of the Portuguese Crown. The "Carta das Nitrateiras de Monte Rorigo" (1803) and the "Carta da Nova Lorena Diamantina" (1800), both showing locations in the captaincy of Minas Gerais, were produced by José

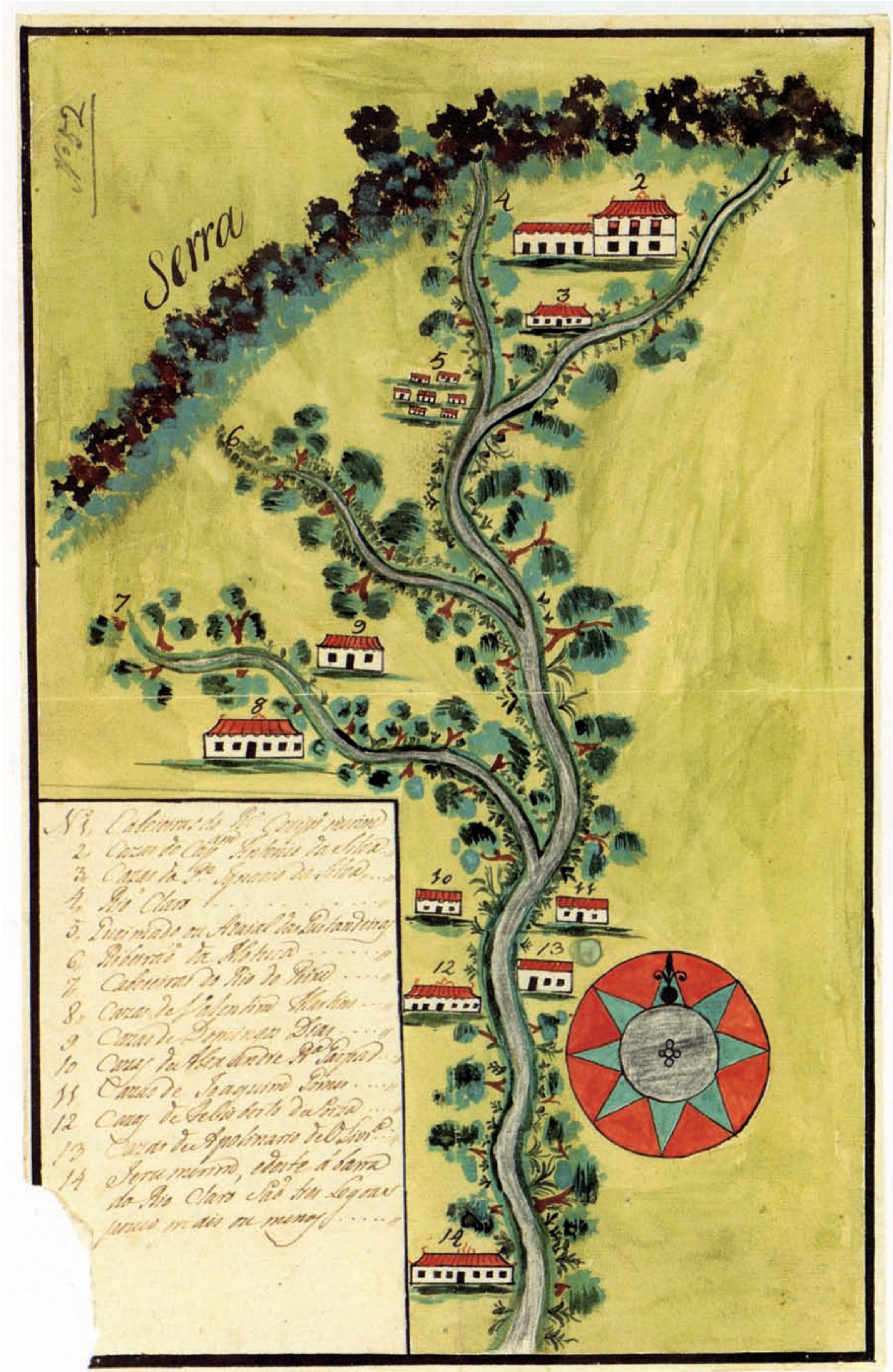

FIG. 684. BASIN OF THE UPPER RIO CLARO, 1755–99.
Size of the original: 34 × 22 cm. Permission courtesy of Vicente Olazabal Albuquerque, Luís de Albuquerque Collection.

Vieira Couto, corresponding member of the Academia das Ciências de Lisboa. They show the diversity of the captaincy's mineral wealth at precisely the moment when gold production began to decline precipitously (Costa et al. 2004, 78).

Jurisdictional disputes between captaincies, towns, bishoprics, and other administrative divisions, which increased with the movement of the population toward the interior, often required the production of maps. For example, the "Mappa de toda a extenção da campanha da Princesa" (1798–1800) was designed to clarify the extent of the bishopric of São Paulo, whose jurisdiction had exceeded the boundaries of its own captaincy and had started to spill over into the captaincy of Minas Gerais (Costa et al. 2004, 125). In addition, the appearance of a new town created innumerable disputes over the control of a territory that had changed jurisdiction. Occasionally, these disputes became so vicious that they required the intervention of metropolitan authorities. Such was the case in 1763, when Luís Diogo Lobo da Silva, then governor of Minas Gerais, resolved certain conflicts between Vila Rica, the seat of the captaincy, and the town of São João del Rei. The resulting map shows the route taken by the governor and proposes boundaries between the two towns based on the governor's travels (Costa et al. 2004, 77).

Large-scale maps also contributed to the repression of *quilombos* (secluded communities of fugitive slaves), as they aided many punitive expeditions. Maps were created to alert authorities about the structure of these greatly feared societies-in-hiding, such as the plan of "Buraco do Tatú" (Tatú's hole) (fig. 685), which shows a *quilombo* in Bahia (Reis Filho 2000, 54, 320); similar maps accompanied the 1765 anti-*quilombo* campaigns

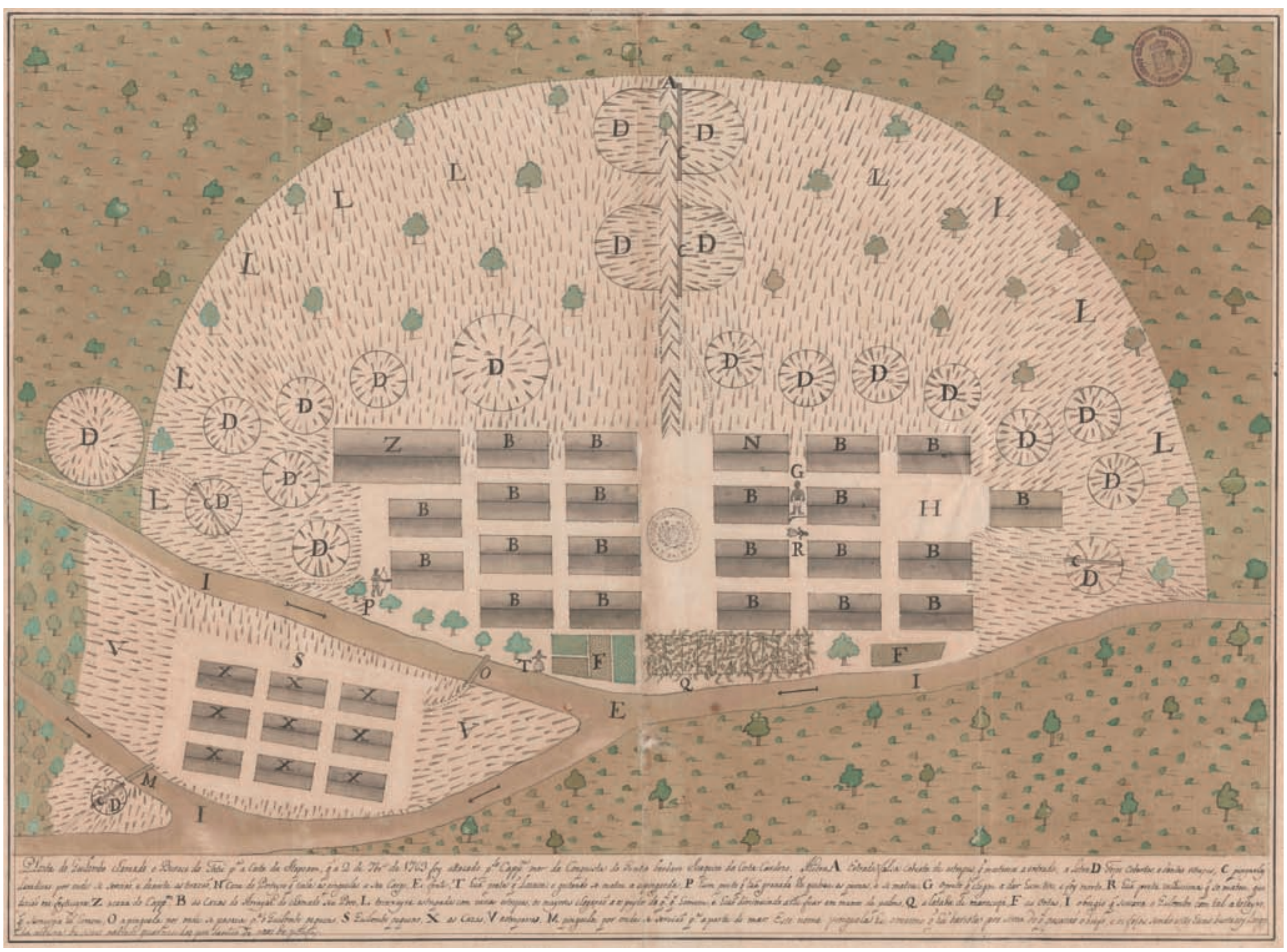

FIG. 685. "PLANTA DO QUILOMBO CHAMADO O BURACO DO TATÚ," CA. 1764. The fugitive slave settlement is shown after an attack in September 1763 by "Cappitam mor da conquista do Gentio Barbaro" Joaquim da Costa Cardozo. The manuscript plan, made from the military point of view, gives the impression of a well laid out and organized settlement.

Size of the original: 43.2 × 59.0 cm. Image courtesy of the Arquivo Histórico Ultramarino, Lisbon (AHU CARTm_005, D. 982).

of Captain Antônio Francisco França, who traveled through areas of Minas Gerais, São Paulo, Piauí, and Goiás (Costa et al. 2004, 62).

Coastal defense emerged as yet another theme in the large-scale cartography of this period. Many maps show the evolution of the fortress of Colonia del Sacramento, at Brazil's southern frontier in the eighteenth century, or Rio de Janeiro's Guanabara Bay. Largely because of French offenses against Rio de Janeiro in 1710 and 1711, a fortress was planned that would surround and protect the city, as is shown in Brigadier João Massé's map of 1714 (Reis Filho 2000, 165, 361).

JÚNIA FERREIRA FURTADO

SEE ALSO: Portuguese America

BIBLIOGRAPHY

Costa, Antônio Gilberto, ed. 2005. *Os caminhos do ouro e a Estrada Real*. Belo Horizonte: Editora UFMG; Lisbon: Kapa Editorial.

Costa, Antônio Gilberto, et al. 2004. *Cartografia da conquista do território das Minas*. Ed. Antônio Gilberto Costa. Belo Horizonte: Editora UFMG; Lisbon: Kapa Editorial.

Garcia, João Carlos, ed. 2001. *A Nova Lusitânia: Imagens cartográficas do Brasil nas colecções da Biblioteca Nacional (1700–1822): Catálogo*. Lisbon: Comissão Nacional para as Comemorações dos Descobrimentos Portugueses.

———, ed. 2002. *A mais dilatada vista do mundo: Inventário da colecção cartográfica da Casa da Ínsua*. Lisbon: Comissão Nacional para as Comemorações dos Descobrimentos Portugueses.

Pinto, Francisco Eduardo. 2014. *A hidra de sete bocas: Sesmeiros e posseiros em conflito no povoamento das Minas Gerais (1750–1822)*. Juiz de Fora: Editora UFJF.

Reis Filho, Nestor Goulart. 2000. *Imagens de vilas e cidades do Brasil colonial*. São Paulo: Editora da Universidade de São Paulo; Imprensa Oficial do Estado.

Property Mapping in Russia. The first attempt to conduct a general land survey in Russia was made in Ingria, which Peter I acquired from Sweden in 1702. Parcels in the region were soon distributed to the nobility, and in 1723 Peter I dispatched Major General Aldebert de Vacherie de Coulon and a team of surveyors to take measurements for "individual land maps." Coulon, accompanied by surveyors from the Admiralteystv kollegiya, remained in Ingria until 1726, but produced almost nothing. Only a few drawings, maps, and survey journals survive (German 1910, 153).

After Peter I's death in 1725, Empress Anna Ivanovna attempted a general land survey on a more extensive scale. In 1731, she ordered surveyors to all cities (except Astrakhan) starting with the Moscow *guberniya*. The surveyors were ordered to "make a land map for each estate" (Moscow, Rossiyskiy gosudarstvennyy arkhiv drevnikh aktov [RGADA], f. 248, op. 13, no. 746, l. 44–46). The plan proved more ambitious than the result. Efforts to write a surveying manual proved fruitless; nothing was published, and the draft version provided no specific guidelines for measurement. The failure of a national survey left local governments to conduct their own surveys as needs arose over the next two decades. Estate surveys in Ukraine (1731), along the Tsaritsyn Defense Line (1737), near the lands of the Bashkirs (1735, 1740), and in Novgorod (1740s–1750s) and Vyatka (1751) provinces followed.

Empress Elizabeth made another start on a general survey in 1754–61, the first real attempt to bring the work under centralized control. A special directive was issued on 13 May 1754 (old calendar) for survey departments and offices (*Instruktsiya kak pri razmezhevanii vo vsem gosudarstve zemel' mezhevshchikam i prochim, do kogo sie prinadlezhit, postupat'*, 1754), and an *ukaz* (decree) issued 5 February 1755 (old calendar) established the main survey department, Uchrezhdena glavnaya mezhevaya kantselariya (Ivanov 1843, 15). In 1757, Dmitriy Pavlovich Tsitsianov published a short mathematical exposition of land survey that essentially became the official manual and basic textbook for eighteenth-century surveyors (fig. 686).

Survey plans and maps were primarily legal documents whose main purpose was to affirm the gentry's right to the land and to the serfs working on it. This necessitated the standardization of survey methods and survey report formats, as emphasized by Tsitsianov. He stated the need for standard scales of 100, 200, and 400 sazhens per British inch (1:8,400, 1:16,800, and 1:33,600) for special, provincial, and regional plans and maps respectively (Tsitsianov 1757, 77). The procedure for compiling survey plans recommended by Tsitsianov became an integral part of all subsequent manuals and was used in until the mid-nineteenth century.

But not until Catherine II launched the General'noye mezhevaniye, or General Land Survey, in 1765 was any real progress made. And with the *Instruktsiya* (1766), the formal detailed procedures missing from the other attempts at a general survey were finally laid out. These instructions remained in force and went largely unchanged through the 1840s, making them some of the longest-lasting cartographic laws in Russian history.

Surveyors were told exactly what to record. Plans were to include the entire internal situation, i.e., various places of habitation, hamlets, villages, works, factories, and mills, land planted in gardens, plowed land, forests, haymows, rivers, creeks, hills, ravines, lakes, mosses, marshes, roads, and other objects occurring in nature, using such symbols as are ordinarily used and included in the standard plans, while these symbols should be illuminated in the customary colors, and the colors should be strong, clear, and firm. Although surveyors were typically expected to retain original toponyms, they were instructed to keep an eye out for landmarks with "indecent names, especially obscene names" (*Instruktsiya* 1766, 46), and rename these in their survey books and plans.

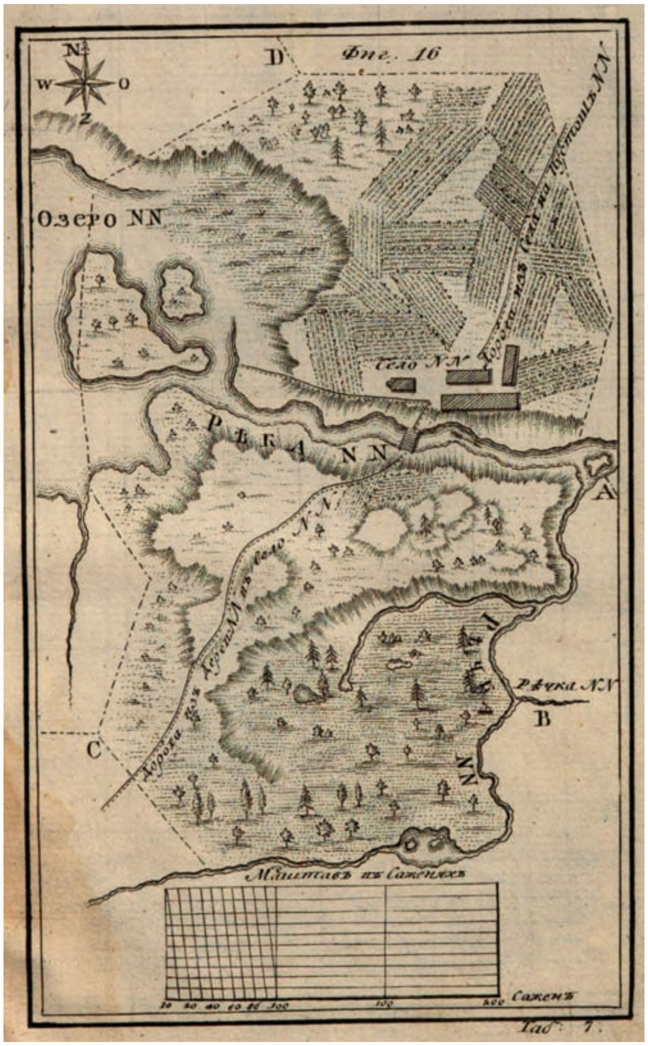

FIG. 686. DMITRIY PAVLOVICH TSITSIANOV, *KRATKOYE MATEMATICHESKOYE IZ"YASNENIYE ZEMLEMERIYA MEZHEVOGO* (ST. PETERSBURG, 1757), PL. 7. The illustration in this seminal printed survey manual shows local surveyors how to render different types of landscape. © The British Library Board, London.

The General'noye mezhevaniye of 1765, like general surveys elsewhere, had the effect of consolidating land in the hands of the nobility. But the specificity of Catherine II's instructions implied an additional purpose. Catherine II said she wanted the surveys done "for the purpose of obtaining necessary official information on all lands and their situations." Awareness of the natural terrain could prove useful to the Empire's economy and defense. The instructions to surveyors asked for not only description, but measurement. They were told to make careful measurements of such things as "forests with wood suitable for buildings" and marshes "that could be drained only with great difficulty" (*Nastavleniye* 1766, 46 para. 6). All of this information had potentially official import.

The surveyors used Tsitsianov's methods, and only in urban areas were they instructed to use a method of parallel traverses with the cityscape between them detailed by means of visual observations and intersections. Standard scales of one verst per inch (1:42,000) for district plans and 100 sazhens per inch (1:8,400) for special plans of individual estates (*Instruktsiya* 1766, 47) were required for mapmaking. Land surveyors were issued standards for map symbols and for plan and chart making in the form of "sample plans." They were given three sample plans for the hypothetical city of Krasny and its district. The first plan illustrated the actions to be taken by the surveyors, the second was the plan of an estate on a scale of one hundred sazhens per inch, and the third was a district map on a scale of one verst per inch. In 1768, instructions were issued to make district maps on scales of two to four versts per inch, and a map of Moscow *uyezd* produced in three copies by Engineer Major Pëtr Abrosimovich Gorikhvostov was adopted as the model for these maps (Goldenberg 1959, 324).

Catherine II's large-scale efforts required a streamlined organizational structure. She established a survey commission called Komissiya o gosudartstvennom mezhevanii or Mezhevaya ekspeditsiya, a team of six who worked under the direction of the senate and who had general oversight of the project (*Nastavleniye* 1766, 32). This commission, with headquarters in St. Petersburg, established a central drawing room nearby. Fieldwork began in 1766 in the Moscow *guberniya*, and a local office and drawing room were opened there to assist. In 1777, the Moscow survey office was renamed the Mezhevaya kantselyariya and given authority over all survey offices and practical surveying activities (German 1910, 204–5, 239). As the General'noye mezhevaniye progressed, local survey offices were established in the gubernatorial seats, all coordinated through Moscow.

The magnitude of the General'noye mezhevaniye required a large number of semiskilled surveyors. Initially, they were recruited as volunteers from among the officer corps and civil service with previous salaries continued. Potential candidates were given a written test involving basic trigonometric problems and a practical test on using an astrolabe, chain measure, and sketchbook (German 1911, 144–45). The tests proved difficult. Needing more men, the Mezhevaya ekspeditsiya founded a school for the education of mapmakers and surveyors, opening in St. Petersburg in 1767. A sister school (which became the Moskovskiy gosudartsvennyy universitet geodezii i kartografii—MIIGAiK) opened in Moscow in 1779. Students at the schools tackled a variety of subjects, but no one could avoid Tsitsianov's textbook. Tsitsianov's emphasis on standardized survey methods and report

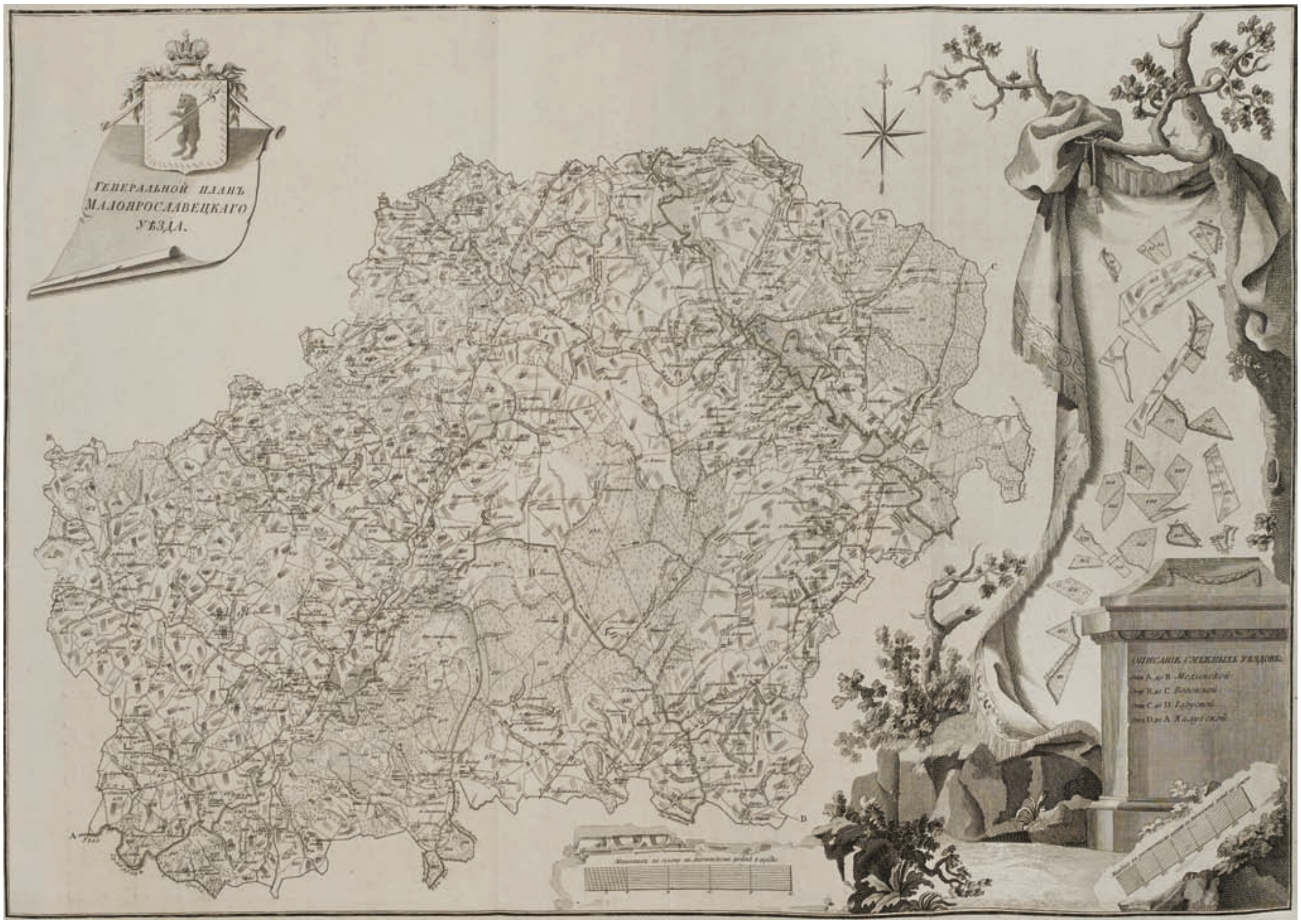

FIG. 687. *GENERAL'NOY PLAN MALOYAROSLAVETSKAGO UYEZDA* FROM THE *ATLAS KALUZHSKAGO NAMESTNICHESTVA* (ST. PETERSBURG, 1782). The map of the *uyezd* employs the scale of two versts per inch (1:8,400) and follows the distinctive format of the atlas, showing the coat of arms of the area along with the title in the drapery held by the double-headed eagle and plans of individual estates at a larger scale (ca. 1:1,680). Separately published descriptions and indices explained the numbered landholdings and provided information on natural resources.
Size of the original: ca. 29 × 41 cm. Image courtesy of the Universität Bern, Zentralbibliothek (SOB RoEu ka 40).

formats buttressed the status of maps and plans as legal documents and thus worked in the gentry's favor.

After 1775, district plans were mainly produced in the form of special manuscript atlases. Surveyors also began work on general provincial atlases whose emergence was largely due to reforms of 1775 in which each province and district was given a land surveyor and a drawing office. These reforms, precipitated by the peasant rebellions of 1773–75, strengthened the local power of the state. The incorporation of these specialists into the local administrative apparatus also helped rationalize the realm overall. The surveyors obtained and updated information on the land within their assigned area; this data was in turn used for revising the general maps of these administrative units. After 1806, the district surveyors were responsible for surveys of estates whose boundaries were mutually agreed upon by owners (German 1910, 242–43).

In 1782, the Mezhevaya ekspeditsiya published the *Atlas Kaluzhskago namestnichestva*. Produced under the supervision of Gorikhvostov, the atlas was engraved at the Tipografiya pravitel'stvuyushchego senata and printed by the Akademiya nauk. An outstanding example of late eighteenth-century Russian cartography, it was the only published atlas from the General'noye mezhevaniye (Postnikov 1985, 151–57) (fig. 687).

In at least one respect, the General'noye mezhevaniye regressed from the maps produced by the Petrine geodesists. The survey plans were almost never referenced to a system of geographical coordinates, decreasing their accuracy. But the General'noye mezhevaniye did establish a kind of uniform map that made it possible to measure, compare, and appraise estates. These were legal and binding documents. Standardized survey, map, plan, and atlas design continued to be refined in Russian survey instructions of the eighteenth and early nineteenth centuries.

Although other general surveys were envisioned after the General'noye mezhevaniye, none approached Catherine II's in coherence and overall success. In 1797, the senate drafted a program for a *guberniya* survey atlas—"Obzornyy atlas gubernii"—requiring descriptions approaching the detail of Catherine II's instructions, but the atlas failed to materialize when the cartographic materials reported by the districts varied widely in quality. From 1798 on, *guberniya* surveyors were instructed to keep records of the changes in ownership since the establishment of the General'noye mezhevaniye, confirming this survey's effectiveness in providing an initial baseline for all estate surveying to follow.

General land surveys were terminated in 1840s, mainly due to creation in 1837 of the ministry of state property, Ministerstvo gosudarsyvennykh imushchestv, with its own Korpus grazhdanskikh topografov (corps of civil topographers), although the land measuring department (Mezhevaya ekspeditsii, later Mezhevaya chast') would continue to work inside the Ministerstvo finansov for local surveys of disputed private estates until the 1917 Revolution. Regional land surveyors also continued to work at solving territorial problems in their regions (e.g., mapping of new villages, changes in roads). The content and quality of their maps were restricted by their tasks and could not be compared in this sense with high standards of plans and maps compiled by the officers of the Korpus grazhdanskikh topografov and Ministerstvo finansov, who received higher education in the Moskovskiy imperatorskiy konstantinovskiy mezhevoy institut or the Sankt-Peterburgskiy gornyy mezhevoy institut for mine surveying.

ALEXEY V. POSTNIKOV

SEE ALSO: Russia

BIBLIOGRAPHY

German, I. E. 1910. *Istoriya russkago mezhevaniya*. 2d ed. Moscow: Tipo-Litografiya V. Rikhter.

———. 1911. *Materialy k istorii general'nogo mezhevaniya v Rossii*. Moscow: Tipo-Litografiya V. Rikhter.

Goldenberg, L. A. 1959. "Kartograficheskiye materialy kak istoricheskiy istochnik i ikh klassifikatsiya (XVII–XVIII vv.)." *Problemy Istochnikovedeniya* 7:296–347.

Instruktsiya zemlemeram k general'nomu vsey imperii nashey zemel' razmezhevaniyu. 1766. St. Petersburg.

Ivanov, P. I. 1843. *O general'nom mezhevanii zemel' v Rossii i polyubovnom spetsial'nom razmezhevanii v Moskovskoy gubernii*. Moscow.

Nastavleniye Pravitel'stvuyushchego Senata iz mezhevoy ekspeditsii. 1766. St. Petersburg.

Postnikov, Alexey V. 1985. *Razvitiye kartografii i voprosy ispol'zovaniya starykh kart*. Moscow: "Nauka."

Shibanov, F. A. 1974. "Ob atlase Kaluzhskogo namestnichestva." *Izvestiya Vsesoyuznogo Geograficheskogo Obshchestva* 106:245–47.

Tsitsianov, Dmitriy Pavlovich. 1757. *Kratkoye matematicheskoye iz"yasneniye zemlemeriya mezhevogo*. St. Petersburg.

Property Mapping in Spain. During the eighteenth century, the cadastre seemed to provide a tool for ending the financial difficulties of the European nation states and for stimulating subsequent economic development. By the first half of the century, these states had sufficiently developed administrative structures capable of establishing cadastres. In Spain three were formed: (1) in Catalonia, the Catastro de Patiño (royal decree, 9 December 1715) covered some 32,000 square kilometers, or 6.3 percent of the Spanish territory, under the driving force of its first director, José Patiño, president of the Junta Superior de Gobierno y Justicia of Catalonia; (2) in the Crown of Castile, the Catastro de Ensenada (royal decree, 10 October 1749) encompassed some 373,000 square kilometers, or 73.7 percent of the Spanish territory (except for the *forales*, or tax-free territories, of País Vasco, Navarra, and the Canary Islands) and was conceived and promoted by Zenón de Somodevilla y Bengoechea, marqués de la Ensenada (minister of the public treasury 1743–54); and (3) the Planimetría General de Madrid (royal decree, 22 October 1749) was established concurrently with the Catastro de Ensenada, promoted by Ensenada specifically for the municipality of Madrid, seat of the court since 1561.

Cadastre-like documentation also developed for the Crown of Aragon, linked to the new order established by the Bourbon monarchy, which planned to impose taxes equivalent to those paid by Castile as *rentas provinciales*. This was the *catastro* or *única contribución* in Aragon, *equivalente* in Valencia, and *talla* in Mallorca. A register of the properties for the city of Melilla, the "Padrón y estado general de las casas, cuebas y solares . . . de Melilla," by Joseph de Ossorno (1753) was compiled without a fiscal objective. However, these documents lack accompanying maps.

The cadastres of Patiño and Ensenada were descriptive texts only, focusing on general wealth appraisal, leaving the cartography to a later phase once financial reform was set in motion. Performed by and for the nation-state, these cadastres affected many territories with several aims: to rationalize the financial system, to ensure coffers of the Real Hacienda (public treasury), and to achieve universal taxation and equity in interterritorial, interstate, and interpersonal contributions. In Catalonia the new tax code was implemented successfully through the Catastro de Patiño, which subsequently incorporated mapping. The tax code of the Catastro de Ensenada remained as it was until 1759, when fiscal reform came to an end. The Planimetría General de Madrid included only cadastres that identified, collected, and mapped taxable property, not all the wealth of the taxpayer.

The 1715 decree establishing the Catastro de Patiño ordered a tax in Catalonia equivalent to that of Castile's *rentas provinciales*, with revenue to be distributed among all the taxpaying entities of the province. In addition to the wealth and family size of each taxpayer, the Catastro sought to record the boundary of each city or town, "the quality of their lands" and the "fruits they produce," information acquired through measuring and mapping the properties (Faci Lacasta and Camarero Bullón 2006, 98). However, a lack of skilled technicians temporarily prevented the measuring and mapping of parcels and municipal boundaries. The first stage of the Catalan cadastre maps (1716–18) was therefore limited to simple sketches of the town boundaries, drawn in the margins at the top of the thirty-two-question reports, the *respuestas generales*. The parcels were described and identified but not drawn. Nevertheless, the decree established that in the future, there should be surveyors and geodesists in towns and in an administrative corps who would measure the land. The cartography of the second phase of the Cadastro de Patiño, begun around 1720, originated in this regulation, which required measured boundaries and parcels during the subsequent decades (Camarero Bullón and Faci Lacasta 2006).

These two survey types, one for boundaries and one for parcels, were collected in the *cuadernos de recanación* (remeasurement notebooks) or, simply, *recanaciones*. The *recanación* usually began with a figure of the district, its boundaries, and measurements. These were followed by the parcels of the district, previously surveyed or measured geometrically, which were drawn individually (fig. 688). Land quality, land use, borders, and owners were also noted (Camarero Bullón and Aguirre Landa 2008). The documents are housed in the Archivo de la Corona de Aragón (Barcelona), the Archivo Histórico Provincial de Lérida, and in some municipal archives. The best and most complete repository is that of Lérida, which includes plans of over eight hundred towns (Faci Lacasta and Camarero Bullón 2006; Burgueño 2009).

In the second half of the century, government administrators attempted to reform the Castilian tax code so that all entities subject to tax would contribute in proportion to their wealth. To that end, the Catastro de Ensenada was initiated in 1749 to chart individual wealth, a prerequisite to evaluating local wealth, then to chart provincial wealth, and finally, to chart the wealth of all the Crown. It was decided to measure the municipal boundaries and prepare geometrically measured maps first, leaving the measurement of the parcels for later. But when the work of the cadastre began in early 1750, there were too few technicians in many of the provinces to carry out the work. The majority

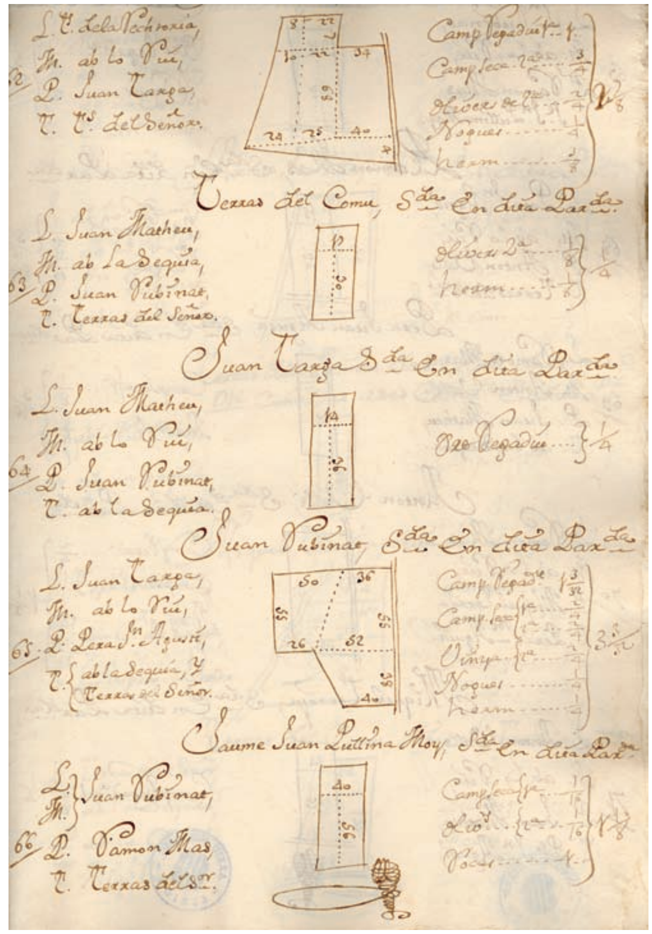

FIG. 688. *RECANACIÓN* OF CIUTADELLA FROM THE CATASTRO DE PATIÑO, 1731. This manuscript illustration incorporates a graphic rendering of the *recanación* of boundaries and plots.
Size of the original: 31 × 20 cm. Image courtesy of the Archivo Histórico Provincial de Lérida (CP 52).

of geodesists were employed in the Cuerpo de Ingenieros, and those who were not were concentrated in the court, in the capitals of the intendancies for the army. Thus, nonspecialist maps were ordered of the boundaries with each parcel drawn by hand "as it appears to view" (*como se alcanza a la vista*) (Camarero Bullón 1998, 250) (fig. 689). The shapes of the boundaries were included in the *respuestas generales*, which contained the responses given by local experts to a questionnaire of forty items. Two contemporaneous copies were made of the *respuestas*; the originals remain today in the *Contadurías de rentas provinciales* (accounts of provincial taxes), housed in the Archivos Históricos Provinciales, except in Burgos, where they are kept in the Diputación; in Coruña, kept in the Archivo del Reino de Galicia; and in Madrid, kept in the Archivo Histórico Nacional. One copy of the *respuestas* was sent to the Junta de Única

FIG. 689. MAP OF DÚRCAL, 1752, FROM THE CATASTRO DE ENSENADA. This manuscript map typifies the cadastral plan drawn "as it appears to view" with no scale and no key. The cardinal points are identified and the nature of the landscape incorporated in the colors, shading, and tree symbols. Size of the original: 31 × 20 cm. España, Archivo Histórico Provincial de Granada (Catastro de Ensenada. Dúrcal. Libro 1.213).

Contribución in Madrid between 1754 and 1756, and passed in 1832 to the Archivo General de Simancas (Valladolid), where they are completely preserved, except for the city of Madrid (Camarero Bullón 2002, 114; see also the Portal de Archivos Españoles [PARES] website). The maps of the copy in the Archivo de Simancas are much simpler than those of the original. A second copy of the *respuestas* was sent in 1761 to the *ayuntamientos* (city councils); conservation is very uneven. These maps or sketches, generally very simple, form the fifteen thousand boundaries of the Crown of Castile.

The quality of maps varied from province to province. On the whole, the mapping of the Kingdom of Granada (today Granada, Málaga, and Almería), of which some seven hundred maps are preserved, is extremely interesting because of its varied approach to rendering the landscape and the properties in question. Each observer followed a unique style in creating a picture of the region and the land use. Fewer in number, but no less interesting, are the maps of the province of La Mancha (today Ciudad Real and Albacete). One of these maps, of Almadén, is the only example of geometrically surveyed mapping to be found in the Castilian cadastre (fig. 690). The maps of Jaén and a handful of the maps of the provinces of Guadalajara, Burgos, Soria, and León-Asturias are of interest for the drawing techniques used in addition to measurements.

Two documents from the Catastro de Ensenada collected the manuscript drawings (*figures a mano alzada*) of millions of cadastred plots: the *memoriales* and the *libros de lo real*, whose conservation is uneven. They include documents completely or almost completely preserved for provinces including Burgos, Jaén, Granada, Toledo, Segovia, Soria, La Mancha, Palencia, Zamora, Galicia, and Guadalajara. Documents for other provinces are completely or partially lost: Seville, Toro, Madrid, Cuenca, Murcia, Valladolid, and Extremadura. The *libros de lo real* were copied and sent to the towns in 1761, but preservation in the municipal archives varies (Camarero Bullón 2007a, 32).

The Planimetría General de Madrid attempted to modernize and adapt the *regalía de aposento*, a real estate tax dating from the Middle Ages that required providing lodging to royal officials in private dwellings. The Planimetría General converted the *regalía de aposento* into a monetary tax based on the value of the buildings, organizing and augmenting the collection of data to support this idea. At the same time, the Planimetría General recorded inherited real estate and established a map that could serve as a basis for urban reform.

The 1749 royal decree ordered visits and preparation of plans for the 7,535 existing dwellings in Madrid, grouped into 557 *manzanas* (blocks/districts). The plans were drawn up by the architects Nicolás de Churriguera, Ventura Padierne, Fernando de Moradillo, José Arredondo, Miguel Fernández, Francisco Pérez Cabo, José Ignacio Gutiérrez, and Tomás Gutiérrez. Altogether, they produced 567 plans (some districts had more than one), some of large size. All are signed and dated. Different scales were used, depending on the dimensions and characteristics of the district. This cartography provided the material for the official map. One new map was produced on large standard-sized paper (52.7 × 36.5 cm) for each of the 557 blocks, today bound into six volumes and preserved in the Archivo Histórico Nacional (Madrid). Each plan includes the number of houses and lots and their sizes (fig. 691). The "Libro registro de las casas de Madrid" was also produced, which comprised descriptions of the houses of each block, the name of its proprietors, the value of its rental income (*alquileres*), its position in terms of the tax, and the value of the tax. The

FIG. 690. MAP OF ALMADÉN, 1751, FROM THE CATASTRO DE ENSENADA. This manuscript is the only geometrically surveyed map in the Catastro de Ensenada. It has a graphic scale in the lower left corner representing 6,400 varas castellanas (1 vara castellana = ca. 0.83 m), a color key (noted in the box top right), and an explanatory key for the letters on the plan. This map was probably created because it was the location of the most important mercury mine in Spain. Mercury was sent to Perú in order to extract silver from the ores mined at Potosí.
Size of the original: 44 × 55 cm. Junta de Comunidades de Castilla la Mancha/Archivo Histórico Provincial de Ciudad Real (Sección de Hacienda, Signatura H 642).

six volumes of the "Libro" are kept in the Archivo General de Simancas. At least three copies were made of this documentation: one for the exaction of the tax (Archivo Histórico Nacional), another for the Biblioteca Real (Biblioteca Nacional, Madrid), and a third for the Academia de Bellas Artes (Madrid). In the nineteenth century the Ayuntamiento de Madrid made two copies for its use (Archivo de Villa) and the Junta General de Estadística made another for preparing the topographical cadastre of small lots of the city (Instituto Geográfico Nacional, Madrid) (Camarero Bullón 2011, 33). The Planimetría General also served as a basis for the magnificent map of the city published in 1785 by Tomás López.

Other practices of large-scale mapping of property in Spain were local and, with the exception of Valencia, are largely unstudied (Faus Prieto 1995). The work of the *agrimensores* (land surveyors) under local jurisdiction involved land measurement, taxation, division of land, and determination of property lines and municipal boundaries—all activities that required manuscript maps and plans, which may be found in local archives.

CONCEPCIÓN CAMARERO BULLÓN

SEE ALSO: Spain; Urban Mapping: Spain

BIBLIOGRAPHY

Burgueño, Jesús. 2009. "Els geòmetres del cadastre de Catalunya (1720–1815)." *Cuadernos de Geografía* 86:261–88.

Camarero Bullón, Concepción. 1998. "La cartografía en el Catastro de Ensenada, 1750–1756." *Estudios Geográficos* 59, no. 231:245–83.

———. 2001. "The Cadastre of the Crown of Castile in the Mid-18th Century." In *Kataster und moderner Staat in Italien, Spanien und Frankreich (18. Jh.)*, ed. L. Mannori, 167–91. Baden-Baden: Nomos.

———. 2002. "Vasallos y pueblos castellanos ante una averiguación más allá de lo fiscal: El Catastro de Ensenada, 1749–1756" / "Castilian Vassals and Villages Face a Verification beyond the Fiscal Scope: The Ensenada Cadastre, 1749–1756." In *El Catastro de Ensenada: Magna averiguación fiscal para alivio de los vasallos y mejor conocimiento de los reinos, 1749–1756*, ed. Ignacio Durán Boo and Concepción Camarero Bullón, 113–388 (Spanish) and 473–545 (English). Madrid: Ministerio de Hacienda.

———. 2007a. "La cartografía de los catastros españoles del siglo XVIII." In *La cartografia cadastral a Espanya (segles XVIII–XX)*, 21–37. Barcelona: Institut Cartogràfic de Catalunya.

———. 2007b. "Les trois cadastres de l'Espagne du XVIII^e siècle: Introduction, contexte, objectifs, méthodes et résultats." In *De l'estime au cadastre en Europe, l'époque moderne*, ed. Mireille Touzery, 147–217. Paris: Comité pour l'Histoire Économique et Financière de la France.

———. 2011. "Planimetría catastral de Madrid, Villa y Corte de los siglos XVIII y XIX." In *Cartografia i agrimensura a Catalunya i Balears al segle XIX*, ed. Carme Montaner, Francesc Nadal, and Luis Urteaga, 29–46. Barcelona: Institut Cartogràfic de Catalunya.

Camarero Bullón, Concepción, and Isabel Aguirre Landa. 2008. "Normativa del catastro ordenado realizar en los territorios de Austria por el emperador José II en 1785." *CT Catastro* 63:121–57.

Camarero Bullón, Concepción, and Pilar Faci Lacasta. 2006. "La estructura documental del Catastro de Patiño, según las reglas anexas al Real Decreto de 9 de diciembre de 1715." *CT Catastro* 56:89–116.

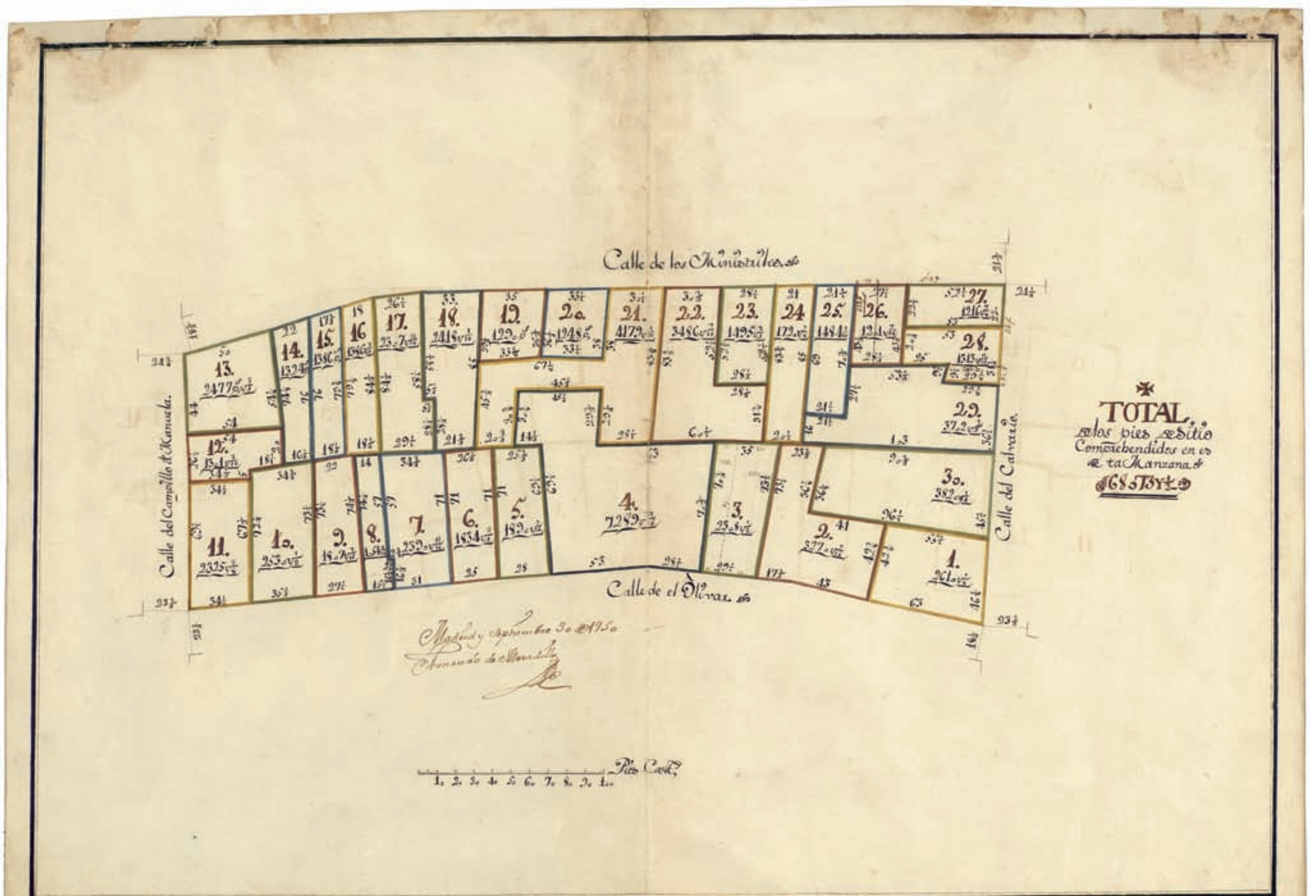

FIG. 691. *MANZANA* 43 FROM THE PLANIMETRÍA GENERAL DE MADRID, 30 SEPTEMBER 1750. Signed by Fernando de Moradillo, the manuscript plan shows the measurements of the plots in *manzana* 43, with the totals of each area noted. Additional information describing the houses, names of proprietors, value of rents, and taxable worth was recorded in an accompanying "Libro registro de las casas de Madrid." Scale in pies castellanos (100 pies castellanos = 10.5 cm; ca. 1:267).

Size of the original: 48.6 × 70.5 cm. Image courtesy España, Ministerio de Cultura, Archivo Histórico Nacional, Madrid (FF.CC., Delegación de Hacienda, fondo histórico, Carpeta 3, plano 43).

Campos Delgado, Jesús, Concepción Camarero Bullón, and Ulises Wensell, eds. 1988. *Planimetría General de Madrid*. Vol. 1, *Planos*. Vol. 2, *Asientos*. Madrid: Tabapress.
Faci Lacasta, Pilar, and Concepción Camarero Bullón. 2006. "La documentación del catastro de Patiño en el Archivo Histórico Provincial de Lérida." *CT Catastro* 57:95–162.
Faus Prieto, Alfredo. 1995. *Mapistes: Cartografia i agrimensura a la València del segle XVIII*. Valencia: Edicions Alfons el Magnànim.
Marín Perellón, Francisco José. 2000. "Planimetría General de Madrid y visita general de casas, 1750–1751." *CT Catastro* 39:87–114.

Property Mapping in Spanish America. Property mapping in Spanish America from 1650 to 1800 was closely related to the process of territorial organization of the Spanish Empire and contrasted with its European counterparts in three ways. First, property cartography did not completely encompass the whole of the Spanish American territory but concentrated on densely populated areas (both urban and rural), conflict-prone border regions, and newly settled areas. Second, land surveying and mapping were only marginal activities in the process of land grants and titles (*letras* or *títulos*); in most cases, the granting of "in-bulk" land titles prevailed, with squatting also frequent. Third, land surveying was affected by the variety and poor quality of surveying techniques, the gradual improvement of measuring instruments, and the empiricism of practical surveyors, who used a rough pictorial graphic instead of a measured and abstract set of symbols.

The scale at which property mapping was executed grew larger over time. Most early colonial maps were rough sketch maps, usually without a specific scale or expressed in leagues (4.19 km each) or varas (0.8359 m each), representing large expanses of land but with little or no detail and only approximate fidelity. The introduction of the metric system to Spanish America after the mid-nineteenth century represented a significant step toward standardization and perceived accuracy. Cadastral property maps prepared at a large scale were available only at the end of the colonial period. Thus, during the period in question, the foundations for property mapping were laid, but examples of specifically large-scale cadastral maps were still evolving.

Two traits distinguish property mapping in Spanish America during this period. First and foremost was the *continuity of the preexisting styles and techniques* rooted in the period of Spanish conquest and colonization of indigenous kingdoms of North, Central, and South America. These include the indigenous mapping techniques and methods implemented in the policy of *composiciones* (fig. 692).

The second trait was the *appearance of emerging styles and techniques* on the eve of independence of most Spanish American countries. These include more theoretically based surveying practices, connected to the incipient formation of professional guilds, a sharper definition of the duties and responsibilities of the surveyor, and more precise surveying instruments. These developments contributed to the large-scale, cadastral-type, property maps that appeared by the end of the eighteenth century (fig. 693).

The preexisting cartographic styles and techniques played against the trends that created large-scale maps in three contexts that required such cartography. Official property cartography was promoted by the Spanish American colonial administration to assess real estate property in order to collect taxes, determine ownership, and establish boundaries. Private cadastral cartography was sponsored by landowners to support their agrarian disputes, claims, and litigation. Finally, a theoretical approach to cadastral cartography comprised those writings about the theoretical foundations of surveying and laid down surveying standards (e.g., cost/fee regulations, procedures) and drew on the practical experience of professional surveyors.

State Sponsored Colonial Property Mapping

From the early days of the Spanish conquest of the New World, colonial authorities were aware of the need for property maps (Solano 1991). On the one hand, town foundations were accompanied by maps and plans for city layouts, although in most cases these were just *diseños nominales*, a few parcel sketches with proprietors' names but without terrain surveys, sometimes called "textual surveys" (Hunter and Sluyter 2011). This kind of parcel allotment caused many problems later when the granted parcels were inspected by the surveyors. For instance, during the second foundation of Buenos Aires (1580), Juan de Garay laid out the bounds of the *suerte* (agricultural) lots and *estancia* (ranch) parcels, which measured on average 500 varas in width and 1.5 leagues in depth. The narrow side of each *suerte* was placed along the coastline of the La Plata, Paraná, or

(*facing page*)
FIG. 692. THE RANCH OF "LA CAÑADA" IN THE PUEBLO OF MAGDALENA, SOUTHERN MEXICO CITY, BY GERÓNIMO CARRILLO, 1690. This manuscript map was produced for the sale of the ranch La Cañada (which also includes Pueblos de Ajusco, San Ángel; Coyoacán, Mexico City) and employs the more pictorial style incorporating techniques of indigenous mapping found in some *composiciones*. In this map, drawn by a practical surveyor, a "ranch" is a small patch of cleared land amid hilly forested terrain intended for cultivation.
Size of the original: 43.0 × 29.5 cm. Image courtesy of the Archivo General de la Nación, Fondo Hermanos Mayo, Mexico City (Hospital de Jesús, leg. 99, exp. 1, f. 49).


Sur.
Oriente.
Poniente
Po. Ajusco.
Nuevo Camino de Cuernavaca
Chichi-caspa
Ran-cho
Pedregal
Norte

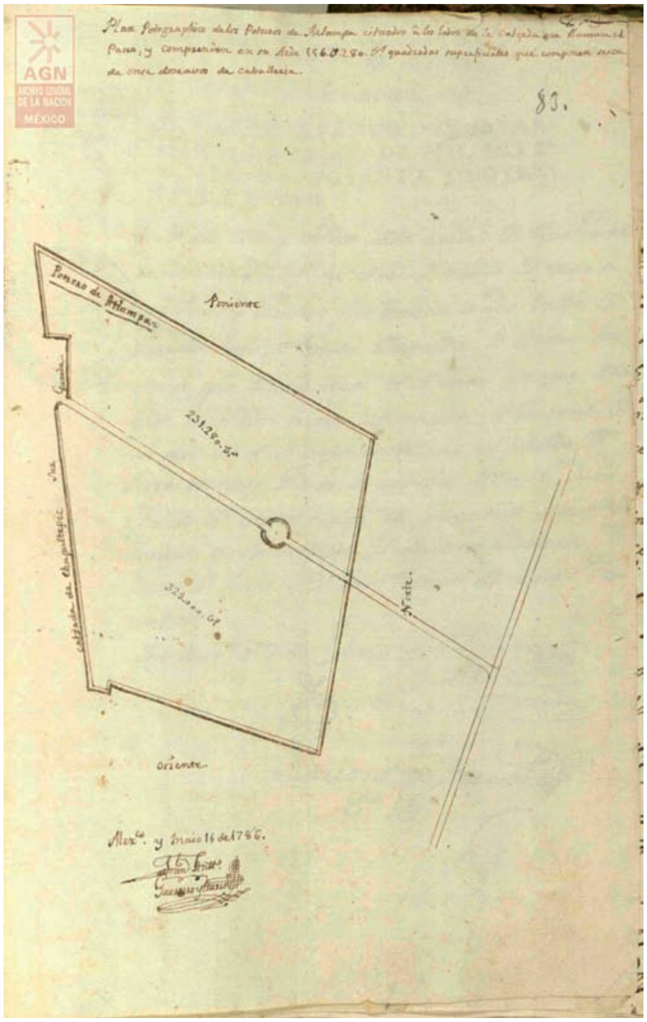

FIG. 693. "PLAN POTOGRAPHICO DE LOS POTREROS DE ATLAMPA," BY FRANCISCO ANTONIO GUERRERO Y TORRES, ARCHITECT, 1786. Manuscript map, ink on paper (Potreros en Candelaria Atlampa; Mexico City). This map, which formed part of the proceedings to clarify the lease of the Atlampa site to Francisco Xavier Barreda, exemplifies the techniques of large-scale measurements for agricultural lands (*caballerías*) used in Spanish American property maps of the late eighteenth century.
Size of the original: paper 30 × 20 cm. Image courtesy of the Archivo General de la Nación, Fondo Hermanos Mayo, Mexico City (Tierras, vol. 3212, exp. 4, f. 83).

Luján River, creating long lots extending inland from the river's edge; the lots tended not to be oriented to the points of the compass, explaining why later drawings of parcels and even the current boundaries of most *partidos* (departments) in the province remained at *medio rumbo* (i.e., midway between points of the compass, at 45° in relation to the grid of parallels and meridians) in their orientation. One of the main problems with this method arose later when the land property titles were reexamined based on surveyed maps: the coastline, irregular by definition, made it impossible for the "sight" measuring employed in the original land allotment to coincide with the actual terrain measurements. In 1608, the first survey of the Buenos Aires *ejido* (common land) was carried out by Francisco Bernal, "urban parcels surveyor" (appointed by the Buenos Aires *cabildo* [council]), a survey later rectified in 1812 (Recalde 1999, 25).

Official property surveying was particularly subject to the mapping techniques dating from the period prior to 1650. The culturally embedded practice of indigenous mapmaking continued well after the conquest, with most of its elements (e.g., glyphs, scale measurements based on the appendages and gait of the human body, colors, iconography, rhetoric) surviving in areas where significant knowledge of native, sedentary civilizations was required (Beyersdorff 2007). In fact, elements of this pre-Hispanic cartographic knowledge were still visible in the maps of the *relaciones geográficas*, spanning from the sixteenth to the eighteenth century (Butzer and Williams 1992). The *relaciones* in New Spain usually included local and regional maps, although this was not the case in Peru (Beyersdorff 2007).

Another pre-1650 holdover was the colonial policy of *composiciones*, after the Atlixco and Huejotzingo models of 1643, implemented in New Spain, Guatemala, Peru, and Venezuela. This policy proposed to legalize and correct the property deeds of land held in excess of that entitled by each original land grant: squatted-on lands, *baldía* (waste lands), *realenga* (royal land), or land with defective titles, whether individually fragmented and discretely allocated lands or collectively owned lands, such as those held by the indigenous communities. The *composiciones* also served to collect taxes and donations to fund royal defense operations in the Caribbean Sea and the Atlantic Ocean. Finally, the *composiciones* were used as an instrument of pressure to avoid expensive land surveys by making the legal confirmation of land titles unnecessary (Aguilar-Robledo 2009). The *composiciones* legalized property rights "in bulk," namely, without the requisite land surveys, because each *composición* included a mandate of not measuring the *compuesta* (legalized) land. The *composiciones* were transformed into more permanent colonial policy by the creation in 1692 of the Superintendencia del Beneficio y Composición de Tierras in the Viceroyalties of New Spain and Peru (Solano 1991, 377–80).

Other factors influencing the development of official property mapping were the existing and variable system of weights and measures and instruments used for land surveying, which were unsatisfactory because they produced unreliable maps and because of the high cost of most land surveys (Aguilar-Robledo 2009, 25–30). Poorly measured maps led to an almost endless colonial effort to correct the ambiguous or contradictory land grants and measures, evidenced in the circular, rectangular, or square land grants for agriculture or stock-raising activities. Colonial cadastres existed as small registers, mostly local or regional as elsewhere in the world, that provided a detailed record of land grants and allowed the rough tracking of landholdings and landowners, whether individual, collective, or corporate (such as the ecclesiastic orders).

PRIVATE CADASTRES AND PROPERTY SURVEYORS While the Crown was carrying out diverse surveying operations, landowners, especially those subject to lawsuits, land claims, or property disputes, reverted to practical surveyors for their cadastral mapping, which was a completely decentralized practice. A case in eastern San Luis Potosí, Mexico (Ciudad del Maíz) in 1800–1801 provides examples of the kind of maps produced in a land dispute between an indigenous community defending its *fundo legal* (granted land intended to provide an urban core) and a wealthy landholding family. It was not unusual for the contentious parties to hire a practical surveyor (i.e., unlicensed and trained via an apprentice system), as employed by the wealthy family, or a licensed surveyor, here representing the indigenous community, to support their legal claims cartographically. The resulting maps contrast sharply: José Mártir Cabrera, the licensed surveyor, prepared a cadastral-type map for the indigenous community (fig. 694), and the practical surveyor, Lorenzo Ferial, produced a colorful but nonplanimetric cartographic rendition (Aguilar-Robledo 2009, 31–32) (fig. 695). Such cadastral maps are confined to legal, agrarian files.

In seventeenth-century Cuba, the surveyor's task was carried out by marine pilots, *maestros de obras* (master builders), and even scribes, in an ad hoc manner. After the revocation of the city council's right to assign land grants in 1729, the subdivision of lands around Havana led to increasing calls for surveyors to testify in land cases and to map the perimeter of haciendas not by radii, as previously done, but by showing the actual boundaries. Domingo de Arrazate, a public surveyor, mapped the limits between Santiago and Havana in 1727, and ten years later military engineer Antonio de Arredondo drew another map showing municipal jurisdictions in Havana's district (Venegas Fornias 2002, 35).

This period marked the emergence of the surveyor (*agrimensor*) as a trained professional, although there is as yet little scholarship with which to confirm a clear trajectory. Public surveyors in Cuba worked for the city council and had to be examined or certified by a competent authority, such as friar José Bolanos, a math professor at the University of Havana, or Bartolomé Lorenzo de Flores, whose measuring cane (*bastón*) became the island's standard length unit. In Mexico as well, land surveys became the responsibility of civilian professionals who added the title of surveyor to other proficiencies, but royal officials managed the accreditation. Ignacio Castera petitioned viceroy Antonio María de Bucareli to be examined to get his title of *agrimensor* in 1777 and passed the tests administered by examiner Ildefonso de Iniesta Bejarano, receiving his title in July of the same year (Hernández Franyutti 2006). In 1787, Castera's map of the Mazapa hacienda in the jurisdiction of Texcoco identified his title as not only surveyor of lands and mines but also *maestro mayor y veedor de arquitectura* of Mexico City and its desiccation project (see fig. 47) (Trabulse 1983, 88–89; additional cases 90–93). Starting in the 1770s, the Archivo General de la Nación records list around a dozen exams proctored and licenses issued for surveyors in half a dozen cities from Aguascalientes to Guadalajara, likely indicating that private property mapping became widespread and increasingly important to judicial resolution of territory disputes in New Spain in the 1770s, nearly half a century later than Cuba.

Surveyors' reports and maps were valued testimony in eighteenth-century judicial cases, covering a wide range of disputes regarding lands both private and public. Their eyewitness accounts and measurements and many of the maps that resulted from them are housed in the Archivo de Indias of Spain and in Mexico's national archives. An example of such judicial mapping is José Martin Ortiz's map of a disputed hacienda (fig. 696, p. 1214).

BOOKS AND MANUALS ON CADASTRAL MAPPING Although the cadastral tradition in Spanish America had been primarily focused on legal questions related to landholding and property, examples of technical writings also survive that established the theoretical principles, cost/fee assessments, and standards underpinning surveying practice. For example, in 1749 the attorney José Sáenz de Escobar wrote his manuscript "Geometría práctica, y mecánica dividida en tres tratados, el primero de medidas de tierras, el segundo de medidas de minas, el tercero de medida de aguas." To the three treatises of the "Geometría" was added the "Brebe noticia de los cenos rectos y de las secantes y tangentes," which was prepared especially for surveyors who wanted a deeper understanding of the geometric basis of their discipline and stressed its legal implications. The first treatise is devoted to surveying, with fifteen brief chapters outlining the practical tasks step-by-step, describing the use of instruments, and explaining the general principles of geometry for the surveyor (Aguilar-Robledo 2009, 34). Although it remained unpublished, this work was widely copied and used into the nineteenth century and was even plagiarized (Nickel 2000; Sáenz de Escobar forthcoming).

Another example is found in the work of brothers Felipe and Francisco de Zúñiga y Ontiveros, who in 1771 wrote a short piece on surveyors and assessors of estates concerning the rural estates abandoned by the Jesuits upon their expulsion in 1767 (Solano 1991, 458–75).

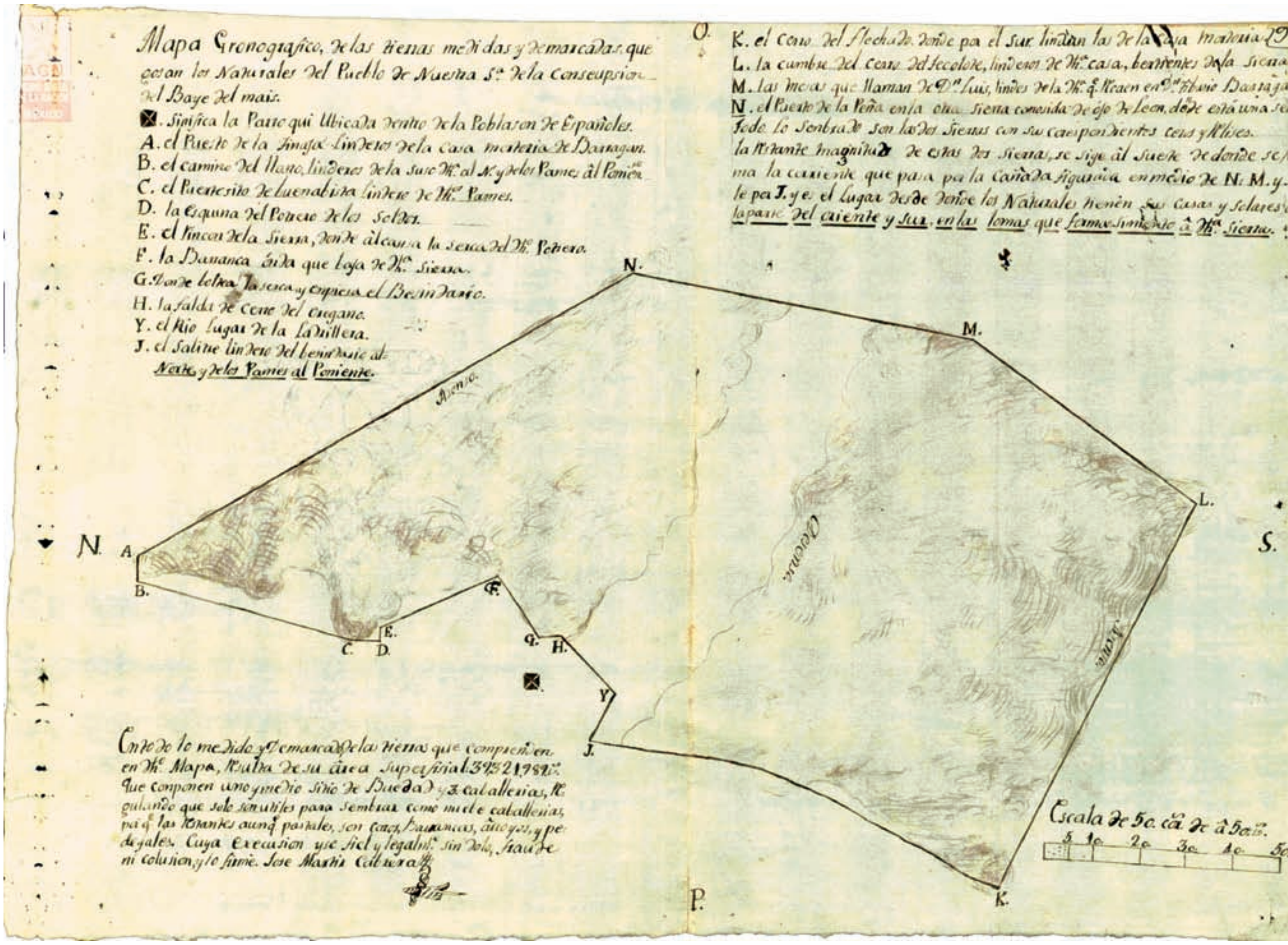

FIG. 694. SURVEY OF INDIGENOUS PAME LANDHOLDING IN CIUDAD DEL MAÍZ, EASTERN SAN LUIS POTOSÍ, MEXICO. "Mapa cronografico . . . del pueblo Nuestra S[a]. de la Conseupsion del Baye del Mais," by José Mártir Cabrera, licensed surveyor, 1801. Graphic scale of 50 cordeles, each of 50 varas. Manuscript, ink on paper. This map was drafted by Cabrera on behalf of the indigenous inhabitants of Ciudad del Maíz in a lawsuit facing the Barragán family.
Size of the original: 30.5 × 42.5 cm. Image courtesy of the Archivo General de la Nación, Fondo Hermanos Mayo, Mexico City (Tierras, vol. 1325, exp. 1, f. 96).

This unusually detailed document includes suggestions for calculating fees that a freelance surveyor should charge his clients based on the type of land to be surveyed, suggested base salaries for state-employed surveyors, tips for measuring broken terrain and forested areas, the differences between surveying and assessing estates, and standard rules for all surveyors to follow. A final example is the work of Professor Juan Bautista Blanes (1798), which contained a set of standard rules for surveying, including a detailed account of the practical steps and procedures a surveyor must follow when measuring any piece of land (Solano 1991, 510–13).

Property mapping in Spanish America did not cover the entire Spanish domain in the New World but was concentrated in specific areas, with large-scale surveying only playing a marginal role in land grants and the acquisition of land titles. As elsewhere, land surveying suffered from inconsistent measuring standards leading to inaccuracy, from the slow development of measuring instruments, and from the lack of formal training of most practical surveyors. Nonetheless, the cartographic record reveals the desire to assess property for revenue and to resolve agrarian disputes, title claims, and land litigation. Also, the existence of works written about the practice of surveying enhances an understanding of large-scale map creation.

MIGUEL AGUILAR-ROBLEDO AND CARLA LOIS, WITH ADDITIONAL MATERIAL PROVIDED BY JORDANA DYM

SEE ALSO: Administrative Cartography: Spanish America; Spanish America

BIBLIOGRAPHY

Aguilar-Robledo, Miguel. 2009. "Contested Terrain: The Rise and Decline of Surveying in New Spain, 1500–1800." *Journal of Latin American Geography* 8, no. 2:23–47.

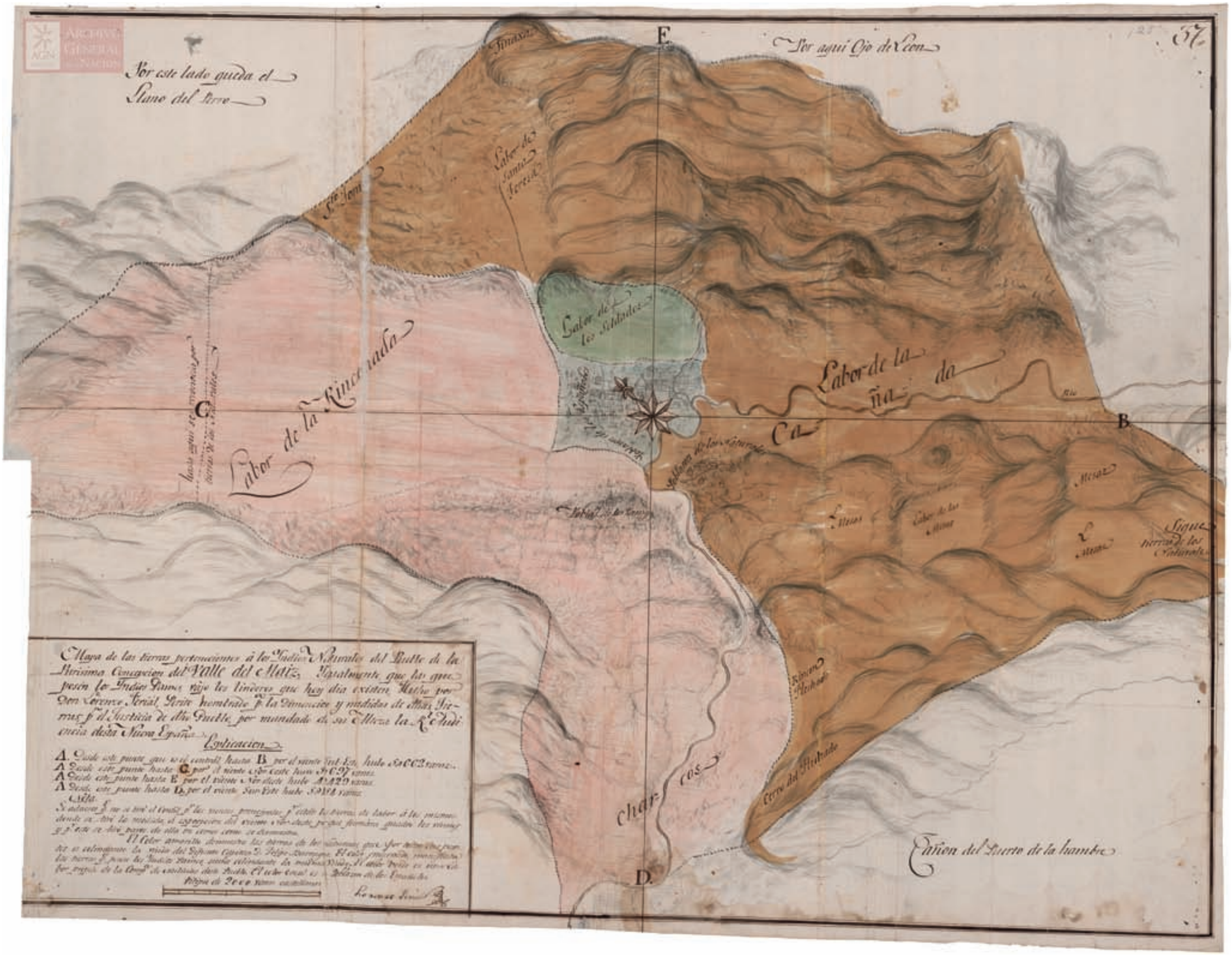

FIG. 695. MAP OF INDIGENOUS PAME LANDHOLDING IN CIUDAD DEL MAÍZ, EASTERN SAN LUIS POTOSÍ, MEXICO. "Mapa de las tierras pertenecientes à los indios naturales del pueblo de la Purisima Concepcion del Valle del Maiz," by Lorenzo Ferial, practical surveyor, 1801. Manuscript. The map shows the survey performed by Ferial on behalf of the Barragán family for presentation in a lawsuit against the indigenes of Ciudad del Maíz. It includes places such as Los Llanos del Perro, Ojo de León, La Rinconada, Soldados, Cañada, and Spanish and indigenous towns; each site shown in a different color.
Size of the original: 56 × 77 cm. Image courtesy of the Archivo General de la Nación, Fondo Hermanos Mayo, Mexico City (Tierras, vol. 1325, exp. 1, f. 125).

Beyersdorff, Margot. 2007. "Covering the Earth: Mapping the Walkabout in Andean *Pueblos de Indios*." *Latin American Research Review* 42, no. 3:129–60.

Butzer, Karl W., and Barbara J. Williams. 1992. "Addendum: Three Indigenous Maps from New Spain Dated ca. 1580." *Annals of the Association of American Geographers* 82:536–42.

Hernández Franyutti, Regina. 2006. "El discurso ilustrado en la cartografía de Ignacio de Castera." *Scripta Nova* 10, no. 218 (79). Online publication.

Hunter, Richard, and Andrew Sluyter. 2011. "How Incipient Colonies Create Territory: The Textual Surveys of New Spain, 1520s–1620s." *Journal of Historical Geography* 37:288–99.

Nickel, Herbert J. 2000. "Joseph Sáenz de Escobar y su tratado sobre geometría práctica y mecánica: Un manual sobre geometría aplicada para personas no cualificadas en la materia, escrito en Nueva España (México) alrededor del año 1700." *Historia y Grafía* 15:241–67.

Recalde, José Martín. 1999. *Evolución de la función social de la agrimensura en el Río de la Plata: Aportes para una historia de la agrimensura*. [n.p.]: Biblioteca del Agrimensor; Publicación del Consejo Profesional de Agrimensura de la Provincia de Buenos Aires.

Sáenz de Escobar, José. Forthcoming. *Geometría práctica, y mecánica dividida en tres tratados, el primero de medidas de tierras, el segundo de medidas de minas, el tercero de medida de aguas*. Preliminary study and edition by Élida Tedesco and Miguel Aguilar-Robledo. Madrid and Frankfurt: Iberoamericana-Vervuert.

Solano, Francisco de. 1991. *Cedulario de tierras: Compilación de legislación agraria colonial (1497–1820)*. Mexico City: Universidad Nacional Autónoma de México.

Trabulse, Elías. 1983. *Cartografía mexicana: Tesoros de la Nación, siglos XVI a XIX*. Mexico City: Archivo General de la Nación.

Venegas Fornias, Carlos. 2002. *Cuba y sus pueblos: Censos y mapas de los siglos XVIII y XIX*. Havana: Centro de Investigación y Desarrollo de la Cultura Cubana Juan Marinello.

FIG. 696. "MAPA DE LA HACIENDA DE S^{N}. PEDRO TENAYAQUE," BY JOSÉ MARTÍN ORTIZ, AGRIMENSOR, 1786. The manuscript map shows not only the disputed areas of the hacienda surveyed for a judicial case, but the hacienda's mills and other buildings for sugarcane, wheat, and corn, along with neighboring communities, *ejidos*, and haciendas. Graphic scale of "5,000 Mexican varas or one league." See previous entry, p. 1211.
Image courtesy of España, Ministerio de Cultura y Deporte, Archivo General de Indias, Seville (MP, Mexico, 714).

Property Mapping in Sweden-Finland. Large-scale land surveying in the northern parts of Sweden and Finland was hindered by difficult natural conditions of wide stretches of forests and swamps or terrain cut up by lakes and rivers. Distances were long, the land was sparsely populated, and parcels of land could be several kilometers away from the villages. This made it almost impossible to survey the area with the technology available. No fieldwork was carried out for more than six months of the year while snow covered the ground. However, the ice-covered waterways facilitated geographical surveys in coastal areas (Huhtamies 2008, passim).

In the seventeenth and eighteenth centuries the plane table, the diopter (surveyor's cross), and the surveyor's rope or chain were the tools of the land surveyor who learned his trade through apprenticeship (some were taught by Andreas Bureus at the University of Uppsala) and through contact with foreign surveyors from Holland and Germany. Brass precision instruments, such as the surveyor's quadrant or theodolite, were still rare. In mapmaking, the diopter was used to take bearings of objects to be surveyed before drafting the map on the plane table (Ehrensvärd 2006, 225–57; Kain and Baigent 1992, 51–53, 58).

During the period of the Swedish Empire (ca. 1620–1720), a program of large-scale property surveying was instituted and carried out from the 1630s to 1650s. The *geometriska jordeböcker* (geometric land books) were designed as compilations of maps from surveys of the three types of Swedish land: the *krono* (Crown), *skatte* (taxable), and the *frälse* (exempt). The purpose of the land books has been the subject of considerable debate, and while their function as taxation tools may be questionable, it is certain that they depicted land ownership, type and use, as well as some economic information such as hay yield, with a variety of symbols and color keys

FIG. 697. MANUSCRIPT MAP OF THE DIVISION OF CROWN AND PRIVATE FOREST LAND IN OVANSJÖ PARISH, NORRLAND, 1702. Christofer Jakobsson Stenklyft, "Geometrisck affrijtningh oppå Ofwansiö Sochens Cronoallmeningar." Stenklyft, a member of the Bureus family, was well known for his mapping of forests in Sweden from 1684 onward.
© Lantmäteriet, Gävle (V 40-1:2).

and in widely individualized styles (Kain and Baigent 1992, 51–56).

A major land reclamation and mapping project began in the 1650s. Land that had been ceded to the nobility was reclaimed during the reductions of the 1650s and 1680s (*stora reduktionen*). *Reduktion* surveys were undertaken, resulting in maps. The *reduktion* was extended to the Baltic provinces, and young commissioners were recruited from the universities to conduct them. A more efficient tax collection system and administration were introduced in the provinces, while surveys and the development of communications bound the provinces to the rest of the realm. A new kind of cadastral map was introduced in the 1680s. Unlike the *geometriska jordeböcker* that preceded them, the new *skattläggningskartor* (tax assessment maps) were made exclusively for taxation purposes. Forest surveys and mapping (1:8,000) were also introduced during the same period (fig. 697). Forest ownership was divided by village, although not yet by estate. Forests owned by ironworks and sawmills were mapped and separated from one another. The fine-blade sawmill was an important technological innovation that spread from the Zaandam industrial area in the Dutch Republic to the Gulf of Finland in the late seventeenth century. In the 1730s, surveyors made plans that emulated the Zaandam industrial area on an island near Helsinki, but the unrealistic project was never fully realized.

The Great Northern War (1700–1721) interrupted the years of strong activity. The destruction of the war affected Finland in particular, where a third of the population perished. Consequently, farms were deserted.

In 1757, however, the great land reform known as land consolidation (*storskifte*), a Swedish version of enclosure, interrupted geographical surveys and early geodetic activities. Although there was from time to time opposition from the villagers to the *storskifte*, one can also identify acceptance of its implementation among the rural people. The Swedish *storskifte* created an independent, free, and strong class of freeholders.

The implementation of *storskifte* started under the direction of surveyors, who in 1725 had obtained the right to interfere in the open field system (*tegskifte*), nearly a hundred years after Sveriges Lantmäteriet was founded. The autonomy of freeholders was strong in Sweden. The *storskifte* meant that small scattered plots of land were consolidated into larger contiguous parcels. Tightly grouped villages began to be scattered, and collective landownership became private. The aim was to rationalize agriculture, which was hampered by the open field system with very narrow strips (*teg*) that forced all villagers to work their strips together at the same time and with the same primitive methods (*bytvång*). Most of the early land consolidation in Sweden occurred near large cities, shipyards (Karlskrona), fortresses (Göteborg, Sveaborg), or large manufacturing facilities (Gadd 2000, 280). Land consolidation was introduced not only to rationalize agriculture, but also to secure the operations of industry. Another significant reason to start land consolidation in Sweden was the rapidly growing population. One of the first modern censuses in the world (*Tabellverket*), begun in 1749, was used to confirm the population increase.

The Swedish *storskifte* was also influenced by developments abroad, especially the beginning in England in the 1750s of parliamentary parish enclosures. Some private citizens who had lived abroad also supported land consolidation. The most vigorous supporter of *storskifte* was Jacob Faggot, director of Generallantmäterikontoret (general land survey office), whose book on hindrances and help for Swedish agriculture, *Svenska landtbrukets hinder ock hjälp* (1746), was widely read. The natural scientist Pehr Kalm had during his voyage to the North America (1747–51) learned about land consolidation in England, and later back home he wrote about its usefulness. The American Revolutionary War (1775–83) and the trade blockade associated with it increased the demand for Swedish and Finnish wood considerably. The Crown wanted its share, and therefore surveyors began to survey superfluous lands (*överloppsjord*) and allocate them for use of the Crown. These were huge forest areas far from populated areas, which until then had been freely usable. This marked the beginning of state ownership of forests and was the foundation for the Finnish and Swedish forest industry.

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SEE ALSO: Sweden-Finland

BIBLIOGRAPHY

Alanen, Timo, and Saulo Kepsu. 1989. *Kuninkaan kartasto Suomesta, 1776–1805: Konungens kartverk från Finland*. Helsinki: Suomalaisen Kirjallisuuden Seura.

Ehrensvärd, Ulla. 2006. *Pohjolan kartan historia: Myyteistä todellisuuteen*. Trans. Jorma Könönen and Anne Sjöström. Helsinki: John Nurmisen Säätiö. In English, *The History of the Nordic Map: From Myths to Reality*. Helsinki: John Nurminen Foundation.

Gadd, Carl-Johan. 2000. *Det svenska jordbrukets historia*, vol. 3, *Den agrara revolutionen, 1700–1870*. Stockholm: Natur och Kultur/LTs Förlag.

Huhtamies, Mikko. 2008. *Maan mitta—maanmittauksen historia Suomessa, 1633–2008*. Helsinki: Maanmittauslaitos Edita.

Kain, Roger J. P., and Elizabeth Baigent. 1992. *The Cadastral Map in the Service of the State: A History of Property Mapping*. Chicago: University of Chicago Press.

Property Mapping in Switzerland. From 1513 to 1798, the Confederation of Switzerland consisted of thirteen fully autonomous urban and rural territories known as cantons, around one thousand less autonomous subordinate entities (e.g., cities, principalities), the internally federally structured republics of Grisons and Valais, the so-called condominiums (*Gemeine Herrschaften*), governed by multiple (but not all) cantons, and a few Protectorates (*Schirmherrschaften*). This complex and heterogeneous political structure informs any discussion of maps and plans created during the Enlightenment in the Swiss Confederation. Since there was no organizational structure in existence on the confederate level besides the Diet (assembly of state representatives), large-scale property mapping was possible at best at the level of the cantons.

A distinct heterogeneity is particularly obvious in the mapping of property as individual cantons undertook very diverse approaches. Initially, three categories of large-scale mapping were pursued: the boundaries of the cantons (including fortification and road building plans) and their subdivisions (*Herrschaftspläne*), the property of dominions and corporations, and individual large-scale plans of private property. The last served to determine ownership and to calculate taxes, as cadastral and tithe maps, or *Zehntenpläne*.

The leaders in large-scale boundary and fortification measurement were the large cantons of Zurich, Bern, and Basel; similar skills were required for property surveying. In Zurich, the painter, guild master, and civil servant Hans Conrad Gyger elaborated tithe plans as well as boundary and fortification plans (Wyder 2006). In Basel, the *Lohnherren* (city engineers) Jakob Meyer and especially his son Georg Friedrich Meyer made tithe plans of numerous municipalities (Burckhardt 1906). The two tithe plans of Sissach produced by the younger Meyer between 1689 and 1692 show the measurements of every property on a scale of approximately 1:2,860 as well as the names of property owners, and they provide a complex color coding for the tithe claims of different entities (Grenacher 1960, 9–10) (fig. 698).

FIG. 698. MANUSCRIPT TITHE PLAN BY THE BASEL *LOHNHERR* GEORG FRIEDRICH MEYER. "Grundriß der Zehnden-güetteren und Räbbergen welche in Sissacher Bann jenseith dem Ergoltsbach gelegen," 1689–92, ca. 1:2,860. Size of the original: 76 × 122 cm. Image courtesy of the Staatsarchiv Basel–Landschaft, Liestal (KP 5003 0349a).

In French-speaking Vaud, which was part of the Bern sovereign territory from 1536, fief commissioners (*Lehenskommissare*) and civil-law notaries who were specially commissioned to maintain terriers and lists of rights and revenues (*commissaires à terrier*) began to supplement the *Urbare* (indices of land tax and tithes) with graphic plans by the middle of the seventeenth century (Radeff 1980, 53–77). The oldest known cadastral plan originated in the Bernese Vaud (Denens by Abraham Dubois, 1651), followed by Fribourg (Estavayer by Franz Peter von der Weid, 1655–57), Geneva (Plainpalais by Jacques Deharsu, 1680–85), and Valais (Collombey, Neyres by Jean Grevoulet de la Salle and Abraham Buttex, 1696) (Radeff 1980, 60, 64). These plans were resurveyed and updated from time to time. Many of the plans in the seventeenth century were drawn *à vue*, that is, as seen—an orthogonal ground plan, without scale, with buildings in elevation, and other features drawn three-dimensionally. Yet some of these, such as those made of Lausanne in 1670 by Pierre Rebeur (and his son Jean-Philippe), a notary who had trained in French Burgundy, include precise measurements of surface area, scale and orientation, names of proprietors, and references to specific pages in the written registers of landholdings and titles (Radeff 2004, 297–98) (see fig. 50).

Tithe plans in French-speaking west Switzerland responded to three factors: the increasing value of land as a source of wealth, the political status of those who lived on and from the land, and the number of fiefs that required precise definition and measurement. Such factors illustrate the function of the tithe plans as an instrument of hegemony and perhaps explain why tithe plans did not significantly spread to the German-speaking part of the canton of Bern until later. Two examples demonstrate this: in Thurgovia, which was a condominium of the ruling cantons of the Old Confederation until 1798, tithe plans were elaborated that covered more than half of its surface area, resulting in a rich local mapping that did not occur as systematically in the ruling cantons themselves (Frömelt 1984, 15–16). In the Further Austrian Fricktal, the northwestern portion of the present-day canton of Aargau, measurement of the country was ordered as a consequence of Maria Theresa's tax reform of 1769 and was carried out by five "sworn surveyors" who recorded more than boundary plans on a scale of around 1:5,000 by 1785 (Rothweiler 2012).

Further examples of property mapping are found in the urban mapping of the period. For example, Jacques-Barthélemy Micheli du Crest, who proposed a universal mapping of all of Switzerland based on detailed measurement, supervised the work of the architect and surveyor Jean-Michel Billon in the creation of the "Plan Billon." Completed in 1726, this cadastral plan of Geneva comprised thirty-four detailed, precisely measured plans, each at 1:240, supplemented in 1729 with an overall plan at ca. 1:800 (see fig. 934).

The most apparent transition in property mapping techniques was the shift from the *plan á vue* to the geometrically measured and scaled plan. Both types might display names of property owners, crop or land use, and surface area expressed in a variety of measures, and make a graphic connection with the written record. Geometric plans not only used more precise linear and angle measurements but also began to follow prescribed rubrics for their content, as for example those laid out by the Chambre des Fiefs of Geneva following the advice of Micheli du Crest in 1722 (Zumkeller 1992, 84–86). This transition in western Switzerland reflected the influence of French and Italian large-scale surveying techniques, particularly those already in place in France and in the work of the Savoy cadastre in the Piedmont (Guichonnet 1963).

While plans drawn by sight were usually performed by city commissioners responsible for revenues or sworn notaries researching land titles, instrumental measure required trained surveyors. In the late seventeenth century, notaries like Dubois and Rebeur also trained as surveyors in an apprentice-master tradition or via some military service; they passed on their techniques to other students, one of whom was Pierre Sevin from Paris who went so far as to open a school of mapmaking in Fribourg (Radeff 1980, 72).

Such training was aided by written work such as the textbooks of Jakob and George Friedrich Meyer (e.g., *Compendium geometriae practicae, sive planimetria*, 1663). By the early eighteenth century, improved surveying instruments and the more rigorous surveying training offered by foreign military service aided the transition to geometric plans. The distance measurements made by a surveyor's chain, supplemented by measurement of the refracting angles in polygonal structures, made it possible to achieve relatively adequate neighborhood accuracy, but in the framework of a large-scale measurement on which individual plans could be based, they largely failed. Only in rare individual cases were large-scale measurements based on previous, and then only graphically executed, triangulation.

Not until the dawn of the nineteenth century did a further epoch-making development take place. Against the backdrop of late-Enlightenment endeavors within the Oekonomische Gesellschaft Bern, Philipp Albert Stapfer, as Minister der Wissenschaft und Künste of the Helvetic Republic, drafted a countrywide land-register measurement in 1798. Bern professor Johann Georg Tralles and his most important pupil, Ferdinand Rudolf Hassler, campaigned for a "large-in-small" (*vom Grossen ins Kleine*) methodology, which would create an initial countrywide triangulation as a benchmark before the subsequent large-scale measurements would be tackled. In contrast, some surveyors postulated the opposite principle of "small-in-large" (*vom Kleinen ins Grosse*), i.e., a country measurement as a compilation of all the municipality measurements (Rickenbacher 2011, 116–20). Neither approach was realized during the five years of the Helvetic Republic (1798–1803). After further false starts in the nineteenth century, the federal land register, Eidgenössisches Grundbuch, was established in 1912, building upon the early work of the Enlightenment.

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SEE ALSO: Switzerland

BIBLIOGRAPHY

Burckhardt, Fritz. 1906. "Über Pläne und Karten des Baselgebietes aus dem 17. Jahrhundert." *Basler Zeitschrift für Geschichte und Altertumskunde* 5:291–360.

Frömelt, Hubert. 1984. *Die thurgauischen Kataster- und Herrschaftspläne des 18. Jahrhunderts*. Zurich: Zentralstelle der Studentenschaft.

Grenacher, Franz. 1960. "Daniel Meyer, ein unbekannter schweizerischer Kartograph und der Kataster seiner Zeit." *Geographica Helvetica* 15:8–15.

Guichonnet, Paul. 1963. "Les cadastres genevois du XVIIIe siècle et de la période française." *Genava*, n.s. 11 (*Mélanges d'histoire et d'archéologie offerts en hommage à M. Louis Blondel*): 519–40.

Radeff, Anne. 1980. *Lausanne et ses campagnes au 17e siècle*. Lausanne: Bibliothèque Historique Vaudoise.

———. 2004. "Destinée européenne d'un Bourguignon: Le notaire et commissaire Pierre Rebeur." *Annales de Bourgogne* 76:291–312.

Rickenbacher, Martin. 2011. *Napoleons Karten der Schweiz: Landesvermessung als Machtfaktor, 1798–1815*. Baden: Hier + Jetzt.

Rothweiler, Werner. 2012. "Maria Theresias Steuerreform und die Gemeindebannpläne des Fricktals 1772–1785 und der rechtsrheinischen vorderösterreichischen Gebiete 1772–1788." *Vom Jura zum Schwarzwald* 86:7–28.

Wälchli, Karl F., et al. 1995. "Berne à la carte: Kostbarkeiten aus der Karten- und Plansammlung des Staatsarchivs." *Berner Zeitschrift für Geschichte und Heimatkunde* 57:3–50.

Wyder, Samuel. 2006. *Grenz-, Zehnten- und Befestigungspläne des Zürcher Gebiets von Hans Conrad Gyger (1599–1674)*. Sonderheft 18. Murten: Cartographica Helvetica.

Zumkeller, Dominique. 1992. *Le paysan et la terre: Agriculture et structure agraire à Genève au XVIIIe siècle*. Geneva: Editions Passé Présent.

Public Sphere, Cartography and the. The idea that the age of the European Enlightenment saw the emergence of a "public sphere" or a "bourgeois public sphere" has been central to a wide range of historical and philosophical inquiries since the conceptualization was first formulated in Jürgen Habermas's *Strukturwandel der Öffentlicheit* (1962, translated into English as *The Structural Transformation of the Public Sphere* in 1989). Habermas defined the public sphere as follows: "The bourgeois public sphere may be conceived above all as the sphere of private people come together as a public; they soon claimed the public sphere regulated from above against the public authorities themselves, to engage them in a debate over the general rules governing relations in the basically privatized but publicly relevant sphere of commodity exchange and social labor. The medium of this political confrontation was peculiar and without historical precedent: people's public use of their reason" (Habermas 1989, 27). In sum, the public sphere is the idea of private individuals congregating (directly in person and/or through the imagined community of print culture) to use their public reason to debate in a rational and civilized manner the nature of their governance and, more generally, the social arrangements governing their individual and collective lives. In Habermas's original version, and true to his training in the ambit of the Frankfurt School, the idea of the emergence of a public sphere was both a historically traceable reality amenable to archival research and a normative ideal—a desired state of public affairs creative of a form of communicative rationality that modern capitalist societies alleged to achieve but of which, as the critical-theoretical perspective could show, they fell short. Habermas's later work focused extensively on the problem of how to create or revive communicative rationality and a public sphere in modern mass society (Habermas 1984–87), but *Structural Transformation* was equally concerned with tracing a historical geography of the emergence of the public sphere. Two elements of this account must be emphasized.

First, for Habermas there was a clear European geography to the emergence of the public sphere. Above all, it was in Britain that the "model case," as he termed it, of the development of a public sphere was witnessed, beginning in the era of the Glorious Revolution (Habermas 1989, 57). Habermas went on to discuss France and Germany, which he saw moving along the same trajectory, but doing so both later and merely as continental variations on the model British case. For Habermas, other countries—notably France—had a more developed sphere of public literary debate than did Britain, but this was not translated into a political model of free and rational exchange until long after this transformation had occurred in Britain. Habermas summarized this European historical geography as follows:

> A public sphere that functioned in the political realm arose first in Great Britain at the turn of the eighteenth century. Forces endeavoring to influence the decisions of state authority appealed to the critical public in order to legitimate demands before this new forum. In connection with this practice, the assembly of estates became transformed into a modern parliament. . . . Why conflicts that were thus fought out by involving the public arose so much earlier in Great Britain than in other countries is a problem not yet resolved.

> A literary public sphere existed on the Continent too as an authority to which appeal could be made. There, however, it began to become politically virulent only when, under the aegis of mercantilism, the capitalist mode of production had advanced to a stage reached in Great Britain after the Glorious Revolution. (Habermas 1989, 57)

Second, this continental historical geography was predicated on a microgeography—that is, Habermas focused attention on new spaces emerging wherein private individuals could publicly debate what arrangements were in the public good. He discussed the French salons of the *philosophes*, but these were open by invitation only, and Habermas saw in the emergence of the English coffeehouse the paradigmatic space of the public sphere: "they were centers of criticism—literary at first, then also political—in which began to emerge, between aristocratic society and bourgeois intellectuals, a certain parity of the educated," with reason replacing rank as the basis of public debate (Habermas 1989, 32).

Habermas depicts the coffeehouse as awash with debate, newly emergent newspapers being seized upon as fodder for public discussion; he also implies in passing that much of this appetite for news fed on geographical and cartographic information about far-flung places: "the traffic in news that developed alongside the traffic in commodities. . . . required more frequent and more exact information about distant events" (Habermas 1989, 16). The coffeehouse indeed became a center for the reception and discussion of global geography and the exotic (Cowan 2005, 113–45) (fig. 699). Yet Habermas never fleshed this out in his original formulation of the historical emergence of the public sphere. More generally, as he admitted retrospectively, he did not address the question of the impact of science on the public sphere and vice versa, let alone unpack the reciprocal interactions between the public sphere and the operation of various branches of scientific and scholarly inquiry (Habermas 1992, 464).

FIG. 699. EDWARD WARD, *THE COFFEHOUS MOB*, 1710. Frontispiece to Ward's *The Fourth Part of Vulgus Britannicus: Or, the British Hudibras* (London: James Woodward, 1710). The coffeehouse not only provided access to the print world of newspapers but also to the visual culture of the period, with its graphic prints on the wall.
Size of the original: ca. 14.5 × 9.5 cm. © The Trustees of the British Museum/Art Resource, New York.

A generation of historians of science have gone a long way to rectifying this lacuna in Habermas's original formulation and in so doing have made important qualifications to his historical thesis that reverse some of its lines of argumentation. Steven Shapin (1994) has shown the extent to which the conduct of science in Restoration England was regulated by canons of civility and courtesy, gentlemanly behavior being demanded as a token of scientific respectability and gaining one a hearing in the rational forum of the Royal Society. To be accused of "impolite learning" was to be cast out from the ambit of the public sphere of scholarly debate (Goldgar 1995). If this form of public reason was still highly socially exclusive, others have traced the ways in which the creation and promulgation of scientific knowledge became far more democratic during the late seventeenth and eighteenth centuries. Scientific works were printed in increasingly user-friendly ways and the emergence of public lectures, often delivered in Habermasian spaces of the public sphere such as coffeehouses, ensured that a wide audience could learn and debate the findings of science, less constrained by Restoration conventions of gentlemanly scholarship than was the case in the Royal Society and other European scientific academies (Golinski 1992; Stewart 1992). A tight nexus between the space of the coffeehouse, commercial print culture, and the production and consumption of scientific and scholarly knowledge was formed in the late seventeenth century and endured through the period (Johns 1998). If this appears to show science mirroring or following the conventions of the political public sphere, a more radical argument has emerged in recent work. Simply put, it seems increasingly that what Habermas viewed as central—the emergence of a public form of political rationality—was in fact the by-product of a culture of virtuoso learning that sought to create a model for the courteous exchange of scientific ideas to replace that which had torn England apart in the Civil War. “The coffeehouse was not simply one among many backdrops or stages upon which the development of experimental science was played out; it was *itself* the product of the cultural world forged by the virtuosi in Britain’s age of scientific revolution. . . .The scientific laboratory, the academic journal, the learned society and the coffeehouse were all products of the social and cultural legacy of virtuosity” (Cowan 2005, 260). The culture of science, then, created the spaces and codes of the political public sphere rather than being their offshoot.

Cartography in the European Enlightenment is implicated in all the elements of the public sphere, in both its Habermasian formulation and the broader and more historicized arguments developed by intellectual historians and historians of science. If Britain was Habermas’s “model case,” many cartographers of the English Enlightenment could have been his model citizens. Herman Moll, “Great Britain’s most celebrated geographer and mapmaker of the first half of the eighteenth century” (Reinhartz 1997, 1), is a good example of one who interwove cartography and the public sphere. Socially, Moll was part of the “emerging bourgeois intellectual elite of London” (Reinhartz 1997, 4), engaged in a commercial operation to make his living out of mapmaking. Geographically, Moll was not simply a denizen of London, but, because of his situation at the heart of London’s print centers, was close to many of the coffeehouses of the time. More specifically, Moll exhibits the interaction of print, coffee, politics, and conversation that Habermas and the historians of science have discussed. He was a habitué of Jonathan’s Coffee House, one of the most famous of the age, being part of the circle that surrounded Robert Hooke, a coffeehouse scientist par excellence. Also part of this circle was Moses Pitt, who gave Moll his first job as an engraver and himself engaged in cartographic publishing, notably in the abortive project for *The English Atlas* (1680–83), to which the Royal Society, encouraged by Hooke, had lent its imprimatur. Moll’s own far more protracted and successful career as a cartographer shows him developing new print projects designed for the emergent styles of discussion and debate in the coffeehouses that have been seen as emblematic of the birth of a public sphere. Thus, Moll drew upon the burgeoning market for information in the form of daily and monthly newspapers and developed his *Atlas geographicus* (1711–17), a monthly magazine of geographical information, supplemented by maps, mostly by Moll himself. Clearly, the public appetite for news could be drawn upon in a new style of cartographic publication. Also, Moll was attuned to the ephemeral nature of coffeehouse politics and would rapidly produce maps and geographical descriptions to cater to the latest topics. Thus Moll tapped into the moment of speculative investment in an English company granted monopoly trading rights in South America and the area of the Southern Atlantic in general, a political incident known generally as the South Sea Bubble, producing both a book, *A View of the Coasts, Countries and Islands within the Limits of the South-Sea-Company* (1711), and the accompanying *A New & Exact Map* of the same (fig. 700). In works like this, of course, Moll was not just profiting from the emergence of a sphere of public political debate, he was also contributing to it, as his maps helped to shape public opinion and the attitudes of policy makers. Moving out from Moll, English cartographic culture more generally, by its close connections with the rest of the London print trade, was intellectually, geographically, and socially in constant interconnection with the spaces and ideas of the emergent public sphere. This led to a reciprocal relationship where the demand for maps was boosted and its nature altered by the public sphere’s incessant demand for ephemeral information and where maps played an active part in formulating the opinions and positions adopted in coffeehouse politics.

If the culture of cartography was interacting with the nascent public sphere, it is also the case that the paradigmatic print spaces of coffeehouse politics—the newspapers—developed a new relationship with cartography at this time. An icon of the public sphere, Joseph Addison and Richard Steele’s fictional proprietor of their publication, “Mr. Spectator,” suggested this interaction of news, maps, and the coffeehouse when mentioning a correspondent who responded to the visit of Prince Eugene of Savoy to England in 1712 by asking for a “very exact . . . Account of that wonderful Man who had marched an Army and all its Baggage over the *Alps*; and, if possible, to learn whether the Peasant who shewed him the Way, and is drawn in the Map, be yet living” (Bond 1965, 3:263). Mr. Spectator’s correspondent had clearly been poring over maps as he read of European campaigns, ready to debate their merits. In the factual realm, the most influential monthly magazine in the English Enlightenment, the *Gentleman’s Magazine*, within a decade of its first publication in 1731 started to make extensive use of maps. Some of these maps were merely of general interest, as with a copy of Jean-Baptiste Bourguignon d’Anville’s map of

FIG. 700. HERMAN MOLL, *A NEW & EXACT MAP OF THE COAST, COUNTRIES AND ISLANDS WITHIN Y^E LIMITS OF Y^E SOUTH SEA COMPANY*, 1711. Size of the original: ca. 65.5 × 49.5 cm. Image courtesy of Barry Lawrence Ruderman Antique Maps, La Jolla.

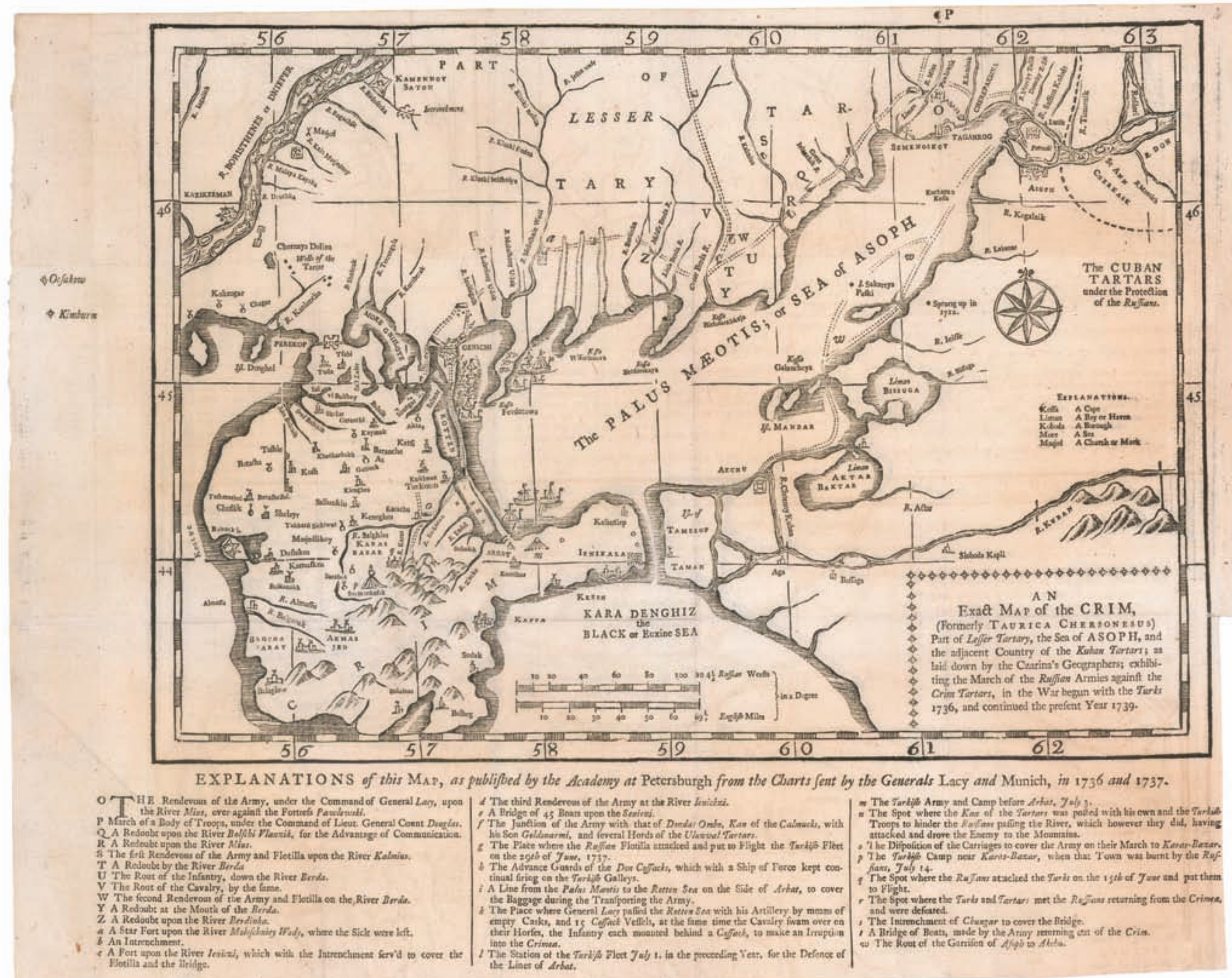

FIG. 701. *AN EXACT MAP OF THE CRIM*, 1739. From *Gentleman's Magazine* 9 (1739), following 50. Woodcut map with typeset lettering, showing the Crimean peninsula and Sea of Asov, based on work published by the Akademiya nauk in St. Petersburg. Size of the original: ca. 29.0 × 35.5 cm. Image courtesy of Barry Lawrence Ruderman Antique Maps, La Jolla.

Italy published in the journal in 1747 or Thomas Jefferys's map of Africa in 1748, but the vast majority were published for their topical importance, illuminating as they did key military and political events that were the stuff of political debate in the public sphere. Thus the first map ever published in the *Gentleman's Magazine* was of Crimea in 1739 (fig. 701), whose subtitle explained this was the seat of the conflict then raging between Russian and Turkish armies, hence its interest to an audience obsessed with public affairs. Likewise, the hostilities between England and Spain in the following year led to the publication of city plans of Havana, Portobelo, and Cartagena, together with a map of the West Indies showing the territories of the Spanish, French, and British Empires. A similar cartographic eruption allowed readers to understand more fully the Jacobite Rebellion of 1745, with a city map of Edinburgh, a map of the Battle of Gladsmuir (Prestonpans), and a map of the Carlisle area with the rebels' route inscribed—all appearing in 1745–46. The *Gentleman's Magazine* shows how central maps and other cartographic projects such as city plans could enable literate public intellectuals and politicians to make, debate, and visualize their arguments about state affairs (Reitan 1985). Thus, the emergence of the public sphere both encouraged the widening of the circle of those who were au fait with cartographic culture and led to new print spaces in which cartographic projects could flourish.

Moving beyond the space of the coffeehouse, maps were also part of the public political debate, both in

fig. 702. THOMAS BARNARD, *A MAP OF THE EAST INDIA COMPANY'S LANDS ON THE COAST OF CHOROMANDEL, FROM AN ACTUAL SURVEY MADE AT THE COMPANY'S EXPENCE . . . 1778*. Published in March 1779 by Alexander Dalrymple with the East India Company's approbation.

Size of the original: 60 × 115 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [7006 B]).

Habermas's literary public realm and in the fully fledged public sphere, which for him reached its apogee in a parliamentary democracy where individuals debated as equals rather than bearers of positions determined by hereditary estates. Even where a full public political sphere did not exist, maps could be used as part of allegorical discussions whose purpose was to question societal arrangements in general and the best ways to govern in particular, this activity being characteristic of Habermas's literary public sphere. Seventeenth-century France, for example, saw a proliferation of allegorical maps and the use of a language of cartography to debate societal questions such as gender relations and sexuality, which was inspired by Madeleine de Scudéry's map, *La Carte de Tendre* in *Clélie* (1654) (Peters 2004) (see fig. 54). More directly political was Jonathan Swift's book on Gulliver's travels, *Travels into Several Remote Nations of the World* (1726), which again shows that Habermas's literary public sphere could deploy maps in its construction of arguments about state affairs. While Swift did not believe people would be fooled into thinking that Gulliver's were genuine travels, he did deploy the print conventions of the travel narrative, including the use of five maps as he constructed his dystopian political satire (see fig. 389). These maps were probably engraved by Moll, whom Swift knew and whom Gulliver mentions in suggesting that maps and charts generally place New Holland "at least three Degrees more to the *East* than it really is; which Thought I communicated many Years ago to my worthy Friend Mr. *Herman Moll*" (Swift 1971, 292; Reinhartz 1997, 91–96).

Finally, maps became increasingly important in public debates in formal political forums as well as the coffeehouses and the literary public sphere. If, for Habermas, "the assembly of estates became transformed into a modern parliament" as a central part of the emergence of the public sphere (Habermas 1989, 57), parliamentary democracy by the late eighteenth century was most definitely cartographically aware. Moreover, and accordant with Habermas, whereas in early modern Europe maps were a tool of statecraft (Buisseret 1992), in Enlightenment Europe they retained this function but could also be deployed to take critical stances about state policy in the name of public reason. These contentions can be made good by looking at perhaps the greatest parliamentary orator of the English Enlightenment, Edmund Burke. Burke campaigned for the removal of power from the East India Company throughout his political life, arguing that its administration of India was irrational and ruinous. As part of this campaign, Burke repeatedly had recourse to cartography as a metaphor and a reality, arguing that his fellow members of Parliament and the general public need only become apprised of the geographical realities of the subcontinent to see the rationality of his argument. In his famous "Speech on Fox's India Bill," delivered in the House of Commons on 1 December 1783, for example, Burke tried to itemize the political misdemeanors of the East India Company in what he called "this map of misgovernment before me" (Burke 1981, 425). This metaphorical map came toward the close of a speech wherein Burke had also laid out a prolonged descriptive map of the territories under the Company's control. Arguing that "the object affected by the abuse should be great and important" for political intervention by Parliament to be warranted, Burke had provided a concise geographical description of the Indian territories, asking that elected members "permit me to recall to your recollection the map of the country which this abused chartered right affects" (Burke 1981, 387). Whether Burke actually presented a map at this time is unclear, but a year later, in a speech on the Nabob of Arcot's debts, he did: speaking on 28 February 1785, he laid before the House of Commons a copy of Thomas Barnard's map of the East India Company's lands (fig. 702), arguing that the map showed the paucity of the area's natural resources and the avarice of the East India Company's attempts to leverage revenue from the area: "I have therefore brought down my own copy [of the map], and there it lies for the use of any gentleman who may think such a matter worthy of his attention. It is indeed a noble map, and of noble things; but it is decisive against the golden dreams and sanguine speculations of avarice run mad" (Burke 1981, 521). Here, the map becomes a tool for criticism of current political practice. Furthermore, the map is positioned as a self-evident and self-explanatory remonstrance against irrational governance, a transparent bearer of reasoned argumentation. Burke's was not a lone voice; indeed, the same decade saw extensive cartographic argumentation of the same sort about the natural boundaries of the fledging United States of America (Brückner 2006, 98–141). In both cases, by the late Enlightenment cartography had positioned itself as a rational voice in public political debate. Not simply enabling the public sphere, the map here became the public sphere. Enlightenment cartography made reason visible.

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SEE ALSO: Antiquarianism and Cartography; Consumption of Maps; Decoration, Maps as; Education and Cartography; Enlightenment, Cartography and the; Geography and Cartography; Globe: Cultural and Social Significance of Globes; History and Cartography; Metaphor, Map as; Nationalism and Cartography; Religion and Cartography; Science and Cartography; Travel and Cartography; Women and Cartography

BIBLIOGRAPHY

Bond, Donald F., ed. 1965. *The Spectator*. 5 vols. Oxford: Clarendon Press.

Brückner, Martin. 2006. *The Geographic Revolution in Early America: Maps, Literacy, and National Identity*. Chapel Hill: For the Omohundro Institute of Early American History and Culture by the University of North Carolina Press.

Buisseret, David, ed. 1992. *Monarchs, Ministers, and Maps: The Emergence of Cartography as a Tool of Government in Early Modern Europe*. Chicago: University of Chicago Press.

Burke, Edmund. 1981. *The Writings and Speeches of Edmund Burke*, vol. 5, *India: Madras and Bengal, 1774–1785*. Ed. P. J. Marshall. Oxford: Clarendon Press.

Cowan, Brian. 2005. *The Social Life of Coffee: The Emergence of the British Coffeehouse*. New Haven: Yale University Press.

Goldgar, Anne. 1995. *Impolite Learning: Conduct and Community in the Republic of Letters, 1680–1750*. New Haven: Yale University Press.

Golinski, Jan. 1992. *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760–1820*. Cambridge: Cambridge University Press.

Habermas, Jürgen. 1984–87. *The Theory of Communicative Action*. 2 vols. Trans. Thomas McCarthy. Boston: Beacon Press.

———. 1989. *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society*. Trans. Thomas Burger. Cambridge: MIT Press.

———. 1992. "Further Reflections on the Public Sphere" and "Concluding Remarks." In *Habermas and the Public Sphere*, ed. Craig Calhoun, 421–61 and 462–79. Cambridge: MIT Press.

Johns, Adrian. 1998. *The Nature of the Book: Print and Knowledge in the Making*. Chicago: University of Chicago Press.

Peters, Jeffrey N. 2004. *Mapping Discord: Allegorical Cartography in Early Modern French Writing*. Newark: University of Delaware Press.

Reinhartz, Dennis. 1997. *The Cartographer and the Literati—Herman Moll and His Intellectual Circle*. Lewiston: Edwin Mellen Press.

Reitan, E. A. 1985. "Expanding Horizons: Maps in the *Gentleman's Magazine*, 1731–1754." *Imago Mundi* 37:54–62.

Shapin, Steven. 1994. *A Social History of Truth: Civility and Science in Seventeenth-Century England*. Chicago: University of Chicago Press.

Stewart, Larry. 1992. *The Rise of Public Science: Rhetoric, Technology, and Natural Philosophy in Newtonian Britain, 1660–1750*. Cambridge: Cambridge University Press.

Swift, Jonathan. 1971. *Gulliver's Travels*. Ed. Paul Turner. Oxford: Oxford University Press.