
E

Earth, Size and Shape of. See Geodesy and the Size and Shape of the Earth

East India Company (Great Britain). The English East India Company of the seventeenth century originated as a coalition of London merchants with trading ventures to the East Indies. In the eighteenth century it evolved into the United Company of Merchants of London trading to the East Indies (or United East India Company), a joint-stock investment company whose stockholders' income depended on investment in the continuous and reliable import and export of commodities by ships' voyages to and from India, the East Indies, and China. To render these voyages safe, profitable, and repeatable, the directors of the Company, its officials overseas, and the commanders of the ships it chartered had to develop an understanding of the oceans they crossed and of the geography and relative topography of the coasts they reached, the settlements at which they anchored or docked, and the hinterland from which their agents or factors attracted to the coastal factories the bulk commodities for export.

The East India Company's outsourcing of its transport requirements left the owners, and consequently the commanders, of the ships it chartered responsible for providing ships' equipment, including charts, atlases, and sailing directions. The Thames (or Drapers') School of chartmakers had grown up during the seventeenth century, and by 1700 a manuscript-copying industry on the banks of the Thames was supplying sets of coastal charts from the Persian Gulf to the Bay of Bengal and from the Andaman Sea to Macao and Amoy, derived primarily from Dutch manuscript sources but also using French and English information. John Thornton's 1703 reissue of John Seller's 1675 *The English Pilot, the*

Third Book . . . the Oriental Navigation brought many of the Thames School manuscript charts into print for the first time, though manuscript copying, particularly of voyage crux points such as the Strait of Singapore, the approaches to Macao, and the Strait of Bab el Mandeb (fig. 207), continued well into the 1730s.

Although *The English Pilot, the Third Book*, continued to be revised and reprinted until 1761, it was not without competition. In 1753, the release of the previously restricted sixth volume of Johannes van Keulen's *De nieuwe groote lichtende zee-fakkell* updated Dutch cartographic knowledge of the East Indies. In 1745 Jean-Baptiste-Nicolas-Denis d'Après de Manneville's *Le Neptune oriental* appeared; an atlas of sea charts and sailing directions of the East Indies created for the Compagnie des Indes, it soon overtook Thornton's work. An English translation of *Le Neptune oriental*, published as *A New Directory for the East Indies* by William Herbert and Samuel Dunn from 1758 in several editions, kept French cartography of the Indian Ocean at the front of British mariners' minds. Alexander Dalrymple's dissatisfaction with the lack of revision of the coastal charts in the second (1775) edition of *Le Neptune oriental* contributed to his plan, on his appointment by the East India Company in 1779 "for examining the Ships Journals" (Cook 2006, 83), for his own series of Indian Ocean coastal charts. The lack of accurately observed reciprocal longitudes of known places in the East Indies inhibited Dalrymple's plan, much as it had restricted earlier chartmakers, and Dalrymple's legacy, before the advent of significant numbers of chronometer runs, was a large contributory collection of manuscript and engraved plans of ports, harbors, and coastal details.

Apart from trade to China (Canton) for tea, Sumatra (Bencoolen) for pepper, and the Persian Gulf, the Company's increasing concerns in the eighteenth century with factories in India were not at first mirrored in cartography. Guillaume Delisle's *Carte des Indes et de la Chine* (1705) and the two maps of India in Herman Moll's *Atlas Geographus: or, A Compleat System of Geography, Ancient and Modern* (1711–17) were the next significant developments in the depiction of India after William Baffin's 1619 map from Thomas Roe's



FIG. 207. JOHN FRIEND, STRAIT OF BAB EL MANDEB, 1714. Manuscript.

Size of the original: 66.0 × 87.2 cm. India Office Records. © The British Library Board, London (IOR/X/10308).

embassy. The rudimentary state of East India Company geographical knowledge is exemplified by the manuscript map of southern India sent home from Madras in 1705, setting out the Company officials' understanding of the relationship among settlements and territories (fig. 208). Jean-Baptiste Bourguignon d'Anville's *Carte de l'Inde*, published in Paris in three sheets in 1752 with accompanying *Éclaircissements géographiques sur la carte de l'Inde*, and reissued in London by Herbert in 1759 with his translation *A Geographical Illustration of the Map of India*, represented, for both French and British, the next significant advance in the cartography of India. D'Anville's map, despite its many blank areas and its dependence on travelers' routes, formed the basis for French and British small-scale mapping of India for the campaigns of the Seven Years' War (1756–63) and the twenty years following.

From the early eighteenth century, the East India Com-

pany focused the administration of its factories in India on the three presidencies of Calcutta (Fort William), Madras (Fort St. George), and Bombay. This developed the three presidency cities by midcentury as administrative headquarters, each with a military presence and an increasing responsibility for administering surrounding territory. Public buildings and defenses brought military engineers and surveyors to produce town and fortification plans, many of which remained in manuscript, particularly those from the military campaigns in southern India. Some were eventually published, such as Thomas Kitchin's *Territory of Calcutta MDCCLVII* and the *Plan of Bombay* in the third edition of John Henry Grose's *A Voyage to the East Indies* (1772).

Territorial administration required communications and routes to be mapped. After the cession of the territory of Twenty-four Parganas in Bengal to the East India Company in 1757 following the Battle of Plassey, and



FIG. 209. DETAIL FROM THOMAS JEFFERYS, *THE EAST INDIES, WITH THE ROADS*, 1768. Detail of Bengal.

Size of the entire original: 107 × 138 cm; size of detail: ca. 54.5 × 70.0 cm. Image courtesy of the Geography and Map Division, Library of Congress, Washington, D.C.

and it was eventually abandoned on Rennell's advice in London in 1791. Charles Reynolds, surveyor in Bombay, and Robert Hyde Colebrooke, surveyor general in the 1790s, each attempted a fresh general map of India, neither of which saw publication. Lacking memoirs of their construction, the maps made after Rennell's could not be accurately revised in light of the many new linear route surveys that resulted from the increasing penetration of India by military expeditions. Thomas Goddard's march from Kalpi to Surat in 1778, Thomas Deane Pearse's expeditions southward from Midnapore along the east coast in the 1780s, and Reynolds's political mission from Surat to Gwalior and Cawnpore in 1785 are early examples of route surveys crossing India between presidencies, enabling the correction of earlier maps. Military campaigns, particularly those against Tipu Sultan in southern India in the 1790s, dictated the thrust of

survey activity. Surveys were carried out separately by Colebrooke in Calcutta, Reynolds in Bombay, and Michael Topping in Madras. Colebrooke produced a map of Mysore in 1792 (Phillimore 1945, 112–13), while Reynolds and the surveyors of the Bombay Army ran lines of survey from Poona to Seringapatam and from the Malabar Coast into Mysore. Topping, employed initially on coast and harbor surveys in the Northern Circars, surveyed the Kistna and Godavari Rivers in 1793. On Topping's death in 1796, Colin Mackenzie, surveyor to the army now based in Hyderabad, sought the post of surveyor general in Madras on the basis of his continuing surveys of the Hyderabad and Mysore territories. Political missions, such as those of William Kirkpatrick to Nepal in 1793 and Michael Symes to Ava in 1795, resulted in surveys that only emphasized the uncertainty of geographical knowledge of border regions. At sea the

safety of communications between the presidencies had to be secured: John McCluer spent the 1780s surveying the Malabar Coast and the navigation to the Persian Gulf on Company orders from London, while Archibald Blair and Alexander Kyd successively surveyed the Andaman Islands and Penang. In the 1790s, India was thus being explored in all directions from the three military centers of Calcutta, Madras, and Bombay, even though a central geodetic framework to connect the results of many separate operations had yet to be established.

From the 1750s, the East India Company in London increasingly required geographical information to enable it to understand reports and plans about political and military commitments undertaken by the three presidency administrations. Exasperation overflowed in the directors' letters to Calcutta in the 1760s about the lack of transmission to London of the surveys of the "new lands" in Bengal. It was natural that junior army officers charged with survey tasks would submit and dedicate their fair copies of manuscript maps to senior officers, and equally clear that these political and military officials would retain such maps first for their own use. Robert Clive's private collection of Rennell's maps far exceeded, in quantity and quality, the maps first sent back officially to London. Rennell brought his fair manuscripts to London from Calcutta in 1777, and Colin Mackenzie was later to do the same. Rennell latterly had the freedom to use Company geographical materials in London and frequently instigated requests to India for maps in the 1780s and 1790s (he had applied from India in 1776 to be put in charge of the geographical materials at India House). Copying for London was intermittently undertaken, and there developed, from the 1790s, separate collections of fair copies of maps in the surveyor general's office in Calcutta, the survey office in Madras, the quartermaster general's office in Bombay, and India House in London. The collections in India were brought together by the Survey of India in the nineteenth century and are largely found in the National Archives of India, while the London collections of the East India Company are administered by the British Library as part of the India Office Records.

The apparent reluctance and delay in sending maps and manuscript surveys from India to England stemmed partly from perceptions of confidentiality, partly from pride on the part of successive surveyors each wishing to create his own general map of India, and partly from problems in copying. The directors in 1784 required all geographical documents to be copied in triplicate for London; in 1786 they sent oil paper for this to be done; and in 1788 they required all original documents to be sent to London, "reserving a copy in India to prevent accident" (Phillimore 1945, 252). The copying of complex surveys was laborious for draftsmen, so that

Wood suggested in 1792 that only certain categories of maps merited being sent to London in original or copy (Phillimore 1945, 252). From the 1760s the East India Company had reserved the right to authorize engraving and printing of maps of India. Rennell's maps of Bengal, Bihar, Delhi, Agra, Oudh, and Allahabad, sent home in 1773, were first sent for engraving by Andrew Dury in London in 1776 and 1777. The Company in London effectively controlled the printing of maps of India for as long as large-format copperplate engraving and printing (the only viable print medium) remained undeveloped in India. Letterpress printing was commonplace in India, but it is thought that the climatic conditions that necessitated modification of ink recipes also inhibited the damping and drying of paper necessary for the engraved-plate rolling press. Small-format copperplate printing was practiced, but the earliest known engraved maps to be printed in Calcutta were William Baillie's 1791 reduction of Wood's 1786 plan of Calcutta and Aaron Upjohn's *Map of Calcutta and its Environs* (1794).

The copious effort that the East India Company put into mapping India in the eighteenth century is undeniable, but it inevitably remained uncoordinated until the development of a reliable geodetic framework for surveys, and rapid lithographic printing of their results, in the early nineteenth century.

ANDREW S. COOK

SEE ALSO: Administrative Cartography: Great Britain; Dalrymple, Alexander; Marine Charting: Great Britain; Rennell, James

BIBLIOGRAPHY

- Cook, Andrew S. 1978. "Major James Rennell and *A Bengal Atlas* (1780 and 1781)." In *India Office Library and Records Report for the Year 1976*, 5–42. London: Foreign and Commonwealth Office.
- . 2006. "Surveying the Seas: Establishing the Sea Routes to the East Indies." In *Cartographies of Travel and Navigation*, ed. James R. Akerman, 69–96. Chicago: University of Chicago Press.
- Edney, Matthew H. 1997. *Mapping an Empire: The Geographical Construction of British India, 1765–1843*. Chicago: University of Chicago Press.
- Gole, Susan, comp. 1980. *A Series of Early Printed Maps of India in Facsimile*. New Delhi: Jayaprints.
- . 1983. *India within the Ganges*. New Delhi: Jayaprints.
- Lahiri, Manosi. 2012. *Mapping India*. New Delhi: Niyogi Books.
- Madan, P. L., comp. 1982. *Catalogue of the MRIO [Map Record and Issue Office]—Miscellaneous Maps of the Survey of India (1742–1872)*. New Delhi: National Archives of India.
- . 1997. *Indian Cartography: A Historical Perspective*. New Delhi: Manohar.
- Markham, Clements R. 1878. *A Memoir on the Indian Surveys*. 2d ed. London: [India Office].
- Phillimore, R. H. 1945. *Historical Records of the Survey of India*, vol. 1. Dehra Dun: Survey of India.
- Prasad, S. N., ed. 1975. *Catalogue of the Historical Maps of the Survey of India (1700–1900)*. New Delhi: National Archives of India.

Eclipse Map, Solar. The mapping of the track across the earth's surface of the shadow ("umbra") made by a

solar eclipse was an innovation of the Enlightenment. The idea seems to have occurred first to Jean-Dominique Cassini (I) in conjunction with his development of a new technique to determine longitude from solar eclipses. In particular, he used an ingenious application of the isoline to help understand the extent and spatial variation of the eclipse of 23 September 1699. The contemporary measure for the degree to which the sun appears to be eclipsed by the moon from a given location was the “digit” (or “doit”), with twelve digits indicating total eclipse; Cassini accordingly calculated and plotted the lines for twelve digits (the line of centrality, or center point of the moving umbra), and also those on either side for six digits, on a very small-scale map of Eurasia (fig. 210). His son, Jacques Cassini (II), followed a simi-

lar procedure for the eclipse of 12 May 1706 although without publishing his map (Van Gent 2005, 105–10).

Retrospective eclipse maps remained a feature of the astronomical literature, such as those made after 1706 by Johann Gabriel Doppelmayr and published by the Homann company within his various astronomical atlases and texts. Doppelmayr’s particular innovation of combining map and explanatory diagram within the margins of other maps was subsequently copied by several other commercial publishers (Van Gent 2005, 113–27).

The first predictive eclipse map probably appeared in Symon van de Moolen’s *Meet-konstig afbeeldsel van een verduystering in de zon* (1705), a sixteen-page pamphlet on the phenomenon of solar eclipses with special



FIG. 210. CASSINI I'S UNTITLED MAP OF THE SOLAR ECLIPSE OF 23 SEPTEMBER 1699. From sunrise to sunset, Cassini mapped lines of centrality (twelve digits), partial eclipse (six digits), and the limits of the eclipse. The projection is a normal aspect azimuthal equidistant. From Jean-Dominique Cassini, “Reflexions sur l’eclipse du 23. Septembre

1699 par M. Cassini, qui ont été omises dans leur place,” *Histoire de l’Académie Royale des Sciences, année 1699* (1732): 274–82, map opp. 282.

Size of the original: 16.1 × 25.4 cm. Image courtesy of the Department of Special Collections, Memorial Library, University of Wisconsin–Madison.

(facing page)

FIG. 211. GEORGE WITCHELL, A MAP OF THE PASSAGE OF Y^E MOON’S SHADOW OVER ENGLAND & C. IN Y^E ANNULAR ECLIPSE OF THE SUN, WHICH WILL HAPPEN APRIL THE 1ST 1764 (London, 1764). State 1.

Size of the original: 56.2 × 40.8 cm. © The British Library Board, London (Cartographic Items Maps K.Top. 1.84).

reference to that predicted for 12 May 1706. Van de Moelen provided a very small-scale map of the Eastern Hemisphere on an oblique projection, with the path of the eclipse now shaded to show the extent of the umbra (Van Gent 2005, 111–12). The eclipse of 22 April 1715 prompted at least two predicative visualizations, by Nicolaas Samuelisz. Cruquius (see fig. 802) and Edmond Halley. Halley's was the first published map to show the eclipse path across a relatively small portion of the earth, specifically England and Wales (see fig. 793). At such a scale, the twelve-digit isolines lie wide apart, and between them Halley shaded the umbra itself (as it would extend in one particular moment) as a large oval disk; these he superimposed atop a common geographical map. Halley circulated the map to a number of correspondents with the request that they observe the timing of the eclipse in order to help him refine the tables of planetary motion. Subsequently, Halley reissued the map, having added the observed times of the eclipse (Pasachoff 1999).

With no fewer than five total eclipses visible from parts of Britain in the course of the eighteenth century, London became something of a center for predictive eclipse map production (Armitage 1997; Walters 1999). Those authors that thought to explain the phenomenon to the educated public produced diagrams tracking the moon's shadow around the globe. The first, by William Whiston, Lucasian Professor of Mathematics at Cambridge, for the 1715 eclipse, was rather awkward and abstract but would later be emulated; the York mathematician and land surveyor George Smith constructed a compromise between the Whiston and Halley approaches by mapping the predicted path of the totality of the 18 February 1737 and 14 July 1748 eclipses on an ingeniously skewed oblique projection.

Most of the British predictive maps, however, were made for a general audience and published by the commercial mapsellers, notably John Senex. These followed Halley's model with some modifications, such as the addition of some further isolines as well as icons showing how the sun would look from specific locations at maximum eclipse (fig. 211). Several of these maps were reissued in pirated versions. Moreover, these were either broadsides or included in monthly periodicals and were accompanied by texts explaining how solar eclipses were natural occurrences and so were not occasions for religious or mystical interpretation (Van Gent 2005, 113–15).

Less is known about eclipse maps published on the Continent during the course of the eighteenth century. In his predictive eclipse map, added to the 1752 posthumous edition of Doppelmayr's *Atlas coelestis* (titled *Atlas novvs coelestis*), Georg Moritz Lowitz included a high density of isolines for the degree of eclipse at one-

digit intervals. This innovation was followed by two French maps predicting the eclipse of 1 April 1764: the first by Nicole-Reine Étable de la Brière Lepaute, published by Jean Lattré (see fig. 950), and the second by Louis-Charles Desnos. A third map by Joseph Le Paute Dagelet, also published by Lattré, showed global coverage of the 24 June 1778 eclipse. These are also noteworthy as pioneering efforts in color printing (Armitage 1997, 22–23; 2005).

GEOFF ARMITAGE

SEE ALSO: Celestial Mapping; Halley, Edmond; Isoline; Thematic Mapping: Great Britain

BIBLIOGRAPHY

- Armitage, Geoff. 1997. *The Shadow of the Moon: British Solar Eclipse Mapping in the Eighteenth Century*. Tring: Map Collector Publications.
- . 2005. "A Female Enterprise." In *The Map Book*, ed. Peter Barber, 220–21. London: Weidenfeld & Nicolson.
- Gent, Robert H. van. 2005. "Mapping the Lunar Shadow—the Earliest Solar Eclipse Maps." In *Development of Solar Research/Entwicklung der Sonnenforschung*, ed. Axel D. Wittmann, Gudrum Wolfschmidt, and Hilmar W. Duerbeck, 103–27. Frankfurt: Verlag Harri Deutsch.
- Pasachoff, Jay M. 1999. "Halley as an Eclipse Pioneer: His Maps and Observations of the Total Solar Eclipses of 1715 and 1724." *Journal of Astronomical History and Heritage* 2:39–54.
- Walters, Alice N. 1999. "Ephemeral Events: English Broadside of Early Eighteenth-Century Solar Eclipses." *History of Science* 37:1–43.

Economy, Cartography and the. In an age of European commercial and imperial expansion and rivalry, there were obvious connections between cartography and the economy. Valued, distant lands were frequently portrayed with their bounty tellingly emphasized. For example, the title cartouche to Henry Popple's famous 1733 *A Map of the British Empire in America*, shows a native woman, whose nudity and child at her side emphasize her fertility, gesturing to a background scene of colonizing enterprise: four merchantmen, cargo being manhandled onshore, coopers hard at work, and the tilling of virgin soil. The clear beneficiaries of this distant enterprise are a group of five elegantly dressed gentlemen; a treasure chest lies prominently before them (fig. 212).

Popple asserted on his map that it had the approbation of Britain's Board of Trade and was based on "all the Maps, Charts, and Observations that could be found, especially the *Authentick Records & Actual Surveys* transmitted to their LORDSHIPS [of the Board], by the Governors of the *British Plantations*, and Others, to correct the many Errors committed in former Maps." Its accuracy was accredited by Edmond Halley, a leading scientist of the period who, over thirty years before, had famously mapped trade winds (see fig. 776) and magnetic variation (see figs. 348 and 442).



FIG. 212. THE VALUE OF COLONIAL ENTERPRISE. Title cartouche from Henry Popple, *A Map of the British Empire in America with the French and Spanish Settlements Adjacent Thereto* (London, 1733).

Size of the entire original: 49 × 48 cm; size of detail: ca. 10 × 17 cm. Image courtesy of the Geography and Map Division, Library of Congress, Washington, D.C. (G3300 1733 .P62).

Competition lay at the very heart of Popple's map, which was a political statement in the struggle to define the limits of the rival British, French, and Spanish empires in North America. As such, it exemplified the emphasis various European states had put on overseas trade and empire since the sixteenth century. At a time when it was difficult to see ways of generating economic growth internally, it was easier to imagine that domestic prosperity could be significantly heightened by looking abroad for markets, raw materials, precious metals, and, not least, slaves to work new lands. That there was a nationalistic element to this economic competition between states, what some have called mercantilism, is undeniable, even though the main players might have been private traders, motivated more by profit than patriotism. But competition also operated within Popple's map through its claims of superiority over its predecessors, even though it rested on no new surveys and depended heavily on French maps. This map was indeed a British answer to Guillaume Delisle's *Carte de la Louisiane et du cours du Mississipi* (1718) (Schulten 2007). As such, it neatly symbolizes the fact that by the early eighteenth century, France and Britain were pre-

eminent in Europe in terms of their economies, empires, and cartography, and they accordingly provide the focus of this article.

Yet Popple's map also points to some of the limitations of cartography in representing economic life. An important aspect of this is that the concept of the "economy," which seems so natural today, only began to take a firm hold in Europe after 1750. If the language of political economy slowly spread from its introduction in France in 1615, viewing the economy as a unified system was dramatically advanced by François Quesnay's *Tableau oeconomique* in 1758 and by Adam Smith's brilliant realization in 1776 of the operation of the "invisible hand" (Perrot 1992, 63–95; Hutchison 1988). Even today, however, mapping economies in their totality is problematic because it is impossible to capture the whole; the usual method of understanding economies entails multidimensional national income accounting. Rather it is the location of resources, outputs, infrastructure, and demand that tend to be mapped. In addition, economic matters are often best summarized quantitatively and, therefore, generally better expressed not in cartographic but in tabular, graphical, or algebraic forms. There were certainly important developments in this regard dur-

ing this period, notably the development of “political arithmetic” in late seventeenth-century England and of “*Statistik*” in mid-eighteenth-century Germany. In 1786 William Playfair made a seminal breakthrough with the invention of several of the most important types of graphs, which he called “charts” and which he published as an “atlas” (Playfair 1786). Cartographers could do nothing to match it, and it is notable that many important reference works relating to economic matters paid scant regard to cartography, even while paying considerable regard to geography. Adam Anderson’s substantial history of commerce had only three maps, two of which were reproductions of early maps (see fig. 373), and Jacques Savary des Brûlons’s pioneering commercial dictionary none at all (Anderson 1764, vol. 1, opposite ii, xxxi, and 386; Savary des Brûlons 1723).

Therefore, while geography—an acknowledged, if highly descriptive, science at the time—provided a very important frame for the consideration of economic matters, not least via environmental determinism, the relationship between cartography and the economy rested on the mapping of particular aspects, especially of valued economic locales or regions and the location of significant resources and infrastructures. An important dimension to this was the source of demand for such maps or charts. At the practical level it particularly included landowners (secular and ecclesiastical) concerned with property rights, as in enclosure and tithes; inland traders interested in markets, roads, and waterways; people with marine concerns (ship owners, captains, and merchants) looking for safe passage, good winds, and calm harbors; corporations using maps in their quest for funding or privileges; and states looking, as in Popple’s case, to establish or enhance their authority. Obviously the nature of the maps and charts these consumers commissioned or created depended fundamentally on the quality of the information at hand and the nature of the underlying survey (see below), but also on the extent to which their purpose was more or less persuasive, political, or propagandist. The financial motive often produced maps that, to modern eyes, were highly questionable in terms of their accuracy, veracity, or reliability as graphic representations of current knowledge.

From the methodological point of view, one obvious way to link maps with economics is to look at not only what they tell, but also at *what they do not tell* (Harley 2001; Laboulais 2004; Surun 2003). Indeed, one of the problems that cartographers faced in representing economic matters was to obtain relevant knowledge; often the map just exhibited the level of their ignorance. There were different ways to show this gap of knowledge: through blank spaces or question marks or, more often, with a brief text explaining why uncertainty remained. On the same map, well-known information was often

placed alongside pure conjecture. For example, Delisle’s *Carte de l’Afrique françoise ou du Senegal* (1727) of part of western Africa had statements such as “Tegazel or Tagaza Desert, where rock salt is extracted and carried by caravans from Timbuktu and Morocco,” sitting alongside statements such as “the French have not rowed above Goïna Waterfalls, and their knowledge upstream relies only on local people’s reports.” A little later, Jacques-Nicolas Bellin’s *Carte de l’isle de Terre-Neuve* (1744) of Newfoundland noted in the cartouche that “the rivers, the bottom of several bays, as well as the interior of the island, are completely unknown.”

This raises the issue of how economic knowledge was obtained when correct information did appear on maps. The interiors of distant lands had been barely traveled by Europeans, let alone surveyed; European economic connections were usually with peripheries not heartlands. Geographical maps (medium to small scale) of Africa, for example, rarely had much detail beyond the coastlines, with depictions of the interior depending heavily on information provided by local people, information that might be accurate or inaccurate, mistranslated or misinterpreted. Many seventeenth- and eighteenth-century maps of Africa contain comments such as that found on the *Carte de l’Afrique méridionale ou pays entre la ligne & le Cap de Bonne Esperance et l’isle de Madagascar* (n.d., Elizabeth Visscher, widow of Nicolaas II Visscher): “The Negroes say that the River Cuabo flows from Lake Zambre, which is not quite certain.” Similarly, Jean-Baptiste Bourguignon d’Anville’s *Carte de la partie occidentale de l’Afrique* (1727) included an inset of the Niger region on his map of western Africa but explicitly warned against its accuracy.

The channels through which economic elements were gathered were numerous: copying other maps, geographical dictionaries, or, more interestingly, reports from European travelers, traders, or officials, both military and civilian. Herman Moll’s *A New and Exact Map of the Dominions of the King of Great Britain on ye Continent of North America* (1715) (the “Beaver Map”) was indebted to “Cap.t T. Nearn and others” for the area of Louisiana. Previously employed at the Board of Trade, Popple cited his access to reports from colonial governors sent back to London. The reports and logs of André Brué, director of the French Compagnie du Sénégal from 1697 to 1702 and from 1714 to 1720, recorded his time spent in Africa and influenced maps of this area, including those by d’Anville that accompanied Jean-Baptiste Labat’s *Nouvelle relation de l’Afrique occidentale* (1728) about the European trading posts in western Africa (Broc 1975, 70–71 and n53).

Thanks to Labat it is not only possible to understand how Europeans gathered information to draw their maps, but also to know the lacunae in their knowledge

of Africa. Labat's book also exemplified the debate that engaged European scientists of the eighteenth century, between the *géographie de cabinet* and *géographie de terrain*, between theoretical and empirical geography. According to Labat, because almost no European traveler had visited the interior of Africa, geographers had to rely on pilots' reports or, more commonly, on local testimonies (Surun 2003, 45–52). To understand the path of the Gambia River, for example, one should embrace the “Negroes and Mandingue merchants” who traveled it daily and, “since [their] testimony is unanimous, . . . why should we not use their accounts, which cannot be suspected of deceit?” However, there remained still the big step in drawing a “geographical map of all these places”: Labat lamented the fact that the locals did not know how “to measure heights [i.e., latitudes], and even less longitudes,” and estimated distances in terms of walking days (Labat 1728, 2:161, 4:259–60). But his harshest criticisms were not directed against Africans but against geographers, who “often write without having seen” and “often mutilate the whole world” on their maps (Labat 1728, 2:253). This venomous attack expressed his inherent trust in the supremacy of practical experience over academic knowledge.

Labat also regretted—quite paradoxically—that “trade was the ultimate goal of Companies,” which chose not to explore the interior of lands, thus depriving themselves of “very useful discoveries for Geography and Botany” (Labat 1728, 3:169; similarly Green 1717). Among the few maps that appeared in Labat's book, one was based on a certain Compagnon's travels in the “*pays de Bamboucq*,” what is now Sudan, in 1716 (Labat 1728, vol. 4, between 32 and 33). This employee of the Compagnie du Sénégal found favor with Labat because he had a properly enlightened sense of curiosity, utility, and duty. He designed the map himself—which to Labat heightened its value—and, as new discoveries were made, corrected and improved it (Labat 1728, 4:38–39). However, as a representation of economics, this document was quite crude; gold mines were indicated with a little cross, but where they were very numerous “we could not mark them on the map, because too many crosses would have been confusing” (Labat 1728, 4:50–51). The text, rather than the map, indicated where the mines were located. We might wonder why maps were so imprecise, even for locating wealth. A first explanation could be the fact that such thematic cartography was not well codified at the time, and the data required to accurately locate mineral wealth was not available, especially in unexplored or underexplored territory. Maps at a small scale could not show the exact locations of mines and minerals. But a second hypothesis might explore the real motive behind these maps: to publicize the wealth of these countries and to stimulate public and private investment

into companies rather than locating exactly where this wealth was to be found.

These maps then say something about the priorities of those who commissioned them or their perceived audience, or both. D'Anville's 1727 map of Senegal marked only the roads or tracks that Europeans took, displaying little interest in the native routes. Similarly, maps of the Gulf of Guinea marked commercial territory important to European eyes either by clearly identifying regions as “grain coast,” “ivory coast,” “gold coast,” and “slave coast,” as in Moll's *New and Exact Map of Guinea* in Willem Bosman's 1705 account of the coast of Guinea, or by descriptive texts included on the maps themselves, as in d'Anville's 1729 map of the Guinea coast (fig. 213). Such maps hinted at the nature of economic engagements between Europeans and non-European lands and countries. Slaves, for example, were bought on the coast by Europeans from Africans, not seized inland.

Maps also reflect conflicts of interests inside European states or between them. First, as the Popple case shows, the economic competition between European powers to appropriate the world's wealth could be mapped, especially in the Americas, western Africa, and East Asia, where Britain and France were the main competitors, while the Dutch Republic, Spain, and Portugal were more heavily involved in South America and Southeast Asia. Such maps were occasionally specific, as in depictions of fishing rights, which, at different times, involved rival claims from Dutch, English, French, and Scottish fishermen. Thus did William Doyle mark the allegedly well-stocked “Nymph Bank” off southeast Ireland on his *A New Chart of the Sea Coast of Great Britain* (1738, 30). Further afield, Herman Moll's *New and Exact Map* (1715) summarized the piscine aspect of the Treaty of Utrecht that closed the War of the Spanish Succession in 1713: “The French by the Treaty . . . are allowed to catch Fish, and to dry them on land, in that Part only, and no other, of the Island of Newfound-Land.” Exceptionally, diplomats drew manuscript maps to illustrate specific economic claims. After the War of the Austrian Succession, for example, British and French commissaries discussed the number of maritime prizes each side would be allowed to keep after the signing of the peace treaty. Their claims, which were at odds with each other, were expressed cartographically (Morieux 2008, 160–61).

More often though, European competition for distant economic resources or markets was depicted in general terms. That is, the maps showed the lands that were valued, but gave little indication as to the specific nature of their value. Their meaning in that regard was provided by common knowledge conveyed in an accompanying text or perhaps a “project” or “scheme.” For example, the South Sea Company was formed in Britain in 1711, in part, to try to gain access to some of the

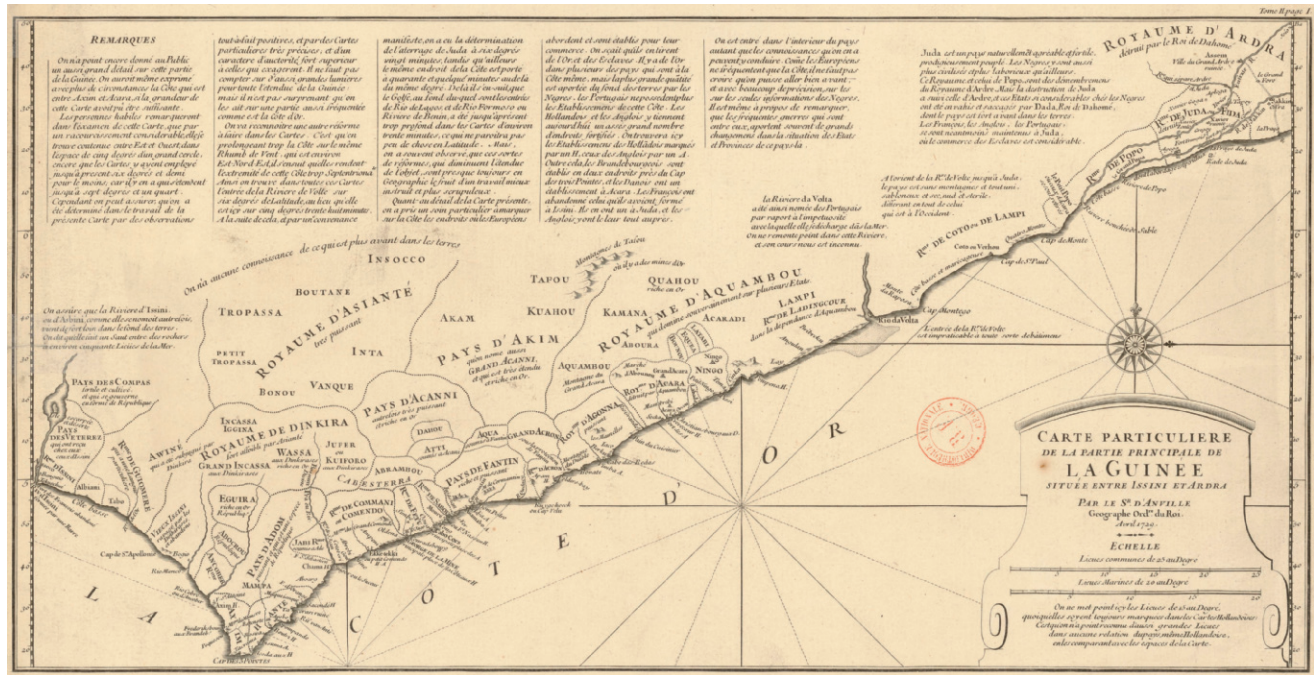


FIG. 213. EUROPEAN COMMERCE AND THE COAST OF WESTERN AFRICA. Jean-Baptiste Bourguignon d'Anville, *Carte particuliere de la partie principale de la Guinée située entre Issini et Ardra* (Paris, 1729). The map shows the native kingdoms and their boundaries along the Gold Coast, as well

as the coastal locations at which the Dutch (H), British (A), and Danes (D) traded for gold and slaves. Size of the original: 33.5 × 61.0 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge D 10864).

markets in Latin America then dominated by Spain and Portugal. Moll's *A View of the Coasts, Countries and Islands Within the Limits of the South-Sea-Company* (1711) visualized that hope, although its general map provided no detail as to the region's natural resources or value. That task was fulfilled in the accompanying text of two-hundred-plus pages in nine chapters. But Moll also knew that the great wealth of South America was a widely believed legend, indeed a myth. Could a map really counter the myth? Moll's map shows that it was not necessary to reflect the true state of economic knowledge of a region; the map served more as a visual appendage than a documentation of reality. Its production was not stimulated by forces that desired to depict economic features, but principally by financial speculation and political maneuvering. Similarly Zacharias Châtelain's map based on documents gathered for the establishment of the Compagnie du Mississippi in the 1710s only hinted at different aspects of the region's value through some highly vague motifs: agriculture, livestock, the fertility of the land, and the way villages were built (fig. 214). As with the Moll map, the Châtelain map did not locate precisely where resources could be found, but created an encyclopedic display, in general and stylized terms, of the wealth of the region to stimulate investment.

If maps played a role in attempts to gain exclusive

trading rights or to encourage people to invest in a project, they could also be used in the debates between holders of exclusive rights and independent traders. An anonymous French manuscript map of the west coast of Africa, from Cabo Blanco to the Sierra-Leone River, dating from the 1720s, expressed the criticisms of French trading interests against the monopoly of the French Compagnie des Indes, which forbade them from trading in regions it lacked the means to control. Trading beyond the Cape of Good Hope, with Madagascar or Arabia, was prohibited for French individuals and was said to be "contrary to French shipping, to the maritime power of the kingdom, and to the good of the state in general" (Paris, Bibliothèque Nationale, Ge B 1702).

So far only general maps of far-flung lands have been cited. Even though they were not directly rooted in new surveys—and indeed were synthetic at best, mere copies at worst—they nonetheless reflected contemporary enthusiasm for the economic value of overseas commerce and empire. But of course most European economic activity was undertaken domestically, especially in agrarian communities. Even in England, probably the most developed economy in Europe in 1800, less than a third of the population lived in towns of more than 5,000 people. While industries were often located in mainly agricultural locales, working the soil was still clearly the

dominant form of economic activity. Property ownership was therefore critically important, as reflected in large-scale manuscript estate maps. For large estates, the plans might aid the management of tenancies, but they often functioned more as elegantly produced statements of ownership, which, like a portrait, could be handed down through the generations. However, where property rights were being redistributed or exchanged, new surveys were often needed, as in the thousands of enclosures or tithe commutations undertaken in England (Kain, Chapman, and Oliver 2004; Kain and Oliver 1995).

From the seventeenth century onward, the sea became a key theater of war between European powers, and maritime concerns elicited repercussions on land. Britain, France, Spain, and Portugal, among others, sought to build powerful navies to compete with one another. To do so, a nation needed guaranteed and regular supplies of good-quality wood. Since the thirteenth century, French kings had passed laws to protect their forests and began to use maps for that purpose in the sixteenth century. Jean-Baptiste Colbert's "Ordonnance . . . sur le fait des eaux et forêts" (1669) was the most important, as it systematized a policy of conservation and expansion of French forests, which were surveyed and mapped in considerable numbers around this time. It is important to point out that these documents were not only descriptive but also prospective, since silviculture required advance planning for forty or fifty years; future felling areas were represented next to actual cuttings. Maps were therefore a tool for governing and managing the state's resources, "to convince of the projects' utility or to estimate the cost of the intended works" (Pelletier 2013, 37).

As with woods and ships, so too with other maps of internal infrastructure; they might seem merely descriptive, but often contain underlying plans for financial and

economic enterprises. Andrew Yarranton's undated map of England's midland counties and rivers, for example, aimed to show "how farr the greate Rivers of England may be made Navigable, And there by serviceable one to the other, soe the carriage of Goods and Merchandize, made Easie and Cheape" (London, British Library, Add. MS 4473, f. 31; Yarranton 1677–81, 1:64–65) (fig. 215). Because of the property rights involved, maps were often needed to gain the legal authority to build housing, turnpikes, canals, weirs, or docks.

For economic historians, the main interest of early modern maps is not what they appear to say about the economy, which was often demonstrably inaccurate, but, like any historical source, why they were produced, how they were drawn, and in what ways they were used. The material conditions in which the map was prepared inform the historian about power relationships in the context of empire, the building of the nation-state, or the rivalry between European powers, as well as notions of property and the means of increasing wealth. They can also testify to the major economic changes of the period—the Industrial Revolution and the conquest of the world by Europeans—from Popple's map to Hanoverian engineer Johann Ludewig Hogrewe's 1778 map of the Bridgewater Canal (see fig. 341), part of his general survey of the canal system in Great Britain.

The relationship between cartography and the economy during the Enlightenment was indeed paradoxical. While the thinking about economy became increasingly elaborate, emphasizing its dynamism, cycles, and different interests, representing it on maps posed cartographers a challenge that they understandably failed to meet. Not until much better statistical data became available in the nineteenth century would it be possible to map economic flows with reasonable accuracy. The main goal of cartographers in relation to the economic



FIG. 214. IDEALIZED IMAGININGS OF NATIVE SOCIETY IN NORTH AMERICA. Detail from Zacharias Châtelain, *Carte de la Nouvelle France* (Amsterdam, 1719).

Size of the entire original: 50 × 55 cm; size of detail: ca. 6 × 18 cm. Image courtesy of the Bibliothèque nationale de France, Paris (Cartes et plans, Ge DD 2987 [8537 B]).

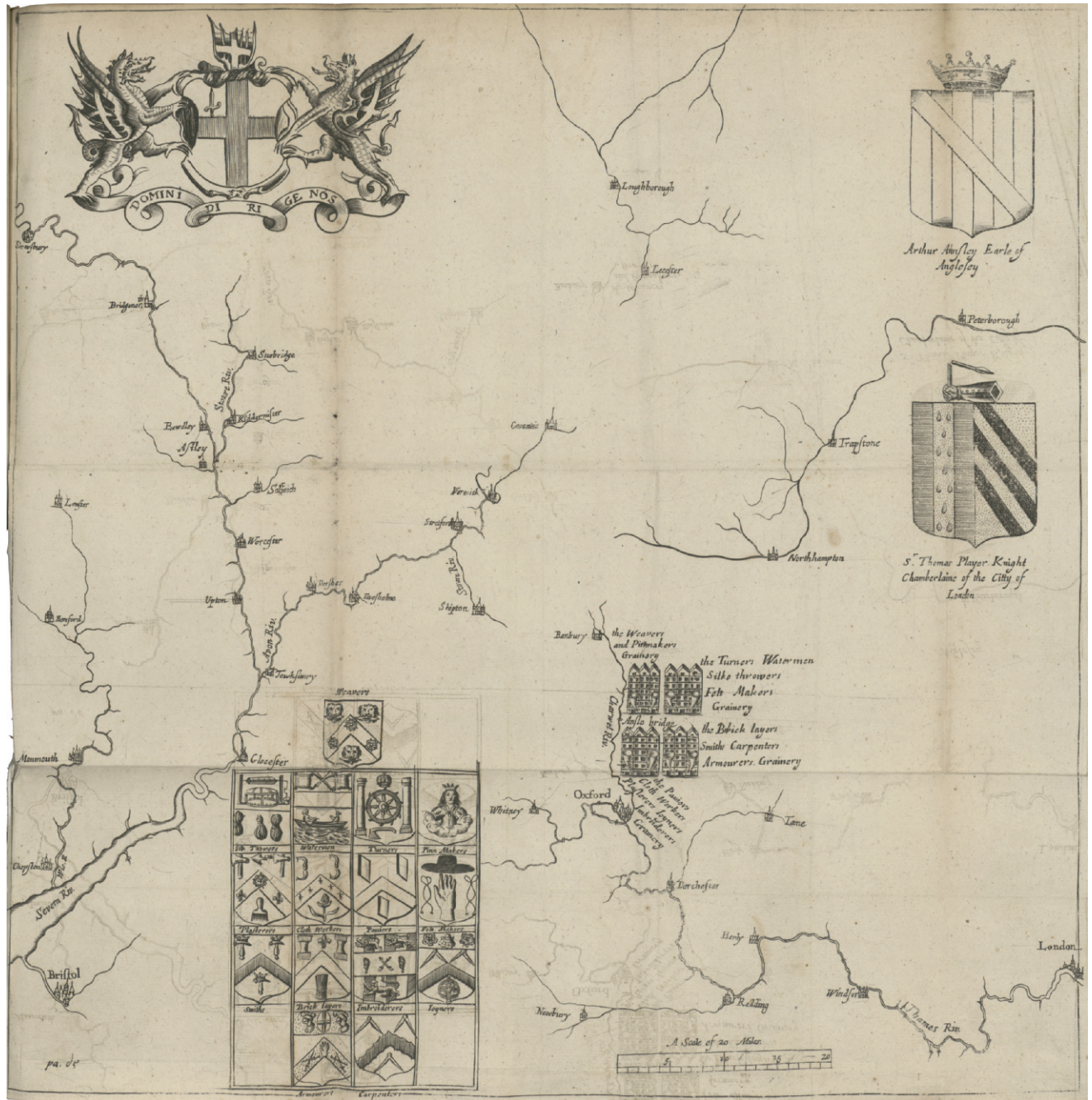


FIG. 215. THE POTENTIAL FOR INFRASTRUCTURAL CHANGE. From Yarranton 1677–81, vol. 1, between 64 and 65.

Size of the original: 41 × 41 cm. Image courtesy of the Special Collections Library, University of Michigan, Ann Arbor.

sphere was, therefore, much the same in 1800 as it had been a century and a half before: to describe a particular reality as precisely as possible. Some of them, such as the Cassinis in France, were conscious that their maps could be nothing more than an image at a given time, a moment that might soon pass with the building of new canals or new roads. On the *Carte de France*, therefore, César-François Cassini (III) de Thury decided to limit his

project to elements of the landscape that were unlikely to change quickly, like church towers (Pelletier 2013, 147–48). However, another type of cartography also developed in the Enlightenment, whose relationship to the economy was very different; instead of focusing on economic facts that were already outdated by the time they were drawn, prospective maps could represent a view of the future, albeit a future often imagined in self-

serving ways by the state, corporations, companies, and the propertied.

JULIAN HOPBIT AND RENAUD MORIEUX

SEE ALSO: Indigenous Peoples and European Cartography; Map Trade; Nationalism and Cartography; Public Sphere, Cartography and the; Statistics and Cartography; Thematic Mapping; Enlightenment

BIBLIOGRAPHY

- Anderson, Adam. 1764. *An Historical and Chronological Deduction of the Origin of Commerce*. 2 vols. London: Printed for A. Millar et al.
- Broc, Numa. 1775. *La géographie des philosophes: Géographes et voyageurs français au XVIII^e siècle*. Paris: Editions Ophrys.
- Doyle, William. 1738. *Two Letters Wherein the Sovereignty of the British Seas, and That the Sole Right of Fishing in Them, Appertaineth to the King of Great-Britain, &c. is Demonstratively Maintain'd and Asserted*. London: Printed for J. Brett.
- Green, John (Bradock Mead). 1717. *The Construction of Maps and Globes*. London: T. Horne et al.
- Harley, J. B. 2001. "Silences and Secrecy: The Hidden Agenda of Cartography in Early Modern Europe." In *The New Nature of Maps: Essays in the History of Cartography*, by J. B. Harley, ed. Paul Laxton, 83–107. Baltimore: Johns Hopkins University Press.
- Hutchison, T. W. 1998. *Before Adam Smith: The Emergence of Political Economy, 1662–1776*. Oxford: Basil Blackwell.
- Kain, Roger J. P., and Richard Oliver. 1995. *The Tithe Maps of England and Wales: A Cartographic Analysis and County-by-County Catalogue*. Cambridge: Cambridge University 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 Catalog*. Cambridge: Cambridge University Press.
- Labat, Jean-Baptiste. 1728. *Nouvelle relation de l'Afrique occidentale: Contenant une description exacte du Senegal & des pays situés entre le Cap-Blanc & la Riviere de Serrelionne*. 5 vols. Paris: Chez Guillaume Cavelier.
- Laboulais, Isabelle, ed. 2004. *Comblant les blancs de la carte: Modalités et enjeux de la construction des savoirs géographiques (XVI^e–XX^e siècle)*. Strasbourg: Presses Universitaires de Strasbourg.
- Morieux, Renaud. 2008. *Une mer pour deux royaumes: La Manche, frontière franco-anglaise, XVII^e–XVIII^e siècles*. Rennes: Presses Universitaires de Rennes.
- Pelletier, Monique. 2013. *Les cartes des Cassini: La science au service de l'État et des provinces*. New ed. Paris: Éditions du CTHS.
- Perrot, Jean-Claude. 1992. *Une histoire intellectuelle de l'économie politique, XVII^e–XVIII^e siècle*. Paris: Editions de l'École des Hautes Études en Sciences Sociales.
- Playfair, William. 1786. *The Commercial and Political Atlas: Representing, by Means of Stained Copper-Plate Charts, the Exports, Imports, and General Trade of England, at a Single View*. London: Printed for J. Debrett et al.
- Savary des Brûlons, Jacques. 1723. *Dictionnaire universel de commerce: Contenant tout ce qui concerne le commerce qui se fait dans les quatre parties du monde*. 2 vols. Paris: Jacques Estienne.
- Schulten, Susan. 2007. "Mapping American History." In *Maps: Finding Our Place in the World*, ed. James R. Akerman and Robert W. Karrow, 159–205. Chicago: University of Chicago Press.
- Surun, Isabelle. 2003. "Géographies de l'exploration: La carte, le terrain et le texte (Afrique occidentale, 1780–1880)." PhD thèse, École des Hautes Études en Sciences Sociales, Paris.
- Yarranton, Andrew. 1677–81. *England's Improvement by Sea and Land: To Out-do the Dutch without Fighting, to Pay Debts without Moneys*. 2 vols. London: Printed by R. Everingham for the author.

Education and Cartography. Mapmaking and map reading were central to consciously modern and progressive education, both military and civilian, during the Enlightenment. Geographical mapping in the eighteenth century was oriented markedly toward educational uses, so the most obvious aspects of education and cartography are discussed in the entries about geographical mapping. By contrast, this entry elucidates the less visible but equally pervasive support for education within the increasingly sophisticated public sphere. The theme is explored here in the specific context of Great Britain; this detailed analysis is intended not to exemplify educational encounters with maps across Enlightenment Europe, but to promote further analysis of this complex phenomenon in other parts of Europe.

Instructions for making and using maps diffused widely in Enlightenment Britain with the production of affordable cartographic objects and images for a middle-class audience, of all ages and both sexes, curious to know about the land and life of places in their own country as well as those abroad, within and beyond the national imperium (Mayhew 1998). These products included mass-produced teaching aids, illustrations in magazines and guidebooks, and decorative, domestic fixtures such as firescreens, wallpaper, fans, and embroidery samplers, both manufactured and homemade (Shefrin 1999).

Based on new surveys and expressed in skilled draftsmanship, the improvement of mapmaking was also central to the modern reform of military strategy throughout Europe, for planning operations in the field, and particularly for increasing mobility of tactics over a range of terrain. Cartography was also deployed for the commemoration as well as the conduct of warfare, for recording successful campaigns in artwork that combined plans, prospects, and vignettes, and placed the field of battle within a wider world and practice of conquest and pacification.

MILITARY EDUCATION From a position in the Drawing Room of the military's Board of Ordnance at Edinburgh in the early 1740s and because of his prodigious graphic skills, Thomas Sandby was appointed draftsman to the commanding general, William Augustus, duke of Cumberland. He produced views of military sites, which also offered commentary on the conflict and its aftermath. His plan of the decisive 1746 Battle of Culloden, executed for Cumberland, is aligned with long-established traditions of military art, showing the strategic positioning of military units, but the sketch of the battle departs from tradition, in viewing it from the perspective of the enemy, with a group of Jacobites in the foreground advancing down the rise (Bonehill and Daniels 2009b, 80–81; Plax 2002) (figs. 216 and 217). Placing the sketch against the regular straight lines

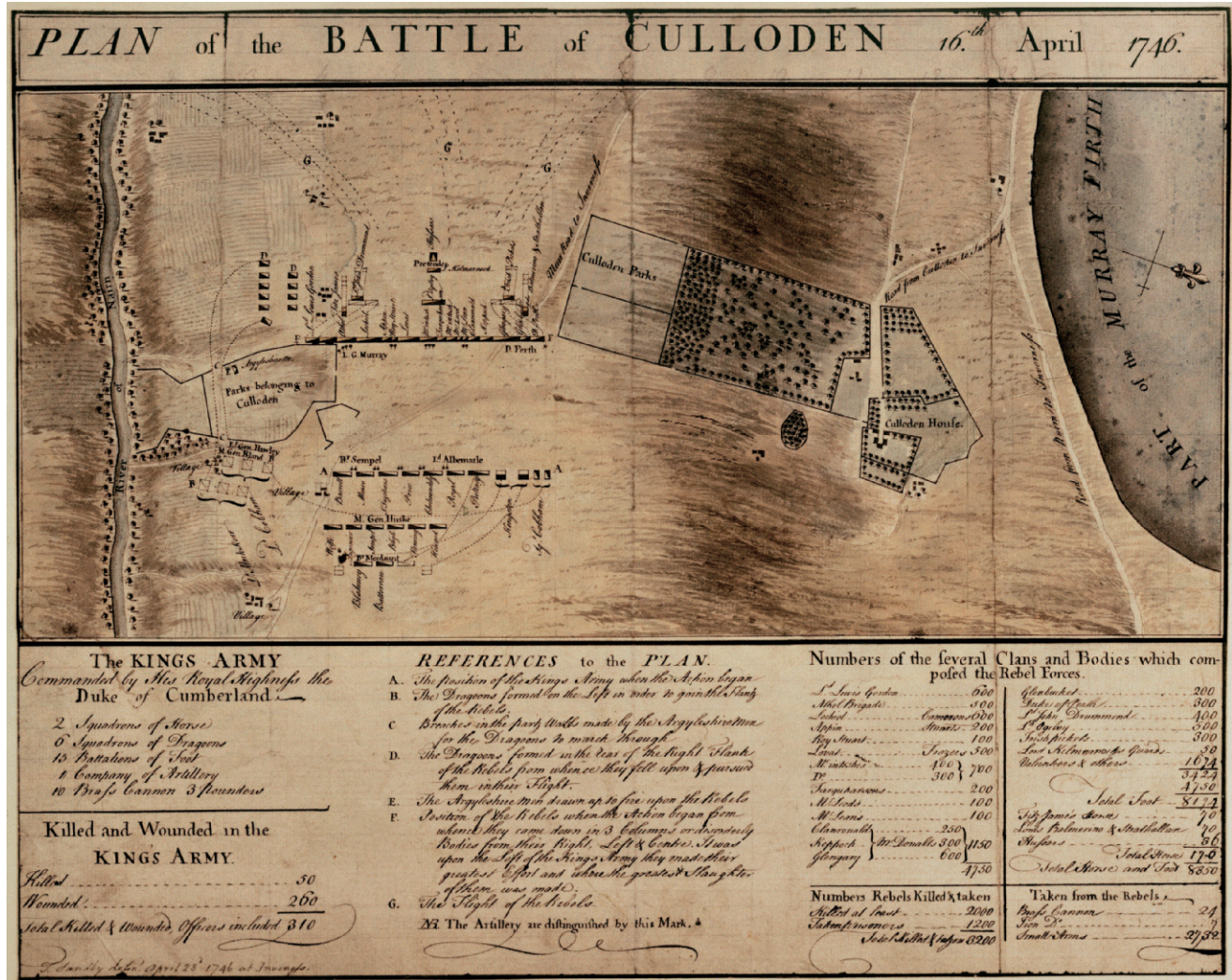


FIG. 216. THOMAS SANDBY, PLAN OF THE BATTLE OF CULLODEN, 1746.

Size of the original: 34.2 × 42.7 cm. Image courtesy of the Royal Collection Trust/© Her Majesty Queen Elizabeth II 2018 (RL 17177).

formed by Cumberland’s troops, as seen in the plan, only serves to accentuate the disorder in the enemy ranks, the contrast of which is noted in an eyewitness account of the day’s events, which described the “great Beauty of Discipline and Order” of government lines in contrast with the “desperate Attack” made by the rebels, who “like Wildcats . . . came down in Swarms” and in “Fury” (Hughes 1746, 38, 41). In a further episode of Sandby’s pictorial narrative, an extensive prospect of the military camp at Fort Augustus foregrounds two kilted Jacobite soldiers as chained prisoners, accompanied by redcoats, with the encircling highland landscape under the watchful eye of British dominion (Charlesworth 1996; Bonehill and Daniels 2009b, 78–79) (fig. 218). Taken from a sketch by Paul Sandby, the highlanders are not portrayed (as so often in English representation)

as wild and scrawny, but in defeat display a resigned nobility, even a shapely elegance. This is evident in other commemorative images, notably the cartouches on John Elphinstone’s manuscript map of North Britain, an old convention of conferring worth on defeated adversaries as well as a sign of conciliation for a conflict that in Scotland and Britain fractured a complex matrix of loyalties, identities, and commitments (Anderson 2010; Barber and Harper 2010, 110–11) (fig. 219).

Paul Sandby followed his elder brother to become chief draftsman of the Military Survey and a highly versatile view maker, accompanying surveying parties in the highlands and overseeing the making of the fair copy of the so-called Great Map in the Drawing Room of Edinburgh Castle (Christian 1990; Bermingham 2000, 78–83; Roy 2007; Bonehill and Daniels 2009b, 82–86).



FIG. 217. THOMAS SANDBY, *A SKETCH OF THE FIELD OF BATTLE AT CULLODEN, 1746.*

Size of the original: 29.2 × 53.1 cm. Image courtesy of the Royal Collection Trust/© Her Majesty Queen Elizabeth II 2018 (RL 14722).



FIG. 218. THOMAS SANDBY, *FORT AUGUSTUS, CA. 1746.*

Image courtesy of the Royal Collection Trust/© Her Majesty Queen Elizabeth II 2018 (RL 14725).

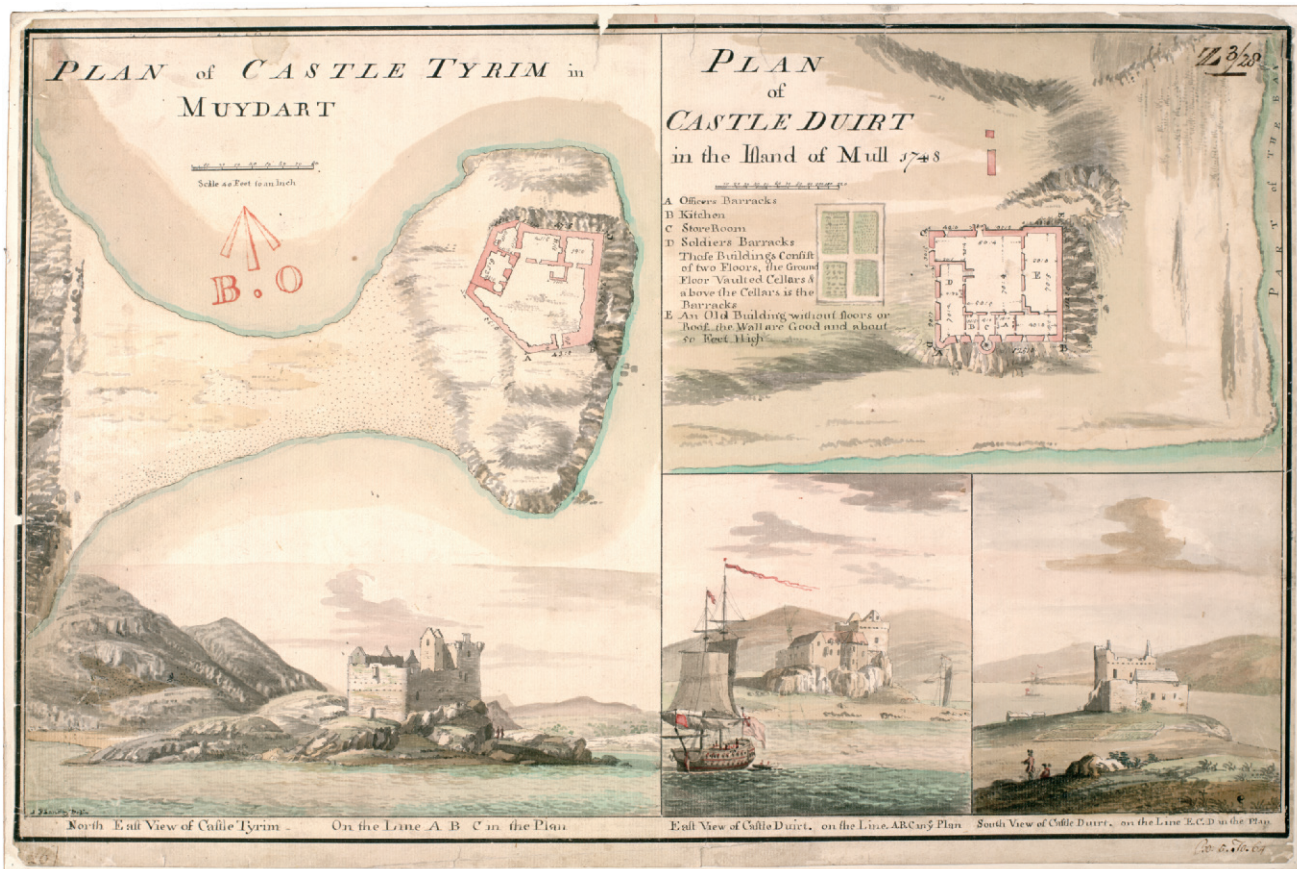


FIG. 220. PAUL SANDBY, *PLAN OF CASTLE TYRIM IN MUYDART, PLAN OF CASTLE DUIRT IN THE ISLAND OF MULL, 1748.*

Size of the original: 32.7 × 52.6 cm. Image courtesy of the National Library of Scotland, Edinburgh (MS 1648 Z.03/28e).

Sandby produced plans and views of strategically important castles as part of a report on their state of repair, including views from boats and showing familiarity with the tradition of maritime draftsmanship and its various types of sketching and delineation (Bonehill and Daniels 2009b, 92–93; David 1988, xxxviii–xli; Sands 1990; Driver and Martins 2002) (fig. 220). Sandby's assemblage of plans and views, accommodating multiple perspectives in the same frame, conveys a good deal about the wider geography of the sites, demonstrating the exchange between traditions of maritime and military draftsmanship. Along with supervising the making of the Great Map, Sandby undertook a virtuoso style of terrain drawing in pen and wash, with aligned brushstrokes indicating the direction of slopes and the gradu-

ation of tones denoting steepness and height, contributing decisively to the artistic effect of the work.

A small but highly sophisticated drawing by the younger Sandby preserved in the king's topographical collection commemorates both projects (fig. 221). It shows in the background the relief of the mountains in the signature style of shading used on the fair copy of the Great Map and in the foreground a compositional device from classical style art, a Claudian-style tree, framing a surveying party at work near Kinloch Rannoch. One man takes a sighting through a circumferentor while two other men drag a chain across a remarkably level, empty space, a blank portion of the paper, reminding the viewer of the paper on which this new view of the land will be inscribed. This is, then, a picture

(facing page)

FIG. 219. JOHN ELPHINSTONE, "A NEW MAP OF NORTH BRITAIN," 1746. This manuscript map includes, among its several inset images, a reduced version of Thomas Sandby's plan of the battle at Culloden (see fig. 216).

Size of the original: 146 × 108 cm. © The British Library Board, London (Cartographic Items Maps K.Top.48.22).



FIG. 221. PAUL SANDBY, *SURVEYING PARTY BY KIN-LOCH RANNOCH*, 1749.

Size of the original: 18.3 × 29.3 cm. © The British Library Board, London (Cartographic Items Maps K.Top.50.83.2).

about viewing landscape and making images, about the practice and performance of various forms of spectatorship that make up the field of vision, including the acts of using instruments of observation and depiction. It also portrays the wider culture of topography and its capacity for social conciliation. The surveying party is not strictly the team of surveyors and soldiers who made up such parties in the field, but a varied and carefully staged group of figures, politely posed in the style of a group portrait, a conversation piece, with elements of a pastoral *fête galante*. On one side is a woman in a full gown, on the other a kilted highlander, taking a step, hand on hip, striking a heroic classical pose. Standing in the middle another highlander looks out, paired with a British officer looking back, along with another soldier holding a British flag toward the raised vantage point of the picture. The vignette stands as a small summary image for the making of the Great Map itself, like an unused frontispiece or cartouche.

In 1768, the year he was made a founding member of the Royal Academy of Arts, Paul Sandby was appointed

chief drawing master of the Royal Military Academy at Woolwich (Bonehill, Daniels, and Alfrey 2009, 17–18; Sloan 2000, 107–8). Established in 1741 to train engineers and artillery officers, Woolwich was instrumental in promoting the idea of military education for a gentlemanly British culture suspicious of Continental models of instruction. It promoted the graphic arts more widely in civil society, as cadets and officers were proud to display their pictorial accomplishments. Under Sandby's overall tutelage, officers took classes several mornings a week in landscapes and perspective alongside lessons on French, Latin, mathematics, and geography (Townshend 1776), with cadets making use of the local landscape and the buildings and grounds of the Academy itself. Students were taught “the best Method of describing the various Kinds of Ground, with its Inequalities, as necessary for the drawing of Plans” as well as “the taking of Views from Nature” (Townshend 1776, 19). This concern with the act of image making—the process of observation and drawing as well as the final product—was to understand the landscape spatially, as a network

of landmarks and features, prospects and refuges, vantage points and lines of fire. Sandby designed the elaborate frontispiece for *An Universal Military Dictionary* (1779) to promote the virtues of the Academy's military science; drum and standard, cannon and shot, are arranged around a collection of engineering and surveying instruments, while the gentlemanly status of the cadets trained at the Academy is indicated by the elegantly posed young officer with a telescope (Bonehill, Daniels, and Alfrey 2009, 17). The skills Sandby taught are demonstrated by the careful perspectival rendering of the Academy buildings. The lessons of field surveying and military drawing were widely used to describe potential battlefields and places of strategic importance at the margins of the British imperium, brought to bear on a range of unfamiliar places in the Americas, transforming them into subject territories and scenic landscapes (Robertson 1986; Sloan 2000, 139–40).

The Military Survey of North Britain, as executed by William Roy and others, following the failure of the Jacobite rebellion, incorporated skilled draftsmanship from a variety of quarters—engineering, architecture, estate surveying, and fine art—producing a range of both official and off-duty imagery displaying the lay of the land and the degree of its physical and social improvement through loyal British governance (Roy 2007). These works also expressed, sometimes self-consciously, the expertise and virtuosity of image making, whether on the ground in sketching and surveying, in finished drawings and engravings, or in copying and adapting existing maps and views. The Sandby brothers made influential contributions to depicting this process topographically, focusing on fields of vision as well as the territory in view.

GEOGRAPHICAL EDUCATION Geographical education was often depicted in family portraiture, which was, in the words of the professor of painting at the Royal Academy in 1799, Henry Fuseli, “fashionable furniture” in the sense that it was made to be displayed in fashionably furnished private houses and to show what he called “the mutual charities”—the affectionate relations of parents, children, and close relations. It was no longer the “exclusive property of princes,” but aided by the patronage of the royal family, a genre of high-minded family portraiture extended to all households that could afford a painted likeness, paying tribute to generic virtues of “beauty, prowess, genius, talent” as well as their embodiment in real people and their affective relations (Fuseli 1831, 2:216–17).

Family portraiture overlapped with genres in which particular identifiable individuals expressed general, often abstract ideas. In so-called fancy pictures, figures pose with familiar objects, especially children with toys

or pets, to express moral or emotional sentiments. Conversation pieces portray older couples and the family circle (sometimes including close friends) in a domestic setting, inside or out; the figures are engaged in forms of polite recreation and instruction, from music, science, and literature to hunting, shooting, and fishing, along with the appropriate instruments or equipment. Forms of geographical knowledge were displayed in both genres of family portraiture: maps, atlases, globes, landscape pictures, and views of scenes on the family estate. Maps and globes might represent specific properties or commercial interests, personal and national, and could also function allegorically, as traditionally in artworks, as instruments of philosophical reflection (Sitwell 1936; Praz 1971; Quilley 1996; Walters 1997; Daniels 1999, 32–37; Retford 2006).

Philippe Mercier's painting *Sight* from his series of scenes of allegories on the senses (ca. 1744–47) shows a group of figures around a map holding optical instruments (fig. 222). A man appears to be giving a lesson holding a magnifying glass over a detail, while one sitting young woman points at the map with two spread fingers like a pair of compasses. Two other young women, with a close family resemblance, stand looking outward, one holding a telescope, the other holding a mirror. Women holding mirrors were traditional emblems of vanity in art, but this woman angles the mirror away from her face to reflect her companion pointing at the map, the image of geography in the phrase of the time, which “shows us, as in a Glass, the whole World; brings every Part of it to our view” (Morant 1742, iii). Maps also had a long history as *vanitas* emblems, but these figures are patriotically engaged in worldly knowledge, for this map shows a contemporary theater of war, the western Mediterranean around the coast of Spain, where Britain was battling its imperial rivals in Europe for ascendancy as the major global power.

In *Sight*, geography is being used to illustrate John Locke's visual epistemology, a picture theory of knowledge that offered art a philosophical basis for exploring the modes and meanings of observation, representation, and spectatorship. In Locke's influential writings on education, in which children were likened to travelers in a new world, geography provided the framework for progressive reasoning. Family members, particularly mothers and elder siblings, were assigned a primary role in Locke's domestic curriculum to develop “a Gentleman, or Man of Business in the World.” With due guidance, the young child could learn “which is the *AEquator*, which the *Meridian*, &c. which *Europe* and which *England* upon the Globes, as soon almost as he knows the Rooms of the House he lives in” (Locke 1705, 331), before progressing to more systematic reasoning as he moved, with the aid of a plan of the Copernican sys-



FIG. 222. PHILIPPE MERCIER, *THE SENSE OF SIGHT*, CA. 1744–47.

Size of the original: 132.1 × 153.7 cm. Image courtesy of the Yale Center for British Art, New Haven (Paul Mellon Collection, acc. no. B1974.3.17).

tem, to survey the place and movement of the globe and planets orbiting the sun. “So proceeding by gentle and insensible steps, Children without Confusion and Amazement, will have their Understandings opened, and their Thoughts extended farther, than could have been expected” (Locke 1705, 329–30).

The British royal family promoted education on Lockean principles as a matter of domestic virtue. Descriptive vignettes emphasized both their family feeling and their personal promotion of understanding the natural and political world and its improvement, for all ages and both sexes. Portraits putting the accomplishments of royal children on show include cartographic objects among the other signs of their progressive environ-

ment—model ships, bows and arrows, and gardens to roam in. In Allan Ramsay’s 1764 portrait, the queen is shown as a conspicuously modern parent with her sons, a copy of Locke’s treatise on education on the spinet next to her needlework (Shefrin 2003, 3).

Geographical education was enlisted as a rational form of female accomplishment, a steadying influence on young women prone to received opinion, idle fantasy, and fashionable display. Dedicated to Queen Charlotte, *The Young Lady’s Geography* sought to rescue readers from “the tyranny of custom and prejudice” and the love of “the appearance of novelty,” being sufficiently attractive as a textbook to “entice from the hands of the Fair, obscene and ridiculous novels, (which serve only to vi-

tiate their morals, inflame their passions, and eradicate the very seeds of virtue)” (*The Young Lady’s Geography* 1765, preface and dedication). Education might promote modern marriage. Some maintained that a young woman should cultivate “the same mental and social talents [as] enlightened men” to make her “instructive, amiable, and interesting” as a conversational partner (Malikin 1795, 284); a “man of sense” wanted a wife to be a “companion . . . not merely a creature who can paint, and play, and dress, and dance” (More 1799, 1:98).

A portrait by David Allan of the children of Henry Dundas, first viscount Melville, positions geography centrally in their family life and education (fig. 223). The scene is a schoolroom, probably in the Dundas townhouse in Edinburgh, and the setting draws on idealized images of such rooms in educational texts. The three Dundas sisters are dressed in neoclassical style, echoing

other figures of cultivated women in contemporary art, including portraits and allegories by Angelica Kauffman, a leading member of the Royal Academy (Sloan 2000, 245–48).

In Allan’s portrait the arts of drawing and measurement are counterbalanced. On the far left the eldest Dundas daughter Elizabeth draws at a table, posed with a *portecrayon* as she copies a drawing or print of a tree. A cast of a bust of Apollo stands on the table, another model artwork for her to copy and also a figure of global knowledge. At the center Anne Dundas is poised with a pair of compasses on the globe, striking the female figure of Geography in emblem books. She is portrayed as a domesticated figure, but dignified and self-possessed, imperious even, recalling regal figures like Queen Charlotte and Elizabeth I as well as the figure of Britannia herself, who adorned so many geographical images and texts of



FIG. 223. DAVID ALLAN, *PORTRAIT OF THE CHILDREN OF HENRY DUNDAS, 1ST VISCOUNT MELVILLE*, CA. 1785.

Size of the original: 122 × 151 cm. Private collection. Photograph courtesy of Sotheby’s Picture Library, London (JL3578).



FIG. 224. PIETRO LONGHI, *THE GEOGRAPHY LESSON*, 1752. Size of the original: 61 × 49 cm. Galleria Querini-Stampalia, Venice/Cameraphoto Arte Venezia/Bridgeman Images.

the time. In contrast to her submissive Venetian cousin in Pietro Longhi's *The Geography Lesson* (fig. 224), this Geographia does not invite the ogling attention of male tutors, but gives the lesson herself, personifying a strong northern constitutional monarchy then gaining a global empire, not—as contemporaries in Britain were keen to observe by way of moral contrast—an effete Mediterranean republic that lost an empire through sensual luxury (Cosgrove 2001, 166–67). Anne instructs the youngest sister, Montague, who is holding a “Map of Europe” and pointing to where Anne places the legs of the compass, marking the position of Britain, one leg in Scotland, the other in England. Anne looks to her left, where the Dundas son and heir Robert arrives through the door from school, clutching his exercise book, hat, and satchel. Shortly after this picture was painted he was taken on a tour of Europe, seeing places on the ground his sisters could only read about or see on the map.

The picture's display of the children's accomplishments is part of a wider portrayal of the power of the Dundas family as a political dynasty. The children's father Henry was Lord Advocate, the most powerful man in Scotland, and an increasingly influential one in Brit-

ain. He played a key role in the remaking of Britain as a political state, not only cementing the union with Scotland, but positioning Scottish interests at the center of its global commercial ambition. Dundas was satirized by James Gillray as a colossal figure astride the globe with one foot in the city of London and the other on the roof of India House in Bengal, part kilted Highlander, part turbaned oriental despot, commanding the sun and moon (Fry 1992, frontispiece). Dundas could not be shown in the portrait because he had scandalously divorced these children's mother, but he is perhaps alluded to by the bust of Apollo. The Dundas dynasty was keenly committed to geography as a form of knowledge, patronizing mapping projects in Scotland and wider projects of remaking space, including neoclassical architectural schemes. We might also see this picture as affirming Edinburgh's self-image as the center of European enlightenment, including the production by its citizens of theoretical texts on global history that center on Northern Europe as a favored site of human development (Withers 2007; Mayhew 2000, 168–92).

EDUCATIONAL GAMES A pastel portrait by William Hoare of Thomas and John Quicke with a dissected map shows these children with a widely popular form of geographical instruction (fig. 225). The practice of dissection was applied to other educational images, such as chronological tables, but with maps the cuts could be aligned with political boundaries of counties or nations and conserve geographical coherence, the connection of part and whole. Available as luxury sets in special



FIG. 225. WILLIAM HOARE, *PORTRAIT OF MASTERS THOMAS AND JOHN QUICKE*, 1770. Size of the original: 61.5 × 74.5 cm. Private collection. Image courtesy of the Paul Mellon Centre for Studies of British Art, London.

cabinets, they were also cheaply manufactured or made at home and diffused to schools and households of all kinds (Shefrin 1999, 2003).

The Quicke family was longstanding Devon gentry who had recently been enriched by developing local manganese mines and had spent their money in fashionable style, replanning their estate, building a manor house in a neoclassical style, taking Grand Tours to Italy, and commissioning a highly fashionable, Bath-based portraitist to depict their children. The portrait of the Quicke brothers is one of a number of fancy picture-style portraits fashionable at the time that displayed a new informality, with people seeming to be interrupted in the course of everyday tasks, such as reading books, doing needlework, looking at pictures, writing letters, or playing with toys, and the pictures often carry a message about such activity. The dissected map of Europe in the Quicke portrait looks to be homemade, although they were commercially available from London engraver and mapmaker John Spilsbury for twelve shillings, “mounted on mahogany . . . the countries coloured in outline” (Newby 1990, 52–53). Britain is securely in place on the map, as are the central pieces of Northern Europe, while the kingdoms of Southern Europe are scattered on the table. John Quicke holds Italy in his hand, looking to his brother for guidance that he is putting it in the correct place. The elder Quicke brother is posed with calm stillness, in contrast to his younger brother’s insistence on completing the map. The portrait of the Quicke children may be a pun on the vaunted quickness with which dissected maps might be assembled. Dissected maps were used in progressive schools like William Gilpin’s at Cheam, in which children were encouraged to draw, cultivate garden plots, and play at shops (Shefrin 1999, 22). They are described as instruments of imagination as well as reason in Benjamin Heath Malkin’s affecting 1806 memoir of his prodigious child Thomas, who compiled a text and map of visionary country Allenstone, among other inventive landscape drawings, before his death at age five: “His dissected maps . . . afforded him pleasure and interest to the last. He had some counties of England in his hands, reading the names of the towns in them, within half an hour of his dissolution” (Malkin 1997, 148). Malkin’s memoir frames Thomas’s life with William Blake’s poetry and art of childhood innocence and Blake’s frontispiece shows the boy’s apotheosis, ascending from a cliff top laid out with book, compasses, and crayons.

CRITICISM OF VISUAL AIDS Dissected maps as well as other cartographic artifacts attracted criticism. Erasmus Darwin’s radical *A Plan for the Conduct of Female Education* (1797) included geographical board and card games but not dissected maps because they emphasized

the “forms of counties and of countries” not “the situations” and “the principal rivers and mountains, which engrave or imboss it’s [*sic*] surface.” He preferred to provide outline maps published by William Faden that children would fill in with the texture of topographical features (Darwin 1797, 21–22; Shefrin 1999, 23). Liberal textbooks such as John Aikin’s *England Delineated* (1785) provided “outline maps of knowledge” to be filled in by observation, perhaps on rambles with the aid of topographical maps and telescopes, or reliably documentary up-to-date information (Daniels and Elliott 2012). The more conservative case against dissected maps is made in Jane Austen’s *Mansfield Park* (1814), a family portrait in fiction that explores both modes of education and forms of geographical knowledge. Here dissected maps, like chronological charts, stand for the superficial knowledge of forward and clever children, as their adult equivalents are attracted to pictorial plans of landscape gardening drawn up with little regard for the social and physical fabric of the countryside. Arriving at a Northamptonshire country house from a much poorer house in Portsmouth, the serious-minded Fanny Price is called “prodigiously stupid” by her smart cousins for not being able “put the map of Europe together,” not knowing the principal rivers of Russia, the chronological order of the kings of England, or “the difference between water-colours and crayons” (Austen 1814, 1:33–34). At a time when no map could conceivably put together a Europe fractured by war, Fanny’s inner life, and her deeper, less articulated learning and feeling about the world, prove the appropriate sensibility to connect and conserve the land and life of the country (Daniels and Cosgrove 1993).

The increasing production of visual aids made geography attractive but threatened its cultural standing as a serious pursuit, a subject too easily reduced to consuming representations of the world rather than observing its reality on the ground. In contrast to Locke’s *Thoughts on Education*, the other main treatise on progressive education, Jean-Jacques Rousseau’s *Émile, ou de l’éducation* (1762), is marked by a suspicion of ready-made cartography that confines a child to a world of signs and is as otherworldly in its way as the fairy stories the philosopher also dismissed. “I remember somewhere to have seen a tract on geography, which begun as follows. *What is the world?—It is a globe of pasteboard.*” “You intend, we’ll suppose, to teach your child geography, and for that purpose provide for him maps, spheres, and globes. What an apparatus! wherefore all these mere representations of things? why do you not rather begin by shewing him the object itself?” An evening walk close to home would educate all the senses, introduce the child to the sounds, fragrance, and touch of nature as well as how it looks. His first points

of geography should be the “city in which he dwells and his father’s country house”; he should be encouraged to make a map himself, a simple sketch map, first formed by these two points then including the places in between, and pin them up to ornament his room (Rousseau 1763, 1:177, 2:11, 3:171).

Émile was of course no more a real boy, no less a philosophical puppet, than other children in educational literature, but he was a more robust, outdoor figure. In its emphasis on firsthand, physical encounters with the world, Rousseauian principles were more radical than those shaped by Locke’s writings and more classically virile. British portraiture shaped by Rousseau’s ideas tends to focus on boys or young men in naturalistic settings, sturdy-limbed figures dressed for recreation. Such pictures also allude to more conventional images of male outdoor pursuits, figures posed for the hunting field, relaxing in parks and gardens, taking walks in the country, observing and sketching the natural world. In practice the most progressive English parents modified Rousseau’s regime. “At night we depart a little from Monsr. Rousseau’s plan,” noted Lady Caroline Fox shortly after publication of *Emilius and Sophia*, “for he reads fairytales and learns geography on the Beaumont wooden maps” (quoted in Shefrin 2003, 145n13).

STEPHEN DANIELS AND JOHN BONEHILL

SEE ALSO: Atlas: School Atlas; Games, Cartographic; Geographical Mapping; Geography and Cartography; Globe: Instructional Texts for the Use of Globes; Landscape, Maps, and Aesthetics; Map Trade; Military Cartography; Public Sphere, Cartography and the; Women and Cartography

BIBLIOGRAPHY

- Anderson, Carolyn J. 2010. “Constructing the Military Landscape: The Board of Ordnance Maps and Plans of Scotland, 1689–1815.” 2 vols. PhD diss., University of Edinburgh.
- Austen, Jane. 1814. *Mansfield Park: A Novel*. 3 vols. London: Printed for T. Egerton.
- Barber, Peter, and Tom Harper. 2010. *Magnificent Maps: Power, Propaganda and Art*. London: British Library.
- Bermingham, Ann. 2000. *Learning to Draw: Studies in the Cultural History of a Polite and Useful Art*. New Haven: Yale University Press.
- Bonehill, John, and Stephen Daniels. 2009a. “‘Real Views from Nature in This Country’: Paul Sandby, Estate Portraiture and British Landscape Art.” *British Art Journal* 10, no. 1:72–77.
- . eds. 2009b. *Paul Sandby: Picturing Britain*. London: Royal Academy of Arts.
- Bonehill, John, Stephen Daniels, and Nicholas Alfrey. 2009. “Paul Sandby: Picturing Britain.” In *Paul Sandby: Picturing Britain*, ed. John Bonehill and Stephen Daniels, 13–27. London: Royal Academy of Arts.
- Charlesworth, Michael. 1996. “Thomas Sandby Climbs the Hooper Stand: The Politics of Panoramic Drawing in Eighteenth-Century Britain.” *Art History* 19:247–66.
- Christian, Jessica. 1990. “Paul Sandby and the Military Survey of Scotland.” In *Mapping the Landscape: Essays on Art and Cartography*, ed. Nicholas Alfrey and Stephen Daniels, 18–22. Nottingham: University Art Gallery, Castle Museum.
- Cosgrove, Denis E. 2001. *Apollo’s Eye: A Cartographic Genealogy of the Earth in the Western Imagination*. Baltimore: Johns Hopkins University Press.
- Daniels, Stephen. 1999. *Joseph Wright*. London: Tate.
- Daniels, Stephen, and Denis E. Cosgrove. 1993. “Spectacle and Text: Landscape Metaphors in Cultural Geography.” In *Place/Culture/Representation*, ed. James Duncan and David Ley, 57–77. London: Routledge.
- Daniels, Stephen, and Paul Elliott. 2012. “‘Outline Maps of Knowledge’: John Aikin’s Geographical Imagination.” In *Religious Dissent and the Aikin-Barbould Circle, 1740–1860*, ed. Felicity James and Ian Inkster, 94–125. Cambridge: Cambridge University Press.
- Darwin, Erasmus. 1797. *A Plan for the Conduct of Female Education, in Boarding Schools*. Derby: Printed by J. Drewry; for J. Johnson, St. Paul’s Church-Yard, London.
- David, Andrew, ed. 1988. *The Charts & Coastal Views of Captain Cook’s Voyages*, Vol. 1, *The Voyage of the Endeavour, 1768–1771*. London: Hakluyt Society.
- Driver, Felix, and Luciana Martins. 2002. “John Septimus Roe and the Art of Navigation, c. 1815–1830.” *History Workshop Journal* 54:144–61.
- Fry, Michael. 1992. *The Dundas Despotism*. Edinburgh: Edinburgh University Press.
- Fuseli, Henry. 1831. *The Life and Writings of Henry Fuseli*. 3 vols. Ed. John Knowles. London: Henry Colburn and Richard Bentley.
- Hughes, Michael. 1746. *A Plain Narrative or Journal of the Late Rebellion, Begun in 1745*. London: Printed for Henry Whitridge.
- Johnson, Dorothy. 1990. “Picturing Pedagogy: Education and the Child in the Paintings of Chardin.” *Eighteenth-Century Studies* 24:47–68.
- Locke, John. 1705. *Some Thoughts Concerning Education*. 5th ed. London: Printed for A. & J. Churchill.
- Malkin, Benjamin Heath. 1795. *Essays on Subjects Connected with Civilization*. London: Printed by E. Hodson.
- . 1997. *A Father’s Memoirs of His Child, 1806*. Poole: Woodstock Books.
- Mayhew, Robert J. 1998. “Geography in Eighteenth-Century British Education.” *Paedagogica Historica* 34:731–69.
- . 2000. *Enlightenment Geography: The Political Languages of British Geography, 1650–1850*. Basingstoke: Macmillan.
- Morant, Philip. 1742. “Preface.” In *Geographia antiqua et nova: System of Antient and Modern Geography, with a Sett of Maps Engraven from Cellarius’s*, by Nicolas Lenglet du Fresnoy, iii–vi. London: Printed for John and Paul Knapton.
- More, Hannah. 1799. *Strictures on the Modern System of Female Education*. 2 vols. London: Printed for T. Cadell Jun. and W. Davies.
- Newby, Evelyn. 1990. *William Hoare of Bath R.A., 1707–1792*. Bath: Bath Museums Service, Alan Sutton Publishing.
- Plax, Julie Anne. 2002. “Seventeenth-Century French Images of Warfare.” In *Artful Armies, Beautiful Battles: Art and Warfare in Early Modern Europe*, ed. Pia Cuneo, 131–55. Leiden: Brill.
- Praz, Mario. 1971. *Conversation Pieces: A Survey of the Informal Group Portrait in Europe and America*. London: Methuen.
- Quilley, Geoff. 1996. “The Sphere of Contemplation: The Imagery of Global Navigation in Eighteenth-Century England.” In *Romantic Geographies: Proceedings of the Glasgow Conference, September 1994*, ed. Colin Smethurst, 55–64. Glasgow: University of Glasgow French and German Publications.
- Retford, Kate. 2006. *The Art of Domestic Life: Family Portraiture in Eighteenth-Century England*. New Haven: Yale University Press.
- Robertson, Bruce. 1986. “Venit, vidit, depinxit: The Military Artist in America.” In *Views and Visions: American Landscape before 1830*, ed. Edward J. Nygren, 83–104. Hartford: Wadsworth Atheneum.
- Rousseau, Jean-Jacques. 1763. *Emilius and Sophia: or A New System of Education*. 2d ed. 4 vols. London: Printed for T. Becket, P. A. de Hondt.

- Roy, William. 2007. *The Great Map: The Military Survey of Scotland, 1747–55*. Edinburgh: Birlinn.
- Sands, John O. 1990. "The Sailor's Perspective: British Naval Topographic Artists." In *Background to Discovery: Pacific Exploration from Dampier to Cook*, ed. Derek Howse, 185–200. Berkeley: University of California Press.
- Shefrin, Jill. 1999. *Neatly Dissected for the Instruction of Young Ladies and Gentlemen in the Knowledge of Geography: John Spilbury and Early Dissected Puzzles*. Los Angeles: Cotsen Occasional Press.
- . 2003. *Such Constant Affectionate Care: Lady Charlotte Finch, Royal Governess & the Children of George III*. Los Angeles: Cotsen Occasional Press.
- Sitwell, Sacheverell. 1936. *Conversation Pieces: A Survey of English Domestic Portraits and Their Painters*. London: B. T. Batsford.
- Sloan, Kim. 2000. "A Noble Art": *Amateur Artists and Drawing Masters, c. 1600–1800*. London: British Museum Press.
- Townshend, George. 1776. *Rules and Orders for the Royal Military Academy at Woolwich*. London: Turner Bequest.
- Walters, Alice N. 1997. "Conversation Pieces: Science and Politeness in Eighteenth-Century England." *History of Science* 35:121–54.
- Withers, Charles W. J. 2007. *Placing the Enlightenment: Thinking Geographically about the Age of Reason*. Chicago: University of Chicago Press.
- Young Lady's Geography, The*. 1765. London: Printed for R. Baldwin and T. Lownds.

Encyclopedias. In words and images, encyclopedias order the world. As texts of classification and summations of learning, encyclopedias have a long and distinguished history. Pliny's *Natural History* (A.D. 77) is considered the first major European encyclopedic work. Where the ancient Greeks and Romans understood *enkyklios paideia* to mean a general education, scholars in the European Renaissance used the term "encyclopedia" to refer to the whole circle of human knowledge. The philosophical foundations of European encyclopedism were laid down during the seventeenth century, notably by Sir Francis Bacon. His 1620 *Instauratio magna* emphasized the importance of classification, hierarchy, and methodical connections between the topics making up the world of human learning, itself organized under three headings, history, poetry, and other knowledge, corresponding to the faculties of memory, imagination, and reason.

The modern encyclopedia is a product of the Enlightenment. All encyclopedias have to confront the contradiction between the interconnectedness of knowledge and the principles for that knowledge's classification, usually alphabetical order. In the Enlightenment, encyclopedic schemes for the classification of knowledge were advanced in association with claims for the social utility of that knowledge and even that human society would be united by the power of the knowledge contained in encyclopedias (Yeo 2001). Enlightenment encyclopedias thus drew on earlier traditions, yet they consistently sought to combine up-to-date definitions and

discussions of topics, organized as alphabetical entries, with schemes for the classification of knowledge that were usually outlined at length in the preface.

In relation to questions of mapping and the nature and definition of maps in the European Enlightenment, eighteenth-century encyclopedias are important for three related reasons. They provided what contemporaries understood as "maps of knowledge" or "charts of learning"—classificatory schemes that, then as now, afforded insight into the world of Enlightenment learning. Individual alphabetical entries such as "map" and "geography" and the relations between these and other such terms can be considered and comparisons may be made between different encyclopedias and, over time, between different editions of the same encyclopedia (Laboulais 2006; Withers 1996). By examining the biographies of the authors of entries in Enlightenment encyclopedias, the connections between them, and the sales and distribution of these works, modern scholars have traced what may be thought of as sketch maps of the production and reception of the Enlightenment as an intellectual phenomenon (Darnton 1979; Kafker 1996).

Metaphors describing the works' classificatory intentions—as the "tree" of human learning, for example, its individual branches separate subjects, or as the "map" of world knowledge—were commonplace in Enlightenment encyclopedias (fig. 226). Ephraim Chambers termed his *Cyclopædia* (1728) "a Survey of the Republic of Learning" and saw it marking "the Boundary that circumscribes our present Prospect; and separates the known, from the unknown Parts of the Intelligible World" (Chambers 1728, vol. 1, dedication). What Richard R. Yeo has considered contemporaries' concern to provide "maps of the sciences" for the Enlightenment intellectual landscape (Yeo 2001, 27–32) is most clearly expressed in the preliminary discourse to the multivolume *Encyclopédie* produced under the general editorship of Denis Diderot and Jean Le Rond d'Alembert. In acknowledging Bacon and Chambers but in emphasizing reason rather than philosophy and, moreover, in displacing theology as the root of all knowledge, the *Encyclopédie* effectively undid the old order of knowledge and presented a new agenda for learning. For these reasons, as well as for the radical tone of many of its entries, the *Encyclopédie* epitomizes the Enlightenment's engagement with the power of secular reason and is arguably the most significant of the Enlightenment's many encyclopedias. Laying out their plans for this new view of knowledge and the emancipatory purposes to which it might be put, the editors considered the *Encyclopédie* "a kind of world map which is to show the principal countries, their position and their mutual dependence, the road that lies directly from one to the other; this road is often cut by a thousand obstacles, which are known

in each country only to the inhabitants or to travelers, and which cannot be represented except in individual, highly detailed maps. These individual maps will be the different articles of our *Encyclopédie* and the tree or systematic chart will be its world map” (d’Alembert 1751, xv). As with Chambers’s *Cyclopædia*, the *Encyclopédie* was, like much Enlightenment mapping, a means to lay down boundaries around spaces of knowledge and a document of uneven intellectual and social progress.

In the first edition of his *Cyclopædia*, Chambers provided this definition for map: “a plain Figure, representing the several Parts of the Surface of the Earth, according to the Laws of Perspective: or a Projection of the Surface of the Globe, or a part thereof, *in plano*. See *Projection*” (1728, 2:495). Distinction was made between “Maps, *universal*” and “Maps, *particular*,” namely, between maps of the whole world and maps of individual countries. By the 1786–88 edition, the entry for map began with very similar words as the first edition entry, but was much enlarged upon. Connections were made with the mapping of regions and, thus, in contemporaries’ terms, with “surveying.” Thus, “For MAPS of provinces, or small tracts, as parishes, manors, &c. we use another method, more sure and accurate than any of the former. In this the angles of position, or the bearings of the several places, with regard to one another, are determined by proper instruments, and transferred to paper. This constitutes an art apart, called SURVEYING” (Chambers 1786–88, vol. 3, s.v. “map”). Chambers defined surveying as: “the art, or act, of measuring lands; i.e. of taking the dimensions of any tract of ground; then laying down the same in a map or draught; and finding the content or area thereof” (Chambers 1786–88, vol. 4, s.v. “surveying”). The entry then gives cross-references to “theodolite,” “circumferentor,” “protractor,” “compass,” and other surveying-related terms, and the author makes wider connections still (and further establishes his own credibility and heightens the value of the entry) by making reference to articles on surveying in recent volumes of the Royal Society’s *Philosophical Transactions*. With reference to map-related terms, we can here see the nature of definitions, developments in those definitions over time, the place of illustrations in accompanying textual descriptions, and how encyclopedias provided connections between branches of carto-

graphic knowledge in a fast-changing intellectual world (fig. 227).

Maps also accompanied descriptions of places and countries. In the more than two hundred volumes of the *Encyclopédie méthodique* ([Panckoucke] 1782–1832)—effectively, the successor to Diderot and d’Alembert’s *Encyclopédie*—maps were used to accompany discussions of the nature and structure of geography as an Enlightenment subject. In 1787, Nicolas Desmarest, the leading French physical geographer, produced with others the *Atlas encyclopédique, contenant la géographie ancienne, et quelques cartes*. He oversaw the production of the *Atlas encyclopédique contenant les cartes et les planches relative a la géographie physique* (1827). Both were illustration volumes to accompany the text volumes of the *Encyclopédie méthodique*. Despite the title of the 1827 *Atlas*, that work also included maps to illustrate themes in related volumes on ancient geography and on modern geography within the *Encyclopédie méthodique* (Laboulais 2006). Elsewhere in the *Encyclopédie méthodique*, maps were used to illustrate the principles of engraving and the coordination between typography and topography as large areas were labeled with larger and spaced letters, smaller and more ornate features such as rivers with more compact lettering following the feature itself.

The entries in the different editions of the *Encyclopædia Britannica* offer a yet different illustration of the ways in which map-related entries and maps appeared in Enlightenment encyclopedias. In the first edition (1771), no entry appears for “map” or “mapping.” Discussion of those topics is included within “geography,” which begins with the description and use of celestial and terrestrial globes and the armillary sphere before referencing a set of five maps—of Europe, Asia, Africa, North America, and South America—that guide the reader on topics such as latitude and longitude. By the second edition (1778), a discussion of maps is again included within the entry on “geography.” Geographical and mapping apparatus are illustrated, including an analemma. New information about geography and exploration is shown on *A Map of the World in Three Sections* drawn by the engraver Andrew Bell, one of the *Encyclopædia Britannica*’s founding “gentlemen.” This map also appears in the third edition (1797) alongside another map by Bell

(facing page)

FIG. 226. GENEALOGICAL TREE OF THE MATHEMATICAL SCIENCES. While not published in an encyclopedia, this genealogical tree, produced by an instructor in mathematics and hydrography at the Collège du Havre, France, exemplifies the encyclopedia-as-map metaphor. Cartography’s multiple aspects occupy several of the outer branches. At left, emerging from pure mathematics, *géométrie* encompasses several aspects of surveying and military science. In the center and at

right, from mixed mathematics, the various branches of *navigation* and *cosmographie* intertwine. The tree’s cartographic fruits include spheres, maps, and globes. Louis-Claude-Étienne Delisle, *Tableau des mathématiques* (Paris: [Jean-Claude] Dezauche, [1779]).

Size of the original: ca. 90 × 59 cm. Image courtesy of the Staatsbibliothek zu Berlin–Preußischer Kulturbesitz; Kartenabteilung (Kart. W 27052).

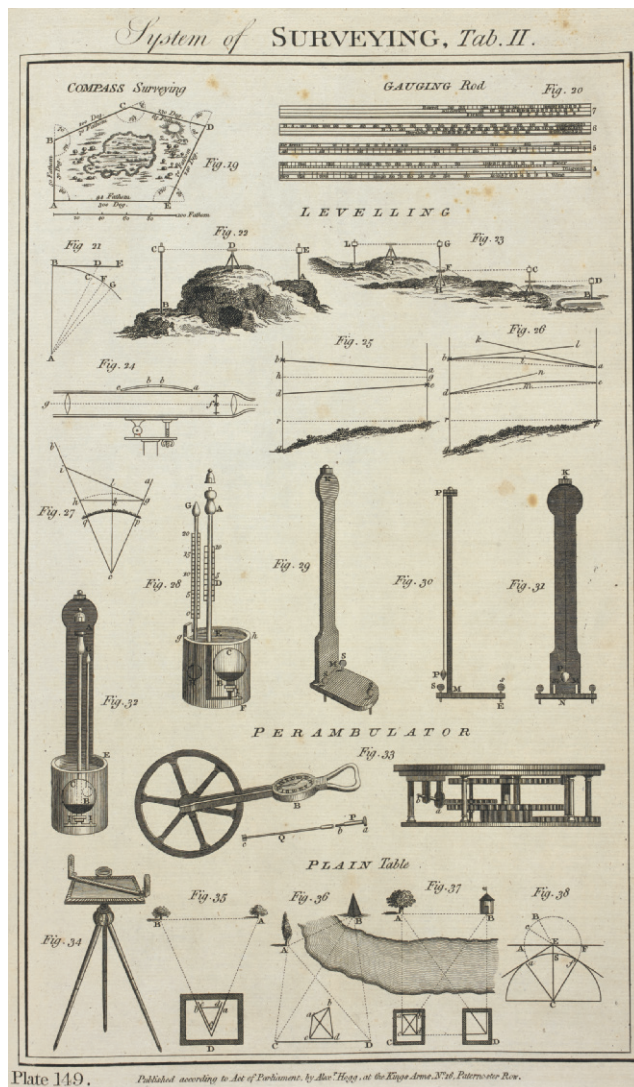


FIG. 227. ILLUSTRATION OF SEVERAL INSTRUMENTS FOR MAPPING AND SURVEYING. From George Selby Howard, *The New Royal Cyclopædia, and Encyclopædia* (London, 1788), vol. 3, pl. 149 (between 1,768 and 1,769). © The British Library Board, London.

titled *Map of the World: Comprehending the Latest Discoverys*. The fact that Bell's earlier map also appears in George Selby Howard's *New Royal Cyclopædia, and Encyclopædia* (1788) emphasizes the importance of such maps within later Enlightenment encyclopedias. Yet a note of caution is also necessary. Encyclopedias and other such works sometimes used the same maps and textual definitions, little if at all altered, given the expense and the difficulties involved in securing the latest information despite, often, the author's claim to have done so.

The authors of the articles making up Diderot and d'Alembert's *Encyclopédie* were mainly literary fig-

ures and scholars from the salons and academic institutions of Paris, with a handful from smaller centers such as Montpellier and Beziers. The leading Parisian mapmaker Didier Robert de Vaugondy wrote the entry "globe" (with d'Alembert) and contributed to those on "géographie" and "fuseau." Unlike him, most contributors were not professionals in the modern sense, and the *Encyclopédie* grew to completion by degrees, "not the creation of a close-knit sect" (Kafker 1996, 35) but of the editorial coordination of geographically dispersed correspondents. Examined from the standpoint of its purchasers and readers rather than its authors, the sales of the *Encyclopédie* reveal how the Enlightenment had a geography of textual reception (Darnton 1979). Lyons dominated the urban geography of the *Encyclopédie's* sales, with subscription numbers nearly twice that of Paris. Sales were generally higher in France's provincial capitals and in towns with an administrative and cultural focus than they were in the Atlantic and Mediterranean port towns and in the textile towns of northern France. Beyond France, the *Encyclopédie* sold well in most urban centers throughout Europe; everywhere, the main purchasers were a heterogeneous group of noblemen, clerics, civic officials, and professionals.

If in this final sense the *Encyclopédie* presents a kind of map of the Enlightenment, Enlightenment encyclopedias more generally provide systems of knowledge classification, descriptive content on individual topics, and connections between individual entries. Encyclopedias reveal their content, and changes in that content, far more readily than they do their readers or their authors. For Enlightenment contemporaries, encyclopedias were an entrepôt designed to lay out the world of learning and to advance new knowledge to the individual and collective good. Their textual and illustrative content was both informative and instructive, in keeping with Enlightenment interests in self-improvement and national improvement. For historians of cartography (and of geography), Enlightenment encyclopedias, if read carefully in context and understood as part of emerging systems of knowledge classification, illustrate changing views of how terms such as "map" and "mapping" were defined, how mapping was thematically divided, how it was to be undertaken, and with what other forms of knowledge such topics were connected on the overall map of Enlightenment learning (Withers 2014).

CHARLES W. J. WITHERS

SEE ALSO: Enlightenment, Cartography and the; Metaphor, Map as; Public Sphere, Cartography and the; Science and Cartography

BIBLIOGRAPHY

Alembert, Jean Le Rond d'. 1751. "Discours préliminaire des éditeurs." In *Encyclopédie, ou, Dictionnaire raisonné des sciences, des arts et des métiers*, ed. Denis Diderot and Jean Le Rond d'Alembert, 17 text vols. and 11 plate vols., 1:[i]-xliv. Paris: Briasson, David, Le Breton, Durand.

- Chambers, Ephraim. 1728. *Cyclopædia: Or, An Universal Dictionary of Arts and Sciences*. 2 vols. London: Printed for James and John Knapton et al.
- . 1786–88. *Cyclopædia: Or, An Universal Dictionary of Arts and Sciences*. 5 vols. London: Printed for J. F. and C. Rivington et al.
- Darnton, Robert. 1979. *The Business of Enlightenment: A Publishing History of the "Encyclopédie," 1775–1800*. Cambridge: Belknap Press of Harvard University Press.
- Kafker, Frank A. 1996. *The Encyclopedists as a Group: A Collective Biography of the Authors of the "Encyclopédie."* Oxford: Voltaire Foundation.
- Laboulais, Isabelle. 2006. "La géographie dans les arbres encyclopédiques de la seconde moitié du XVIII^e siècle." In *Géographies plurielles: Les sciences géographiques au moment de l'émergence des sciences humaines (1750–1850)*, ed. Hélène Blais and Isabelle Laboulais, 63–93. Paris: L'Harmattan.
- [Panckoucke, Charles-Joseph]. 1782–1832. *Encyclopédie méthodique, ou par ordre de matières; par une société de gens de lettres de savans et d'artistes*. Over 200 vols. Paris: Panckoucke.
- Society of Gentlemen in Scotland. 1771. *Encyclopædia Britannica; or, A Dictionary of Arts and Sciences, Compiled upon a New Plan*. 3 vols. Edinburgh: Printed for A. Bell and C. Macfarquhar.
- Withers, Charles W. J. 1996. "Encyclopaedism, Modernism and the Classification of Geographical Knowledge." *Transactions of the Institute of British Geographers* 21:275–98.
- . 2014. "Space, Geography and the Global French Enlightenment." In *The Cambridge Companion to the French Enlightenment*, ed. Daniel Brewer, 214–32. Cambridge: Cambridge University Press.
- Yeo, Richard R. 2001. *Encyclopaedic Visions: Scientific Dictionaries and Enlightenment Culture*. Cambridge: Cambridge University Press.

Engineers and Topographical Surveys. During the Enlightenment engineers increased and diversified the uses of topography to fulfill the military and administrative needs of modernizing states, giving rise to new institutions and techniques of surveying. "It was under Louis XIV that military topography emerged from nothingness," noted the *Mémorial topographique et militaire* ([Soulavie] 1802–3, 76), the first specialized journal in the field. The statement referred not only to the French case but also to "the first military topography that deserved this name": Piedmontese engineer Giovanni Tommaso Borgonio's *Carta generale de stati di sua altezza reale* (1680) (see fig. 108) ([Soulavie] 1802–3, 69; Sereno 2007, 847–53). From that first topography, a century of development in France led to the 1802 Commission topographique at the Dépôt de la Guerre, the French institution in charge of military cartography since 1688. General Nicolas-Antoine Sanson, the chief of the Dépôt, gathered engineers from the various state public services interested in topographical surveys, either military (engineers, artillery, *ingénieurs géographes*) or civil (*ponts et chaussées*, forests, mines, foreign affairs), in order to acquire and promote a universal standardized topography. It was a pattern that would be replicated in other nations throughout the eighteenth century.

Throughout this period, engineers contributed widely to the transformation of practices, the graphic results, the multiple uses of topographical surveying and maps, and even their own role in society, given the standing of their theoretical and practical expertise, which distinguished them from ordinary land (property) surveyors and from other military competitors. Thus, as cartography moved from the geographer's study into the field, away from the compilation of sources to the on-site measurement and observation of surveying, topographical surveys evolved from a craft-based skilled labor to mathematically informed, triangulation-based operations, requiring more complex and sophisticated competence. In parallel, the social structure of engineers evolved from individual craftsmen to institutionalized corps, and their training shifted from apprenticeship toward academic education. As large-scale mapmakers who also used maps, eighteenth-century engineers participated in the dissemination of techniques through their wide travels, their published books, and their instrumental and graphic innovations.

The decades around 1700 saw movement toward the organization of various national engineering corps. Other itineraries based on patronage, apprenticeship, and family training persisted, as they had done since the Renaissance. Yet there were still idiosyncratic career routes. For example, Borgonio was the private secretary of Carlo Emanuele II and tutor of his son Vittorio Amedeo II (Sereno 2007, 851). At the turn of the nineteenth century, Sir Thomas Livingston Mitchell, later surveyor general of New South Wales and famous explorer of Australia, began his career as an officer of the 95th Rifle Regiment, attached to the quartermaster general department of the army in Spain. Later he was chosen to survey the battlefield after Waterloo for James Wyld's atlas of the Peninsular War (Sargent 1984).

Nonetheless, the more customary route to becoming an engineer was via apprenticeship and family training, especially among dynasties of engineers who specialized in topography (e.g., the Masse or Naudin families) or created topographical surveys related to civil engineering projects, like the John Grundys (father and son) in Britain. Many of these engineer-surveyors fulfilled several functions simultaneously or successively, such as William Elstobb, whose father was a teacher of mathematics with a keen interest in physics and fen drainage, and who himself taught mathematics and worked as a land surveyor in the 1730s. Later, the engineering corps provided a better social framework for topographical surveyors and slowly encouraged more specialized careers. Born and educated in Lanarkshire, William Roy was first a land surveyor, then a civil assistant to Lieutenant Colonel David Watson for the military survey of Scotland (1:36,000, 1747–55), after which he was given

a military commission. He soon managed the military surveys in Britain, eventually becoming the director of the Royal Engineers and a major general in the army. Charles Vallancey, born of French Huguenot parents in Flanders, followed a slow path from Eton and the Royal Military College at Woolwich to the highest military grades before transforming the general survey of southern Ireland (1774–90) from a military map to a topographical map. By the end of the century, topographical survey training had permeated the curriculum of military and civil engineering schools and corps.

TRAINING ENGINEERS In general, academic training in topography was first implemented within the military academies created for artillery officers and military engineers from the 1680s to the 1720s, then from midcentury on for civil engineers, mining and forestry engineers, and topographers. The Spanish Crown promoted early experiments in topographical training, following the early establishment of the Academia de Matemáticas in Madrid in 1582 (Lindgren 2007, 507) and subsequent foundations in Brussels (1671) and Barcelona (1720) (Galland Seguela 2008, 55). Early French schools of artillery also participated in the movement toward regular training. The Kingdom of Piedmont-Sardinia simultaneously set up both school training and two corps of military engineers when, in 1736, Giuseppe Ignazio Bertola, first engineer of the king, proposed a military school of fortification, civil architecture, and design, with a thirty-six-member corps of military engineers (*corpo degli ingegneri militari*) and four topographical draftsmen (*disegnatori topografici*). At the royal Scuole teoriche e pratiche d'artiglieria, eventually opened in 1739 in Turin, military topographers (*ingegneri topografici*) learned mathematics—including geometry, if not explicitly applied to mapping—from the great mathematician Joseph-Louis Lagrange, before he left for Berlin in 1766.

In France, two offices of draftsmen (*bureau des dessinateurs*) turned into schools, matriculation at which soon became mandatory for entrance to the relevant corps: in 1747, the same year César-François Cassini (III) de Thury took charge of the *Carte de France*, Jean-Rodolphe Peronet created the École des Ponts et Chaussées, a school for civil engineering in Paris; then in 1748, the École royale du Génie de Mézières started providing the highest scientific training in Europe for military engineering, producing brilliant topographers such as Jean-Claude-Eléonor Le Michaud d'Arçon. But alternative training methods still continued. Pierre-Joseph de Bourcet, *directeur des fortifications* at Grenoble, personally trained his staff in topography for the *Carte géométrique du Haut Dauphiné et de la frontière ultérieure*, prepared from 1749 to 1754. Military engineers eventually replaced

their more specialized rivals, the *ingénieurs géographes*, in mapping border regions, even though the latter had first been in charge of this fieldwork. The failure in 1761 of the *bureau des dessinateurs* of the *ingénieurs géographes militaires* at Versailles to turn into a true school demonstrated that there was no room for a third full school for topography in France. These topographical engineers received only small financial support from the army, which treated them like land surveyors or artisans, skilled laborers trained through apprenticeship instead of through the new academic training supervised by the Académie des sciences. Thus military topographers often had to invest in a regimental rank to supplement their engineer grade.

Such dual commissions, engineer and officer, also existed in Britain until midcentury, adding complexity to both external duties and the hierarchy within the corps, as exemplified by John Montresor, chief engineer in British North America and a lieutenant in the 14th Regiment of Foot, while William Eyre, who ranked below him within the establishment of engineers, was a major in the 44th Regiment. Attendance at the Royal Military Academy at Woolwich, founded in 1741 for artillery and engineer cadets, was not yet mandatory to achieve rank in the establishment engineers under the Board of Ordnance. Alternative routes to entering the corps were through apprenticeship in the Drawing Room at the Tower of London or by appointment of the master general of Ordnance. Moreover, officers of the Foot Regiments were often commissioned as assistant engineers, who proliferated during the American Revolutionary War, especially for topographical surveys. Of the 150 maps from known and identified topographers kept in the collections of General Thomas Gage and Sir Henry Clinton, 50 were produced by establishment engineers; 50 by assistant engineers and officers of the 60th Royal American, a regiment with heavy recruitment among Protestant Germans and Dutch in Europe; and 50 from officers in other branches (Marshall 1973; Campbell 2010).

The dichotomy between engineers and officers was emphasized with the establishment of the Royal Military College at High Wycombe in 1799. Each school, Woolwich and High Wycombe, developed its own topographical survey method, systems that competed in the field during the Peninsular War. Thus, some officers of the Royal Staff Corps preferred a team trained on the Woolwich instruments and their use of contour lines to those trained at High Wycombe with their quick hachure sketching for relief representation, a method taught at High Wycombe by the French émigré General François Jarry (Jones 1974, 21).

Such rivalry emerged in most countries, as every technical corps—civilian or military—could claim some

expertise in topographical surveys. When Joseph Jean François de Ferraris, commander of the *École de mathématiques du corps d'artillerie* at Malines, proposed in 1769 to survey the Austrian Netherlands along with the adjacent principalities of Liège and Stavelot, Chancellor Wenzel Anton von Kaunitz recognized the competence of the artilleryists but thought that the corps of engineers should undertake the project. Ultimately, the survey was headed by Léopold-François Cogeur, Ferraris's deputy and teacher of mathematics to student artilleryists Damien Gillis and Peter Wirtz. Nonetheless, in many circumstances, fieldwork was necessarily collaborative. The so-called Murray Map of the St. Lawrence River in North America, begun in 1760, resulted from the efforts of two establishment engineers (William Spry and Montresor) and three officers (Samuel Holland, formerly a Dutch military topographical surveyor, Lewis Fusier of the 60th Regiment, and Joseph Peach of the 47th Regiment), though not without some conflict between them all (Hornsby 2011, 25–30). The topographical map of Egypt made during Napoleon's expedition was credited to the military *ingénieurs géographes*, even though only two of them had performed the actual surveys; five civil topographers from the Bureau du cadastre and the cadastre of Corsica (who later joined the *Dépôt de la Guerre*), eleven civil engineers, seven military engineers, and one artilleryist, as well as one astronomer, officers of the Marine, and mining engineers all took part in the survey. General Antoine-François Andréossi, an artilleryist, took advantage of his position as chief of the *Dépôt de la Guerre* in 1801 to propose a project for gathering military engineers, artilleryists, and topographers into a single *corps chargé des fonctions industrielles* (corps devoted to the industrial functions), a project that proved futile (Bret 1991, 119).

Andréossi's idea must have been based on experience, for with one corps of engineers focused on topography, rivalries were reduced, collaboration became easier, and uniformity and quality of mapping increased. France, the most populous country in Europe, and its much smaller transalpine neighbor to the southeast, Piedmont-Sardinia, created just such engineering corps. In France the *Dépôt de la Guerre*, established in the last quarter of the seventeenth century, was soon followed by the creation of an autonomous corps of military topographers (*ingénieurs géographes*) in 1691, while military engineers (*ingénieurs du roi*) concentrated on fortification and poliorcetics under Sébastien Le Prestre, marquis de Vauban, although they did surveys as well, mainly in the colonies. The first chief engineer of the *ingénieurs géographes*, named in 1716, was Roussel who, with Jean-François de La Blotière, performed topographical surveys of the boundaries in the Alps and the Pyrenees in 1719, which were of high military importance (Berthaut 1902, 1:15–16; Fröhlich

1960). Nevertheless, topographical surveying was certainly at stake in the competition between the two French engineering corps, a rivalry that reached its climax after the Seven Years' War (1756–63). Already oversubscribed with too many engineers for peacetime work, both corps also competed with the surveyors working under Cassini III on the *Carte de France*. The specialized corps of *ingénieurs géographes* now seemed superfluous, and the 1762 ordinance increased the number of *ingénieurs du roi* to four hundred. While the *ingénieurs du roi* surveyed the topography of Alpine borders, the *ingénieurs géographes* worked on mapping the French coastline (1772–85) under the direction of Jean-Baptiste Berthier. Several of the *ingénieurs géographes* were sent to the French-held West Indies, mainly Saint-Domingue, but also Martinique, where Claude Loupia de Fontenailles and René Moreau du Temple prepared their exceptional map (Bégot, Pelletier, and Bousquet-Bressolier 1998). The masterpiece of the *ingénieurs géographes* was the *Carte topographique des environs de Versailles* (also known as the *Carte des chasses du roi*), a topographical map of the royal hunting grounds, launched as means for continuing financial support of the corps in peacetime. The survey work from 1764 to 1773 also served as a research laboratory for training in topographical mapping; the complete published version appeared finally in the early nineteenth century (Bourcier 1972; Berthaut 1902, 1:42–43; Marcel 1897).

In Piedmont, the tiny corps created under Bertola in 1738 and supervised by the *Ufficio degli Ingegneri Topografi*, grew to seven in 1777, when their director Antoine Durieu died. An engineer-topographer from 1744, Durieu trained as a *trabuccante* (rodman) and as a land surveyor in the cadastral survey of Savoy in 1728. Although influenced by French models, Piedmontese engineers also created their own tradition during the decade 1728–38, when the superintendent of the cadastre supervised topographers working under experienced land surveyors or royal notaries (e.g., Jean-Joseph Boldrino for a map of Evian, and Maurice Roggieri for Annecy) (Bruchet 1988, 16–17, fig. 5). Piedmontese engineers Hyacinthe Cocelli and Giovanni Morosi eventually took over, while Jean Perpiliat was assisted by draftsmen, including the Austrians Gabriel Grienberger and François Schittvein, for the map reduction, “*Carte générale de la Savoie*,” 1737 (Vincennes, Service historique de la Défense, DAT J 10C 1563; Florence, Istituto Geografico Militare, Ord 4, Cartella 2, Doc. 25; and the Bibliothèque municipale de Chambéry, carte Sav. B 189. 1-6 cat. N° 132) (Guichonnet 1955; Pallière 1988, 78). The Italian states had already served as a melting pot for topographical surveyors from various traditions (Pansini 2002), well before the arrival of French topographers with Napoleon.

The spread of French influence during the Napoleonic invasion led to the creation in 1801 of a military topographic corps of the Cisalpine Republic (i.e., the former grand duchies of Lombardy, Mantua, Parma, Modena, and the northern part of the Papal States, including Bologna and Ferrara) under the leadership of Gustaf Wilhelm af Tibell, a Swedish engineer in the French service, who founded the Deposito della Guerra in Milan based on French models. For two years, that Italian corps comprised only Neapolitan engineers, except two Venetians trained at the Collegio militare di Verona. A decade later, when half of its members were from Lombardy, its leaders were still Neapolitan engineers, Antonio Maria Campana and Ferdinando Visconti, who was to replace Giovanni Antonio Rizzi Zannoni at the Deposito della Guerra in Naples in 1815 (Cuccoli 2012).

In Portugal, the establishment of the Real Corpo de Engenheiros in 1790 institutionalized a corps that had been trained in topography since 1647 and established as a corps in 1693. The reforms of Sebastião José de Carvalho e Melo, marquês de Pombal, in the mid-eighteenth century had encouraged mathematical studies and also welcomed foreign help, best exemplified in the person of Marshal General Count Wilhelm de Schaumburg-Lippe (see below). When Prince Regent João VI settled the Portuguese royal court in Brazil in 1808, he promoted topography, requesting that a journal be inaugurated modeled on the French *Mémorial Topographique et Militaire*. Two years later in 1810, he created the Real Academia Militar at Rio de Janeiro for artillerymen and engineers as well as for engineer-topographers (*engenheiros geographos e topographos*).

CROSSING BOUNDARIES During the Renaissance, the scarcity of skilled engineers in any one nation made them a valuable labor force, always in demand. Thus they were among the most transient and versatile cartographic practitioners in Europe in the eighteenth century, despite the development of national schools and engineering corps. National boundaries remained porous for institutions and professions related to topographical surveys (Virol 2010).

Topographic engineers often traveled abroad in the service of various princes, either in the wake of military alliances or invited because of their own reputations. Jacques Naudin, for instance, was secretly sent by France to the Southern Netherlands (1719–23) to complete work begun when he had been assigned to Maximilian Emanuel II, elector of Bavaria, the last governor of the former Spanish possessions. Another family of French military engineers, the Denis, was secretly paid by Piedmont, into whose service Denis *filis* later entered. As Vincenzo Deniso he became director of the Ufficio di Topografia Reale in 1790 and a distinguished Pied-

montese cartographer (Sereno 2002, 83, 100). Despite the modernization of nation-states and the gradual emergence of a topographical surveying profession, the demand for engineering expertise remained high in the second half of the eighteenth century, with Italian engineers still highly prized. Rizzi Zannoni, from Padua in the Republic of Venice, successively served the kings of Poland, Denmark, and Prussia prior to his two decades in France, where he served in high positions, before returning to Italy in 1776, where spent his final thirty-eight years, first in Venice and then in Naples.

In Portugal, foreign engineers and scientists participated in the revival of interest in cartography as it related to Pombal's reforms midcentury and in the boundary surveying efforts in Brazil. Of seventy-nine engineers serving there from 1750 to 1777, eleven were German, nine Italian, one French, one Swiss, and one Swedish (Buono 2011, 331–33). Among them, Miguel António Ciera—another Paduan engineer—surveyed the Brazilian boundaries in the 1750s; later a member of the Academia Real das Ciências de Lisboa, he successively taught mathematics at the Colégio Real dos Nobres, at the University of Coimbra (reformed in 1772), and at the Academia Real da Marinha. His son, Francisco António Ciera, took over his father's position there and headed the triangulation-based topographical surveys of the unfinished “Carta geral do reino.” Foreign topographers also came from Germany following Schaumburg-Lippe, who, like Jacob Crisóstomo Pretorius, was both an artilleryman and member of the Academia Real das Ciências. Schaumburg-Lippe's assistant, Conrado Henrique Niemeyer, worked alongside Portuguese engineers. A second wave of German officers called by Christian August, Prinz zu Waldeck, commander in chief in 1797, were active in the Peninsular War; Brigadier Baron Held de Wiederhold, Lieutenant Colonel Baron Jean-Baptiste de Blumenstein, and First Lieutenant Frederico Varnhagen shared topographical survey work with Portuguese engineers José Maria das Neves Costa, José Joaquim de Freitas Coelho, and João da Mata Chapuzet (Dias 2003; Raeuber 1993, 92). Protestant German and Dutch engineers enrolled in British service by joining the 60th Regiment of Foot, raised in Europe in 1756 by Swiss engineer James Prévost. Much of the topographic mapping of British possessions and coastlines in North America during and following the Seven Years' War was the responsibility of those engineers, including Dietrich Brehm, George Demler, Bernard Ratzer, Samuel Holland, Charles Blaskowitz, Claude Joseph Sauthier, and J. F. W. Des Barres (Widder 1999; Campbell 2010).

The changes wrought first by the American and then by the French Revolution further reinforced tendencies toward transnational circulation, stimulated not just by technical demands but increasingly by political and

ideological considerations. Louis-François Carlet de La Rozière, *inspecteur général des frontières et côtes du royaume* in France, died in Portuguese service after his emigration during the French Revolution. But few moved around as much as José María de Lanz. A Mexican-born Spanish naval officer, Lanz began his professional life surveying coastlines. In 1793 he became a French citizen, then taught applied mathematics at Gaspard Marie Riche de Prony's *École des géographes* and later at the *Escuela de Caminos y Canales* in Carlos IV's Spain, prior to managing the mapping services for José I Bonaparte. After one year at the *Academia de Matemáticas* in Buenos Aires, he continued his career under Simón Bolívar in Colombia (Ortiz and Bret 1997).

Crossing the boundaries between military and civilian services was not unusual in Ancien Régime France. Since topographical surveying in France was the domain of the *ingénieurs géographes*, not the military engineers and artillerymen, the French case was an odd one; yet because the French model was employed throughout Europe, it is worth closer study. Until early Napoleonic times, a few *ingénieurs géographes* (topographers) came from the private company of the Cassini *Carte de France* or from the team employed by Edme Verniquet for the plan of Paris (1790). General Etienne-Nicolas Calon, head of the *Dépôt de la Guerre* from 1793 to 1797, was himself trained in the corps of military topographers (*ingénieurs géographes militaires*) (fig. 228), which was officially suppressed in 1791, though the engineers continued and even extended their activities during the French Revolutionary Wars. But the backgrounds of his successors varied sharply, such as that of Sanson (director 1802 to 1812), who had taught architecture in a military school before entering the *Corps du Génie* in 1793. Many heads of the *Dépôt's* topographical section had also worked within civil institutions, such as Charles-François Frérot d'Abancourt, a topographer formerly assigned to the cadastre of Corsica, to Turkey on behalf of the ministry of foreign affairs, and to the compilation of commemorative maps of the campaigns of Henri de la Tour d'Auvergne, vicomte de Turenne, for the Chevalier Jean de Beaurain's commercial enterprises. During the French Revolution, d'Abancourt organized the geographic creation of the administrative districts (*départements*) of modern France (Ozouf-Marignier 1989), the topographical works of the Bureau du cadastre, and the short-lived *Agence des cartes* (Berthaut 1902; Bret 1991). Similarly diverse were the heads of the Bureau du cadastre who ran civil cartography. Prony, a civil engineer and a physicist, was later a member of the *Académie des sciences*, as well as the director of the *École des Ponts et Chaussées* and the *École des géographes* (1797–1802). Jean-Henri Hassenfratz, a chemist and a mining engineer, had also worked in Beaurain's



FIG. 228. JEAN-BAPTISTE BERTHIER, EIGHTEENTH-CENTURY FRENCH *INGÉNIEURS GÉOGRAPHES MILITAIRES* AT WORK. From Berthier's "Plan de la bataille de l'Affelt," manuscript, 1747 (inside front cover), concerning the battle of Lauffeld (also Laffelt or Lawfeld) near Maastricht during the War of the Austrian Succession. The plane table was the major means for the topographical surveys by the French topographers, both civil and military. Size of the original: ca. 52.5 × 42.0 cm. © Service historique de la Défense, Vincennes (A 2 C 369).

commercial establishment and later held tenure teaching physics at the *Ecole polytechnique* (Grison 1996).

All the same, by their training and their own talents, engineers belonged to a technical elite that benefited from a certain social recognition, at least compared to land surveyors (*arpenteurs* and *géomètres*), who made cadastral surveys of noble estates. Engineers adapted more easily to the increasing sophistication of instruments and generally possessed the intellectual tools required for managing financial and technical complexities. However, some land surveyors did command theoretical knowledge: among those who worked between 1776 and 1791 on the very large-scale "Plans d'intendance," or "Plans des paroisses de la généralité de Paris" at the order of the *intendant* Louis Bénigne François de Bertier de Sauvigny, some owned a library of applied geometry, such as Guillaume Dubray, others wrote elementary books on land surveying, such as Louis-Antoine Didier

and Pierre Picq (Touzery 1995, 28–29). Yet on the whole, their expertise did not yet match that of the engineers. In 1794, in order to recruit twenty-five land surveyors for the national cadastre, Prony organized a competition to find the “most learned citizen in map and plan surveying, measurement and trigonometric calculus” recommended by the chief engineer of Ponts et Chaussées in every new *département* (Bret 2009, 126). In addition to their ability to write a memoir and to understand logarithms and the metric system as well as possessing the accessory talents of coloring, drawing, and elegant handwriting, the candidates had to prove their skill in the field in trigonometric, topographical, and land surveying operations, especially measuring a baseline and using a compass. Nonetheless, in Napoleon’s Egyptian campaign, the new recruits proved their striking inferiority when compared not only to their military and civil school-trained comrades, but also to the surveyors whom Dominique Testevuide had trained as engineers for the cadastre of Corsica (Bret 2009, 135–36). Killed in Egypt, Testevuide was replaced by his nephew and assistant Pierre Jacotin, later a colonel in the new imperial corps of *ingénieurs géographes militaires* (1808) and the head of the topographical section at the Dépôt de la Guerre.

As they gradually professionalized, French engineers definitively surpassed their challengers in topographical surveys. Military topographic training still continued within the Dépôt, until the *École impériale des ingénieurs-géographes* was established in 1809. A former civil engineer, Louis Puissant, the examiner and main professor whose treatises on topography, land surveying, and geodesy were much appreciated, replaced the famous mathematician Pierre-Simon de Laplace at the Académie des sciences. Mathematical geography and topographical survey now shared the curriculum for engineers.

INSTRUMENTS AND INNOVATIONS For engineers, field knowledge had long been more practical than theoretical. What distinguished their manner of topography from that of land surveyors were their overall goals. The property surveyor “measured the land and not the space” (Touzery 1995, 26), while engineers both measured a given space and then visualized it within a broader spatial context articulated within the figure of the earth by references to geodetic coordinates. Attempts to reduce large-scale maps that lacked geodetic triangulation, such as the cadastral maps of Savoy, had failed. By linking topographic local space to geodesy, engineers bridged the wider gap between chorography and geography: they could reduce the large scale to the small scale with minimal error by basing their topographic surveys upon second- and third-order triangulation and inscribing

them within the network of the first-order triangulation along a meridian and a parallel.

Without the framework provided by triangulation, even the most respected maps of eighteenth-century engineers could not meet the standard for quality demanded by their early nineteenth-century users and critics. By the end of the eighteenth century, engineers were making fewer maps of battles and sieges, and the fortification plans advocated by Vauban and his followers did not depict a landscape beyond the short range of a fortified place. The survey techniques of the late seventeenth century, such as found in Borgonio’s *Carta generale* (1680), employed a compass and a *contraguardo* and drew landscape in perspective (*à la cavalière*). Roussel and La Blottière’s eight-sheet manuscript map of the Pyrenees (reduced from the original surveys of 1:36,000 to ca. 1:216,000, published as *Carte generale des monts Pyrenées, et partie des Royaumes de France et d’Espagne*, 1730) was created for obvious military purposes: it was oriented to the south, allowing French staff officers to easily read it with Spain at the top of the map. But despite Roussel’s long service as an engineer and his deserved reputation, “this work, reputedly geometric . . . is nevertheless beneath the estimation we keep for it. Although the framework on it is good, its details would not support critique. The relief is absolutely false and idealized; the mountains were thrown on [the sheet] incompletely and without continuity” ([Soulavie] 1802–3, 81; Frœhlich 1960). Moreover, engineers often perpetuated mistakes by copying their predecessors instead of correcting their work in the field. The work of Claude Masse barely escaped this indictment, since he tried to present the mapped territories like a painter, emphasizing the image rather than the space.

Faced with the challenge of representing an entire territory, topographic surveying entered a different scientific domain with the Cassini *Carte de France* (1:86,400), the first survey based on a national geodetic triangulation. Similar projects of national triangulation-based topography were successively launched in many countries, yielding reputable maps, such as those by Ferraris in the Austrian Netherlands, by Rizzi Zannoni in the Kingdom of Naples, and by the British Board of Ordnance. Demand for accuracy sometimes required transnational cooperation, as with the Paris-Greenwich triangulation (1784–88), which linked the meridian lines of the royal observatories.

The tremendous increase in topographical needs accompanying the growth of the modern state and the social and political upheavals of revolutions multiplied and diversified surveying practices and uses. Like military leaders and administrators, many engineers needed topographical surveys as an intermediary step to a further project, whether for building roads, canals, fortifi-

cations, towns, or mines, or for managing forests. The earlier ornamental map as showpiece was replaced with the utilitarian map as tool.

In Tuscany, topographical mapmaking was tightly linked to the administrative reforms and needs of the House of Lorraine. Ferdinando Morozzi and, especially, Leonardo Ximenes led the development of such cartography in the second half of the eighteenth century, indeed forming a school, which shortly thereafter was to produce documents of extraordinary importance with hydraulic, political, administrative, military, fiscal, and sanitary purposes. Piedmontese engineers also made a collective map of forests, while Spirito Benedetto Nicolis di Robilant produced a mineralogical map.

Such developments were not without tribal claims for the strategic value of topographical surveying. In 1775, Le Michaud d'Arçon, of the military engineers, fought against the Cassini survey of Dauphiné and Provence, two provinces he was himself surveying to complete his fellow engineer Bourcet's map of the Alps: "It is of the highest importance that its knowledge only benefit us. The privilege granted to Mr. Cassini's engineers should exclude the parts of the boundaries, the knowledge of which it would be important to keep. . . . His map will be good or bad. Would it be good, it should be forbidden" (Berthaut 1902, 1:72). The copperplates of Rousset and La Blottière's map of the Pyrenees were sequestered after its publication in 1730, as were those of the forty-seven-sheet map of Egypt and Syria at 1:100,000 in 1808 after Napoleon's campaign, at the same time as those of Jean-Denis Barbié Du Bocage's *Carte de la Morée* in 1807 (Berthaut 1902, 1:276, 278, 2:396).

In a military context, engineers often based their field practice on their own training and the supply of instruments. The most common topographical surveying instruments included a chain for measuring a local baseline; either a plane table with an alidade or a telescope according to the range, more convenient for drawing the field, or a compass for quick surveying; a protractor or a land surveyor square for small areas, or better a graphomètre; and a pocket sextant or a small repeating circle. For both vertical and horizontal angle measurement, reflecting instruments, either sextants or circles, were used. For the *Carte de France*, engineers mainly used a sighted graphomètre (*graphomètre à lunette*) in order to draw rough drafts, which were later copied and improved thanks to registers of place-names and calculations (Pelletier 1990, 96–100). Without any instruments for measuring altitude accurately, the engineers neglected measuring and drawing relief, a topographical aspect of major interest for engineers of the Ponts et Chaussées and military engineers. The chief instrument for an engineer's topographical work in France and Italy was the plane table, introduced by Johann Jakob Ma-

rinoni for the cadastre of Milan (*censimento*) in 1720 (see fig. 399). By contrast, British military topographers set aside the plane table, with the major exception of the survey of Madras Presidency, at the end of the eighteenth century. They preferred to use the theodolite, which was adopted in the following century only for the new 1:80,000 topographic map of France. British topographical surveying relied on local civilian triangulation, such as Peter Perez Burdett's survey of Derbyshire published in 1767.

Some engineers sought improvement to their instruments. In Britain, Henry Beighton designed a new plane table for his trigonometric survey of Warwickshire (1722–25; published 1728) (see fig. 834). French military engineer Nicolas-Joseph Cugnot further improved the plane table with a steadier platform, eventually used widely in France. Gaspard Monge at the École normale supérieure proposed a method for using surveying instruments from a height in 1795. Antoine François Lomet created a special device to make the sextant suitable for expeditious topographical surveying from a moving balloon (figs. 229 and 230). Lomet experimented with the balloon in 1796 at Meudon with Nicolas-Jacques Conté, a former land surveyor, then chemist, mechanical engineer, and head of the École nationale aérostatique (and also the inventor of the artificial graded pencil, indispensable to engineers and topographers). The main result of these experiments was the creation of the École des géographes, which included a two-year common curriculum for topographers, offered with the École nationale aérostatique, after one year at the École polytechnique (Bret 1990–91).

Maps themselves felt the effect of the engineer's quest for improvement. General Franz Ludwig Pfyffer of Switzerland had worked with French and Hessian engineers during the War of the Polish Succession (1733–38) and the War of the Austrian Succession (1740–48). He extended the tradition of the *plans-reliefs* to a smaller scale with his three-dimensional "Plan du canton de Zug" (1780, ca. 1:50,100), built after a topographical survey and a further leveling every ten toises by barometer. Napoleon wanted it for the Dépôt de la Guerre (Bürgi 2007).

The graphic representation of height was an essential requirement for both civil and military engineers. The most creative innovation to meet this challenge was the introduction of contour lines. The Bolognese scientist Luigi Ferdinando Marsigli first used bathymetric lines in 1725 (see fig. 361), and they were further employed by the Dutch surveyor Nicolaas Samuëlsz. Cruquius, who built on techniques used earlier in the sixteenth and mid-seventeenth century (Pieter Bruinsz., River Spaarne, 1584; Pierre Ancelin, River Maas and environs, 1697) (Konvitz 1987, 68). Contour lines were proposed for mountains by Marc Bonifas, dit Du Carla, at the

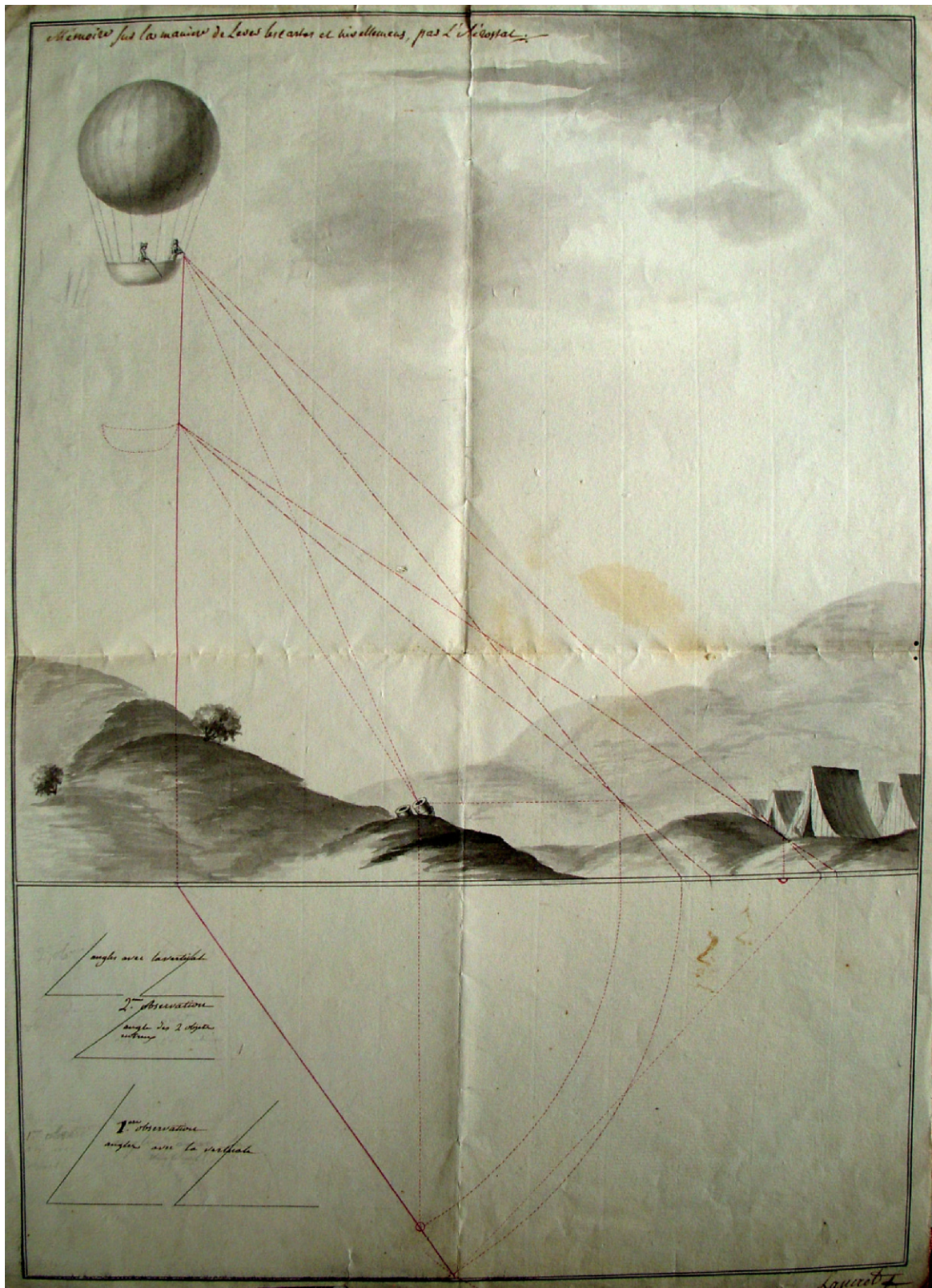


FIG. 229. MICHEL-ANGE LANCRET, "MÉMOIRE SUR LA MANIÈRE DE LEVER LES CARTES ET NIVELLEMENS, PAR L'AÉROSTAT," [1796]. An application of aerostatics and Gaspard Monge's descriptive geometry to topographical sur-

veys by the students of the École polytechnique and the École nationale aérostatique. Size of the original: ca. 56 × 40 cm. Private collection.

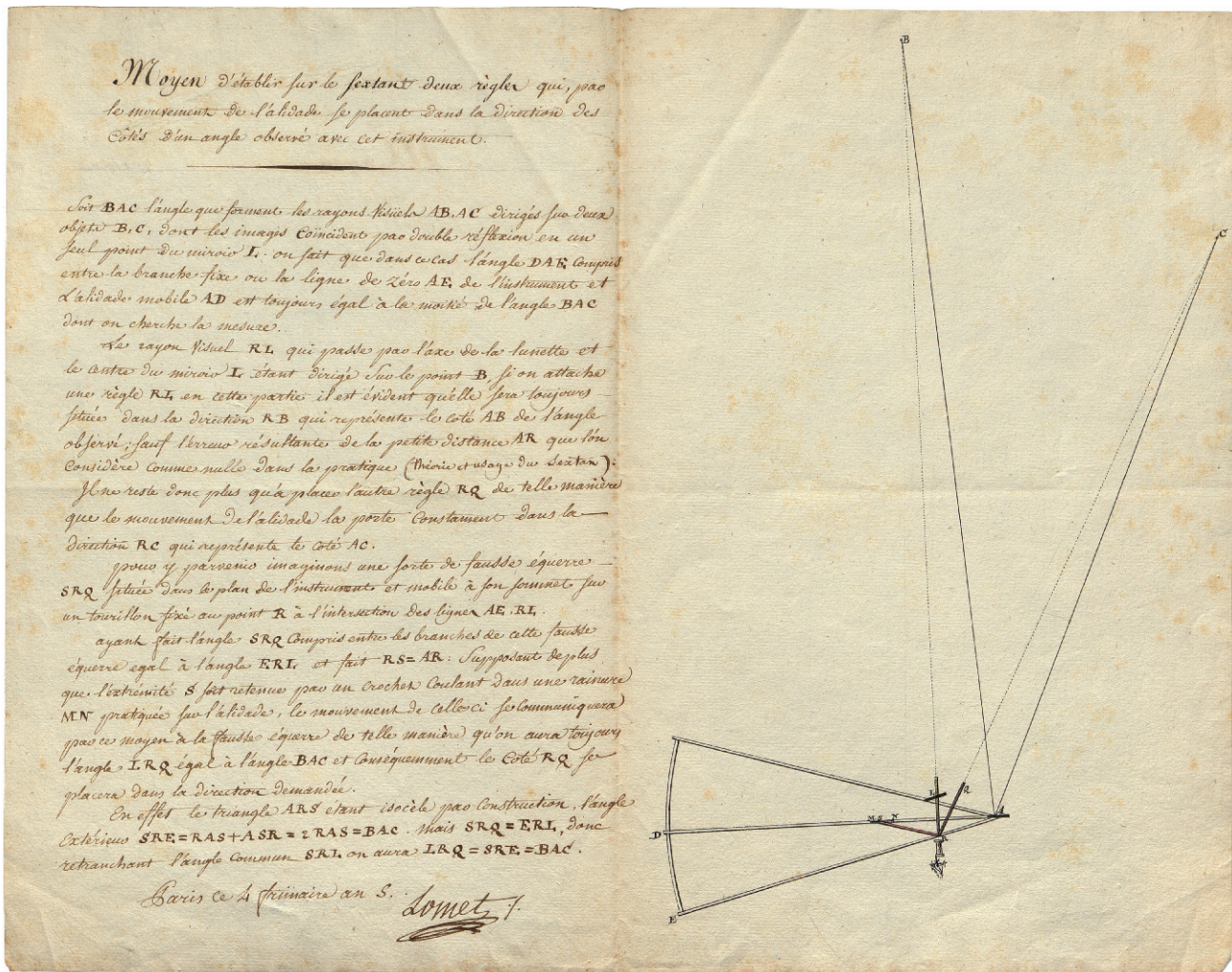


FIG. 230. ANTOINE FRANÇOIS LOMET, AN ENGINEER'S IMPROVEMENT TO THE SEXTANT FOR EXPEDITIOUS AERIAL TOPOGRAPHICAL SURVEYING. Original drawing added to the manuscript "Moyen d'établir sur le sextant deux règles qui, par le mouvement de l'alidade se placent dans

la direction des côtés d'un angle observé avec cet instrument," 4 Frimaire an 5 (24 November 1796). © École nationale des Ponts et Chaussées, Marne la Vallée (MS 1532).

Académie des sciences (1771); then used by Jean-Louis Dupain-Triel fils for a small-scale map of France (1791) (see fig. 357); by French military engineers, among whom most noteworthy was Jean-Baptiste Meusnier de La Place, who displayed water depths on the map of the harbor of Cherbourg (1789) (Konvitz 1987, 98–99) (see fig. 363); and then in fortification projects. The earliest evidence for their use in large-scale terrain mapping dates to the Egyptian campaign (fig. 231), but the method was used in Italy as early as 1801. The 1802 Commission topographique did not standardize the use of contour lines, but it maintained them officially as a specific need for French military engineers. Nevertheless, their use soon spread out from the military; in 1812, civil engineer Pierre-Simon Girard published Verniquet's

Plan de Paris with contour lines added. In addition to administrative requirements, techniques were also transferred from one engineering field to another. At the eve of the nineteenth century, standardized topography had become a method shared by engineers.

PATRICE BRET

SEE ALSO: Boundary Surveying; Enlightenment; Cruquius, Nicolaas Samuelsz.; Heights and Depths, Mapping of; Marsigli, Luigi Ferdinando; Masse Family; Military and Topographical Surveys; Military Cartography; Naudin Family; Topographical Survey Map; Topographical Surveying; Triangulation Surveying

BIBLIOGRAPHY

Bégot, Danielle, Monique Pelletier, and Catherine Bousquet-Bressolier. 1998. *La Martinière de Moreau du Temple, 1770: La carte des ingénieurs géographes*. Paris: Comité des Travaux Historiques et Scientifiques.

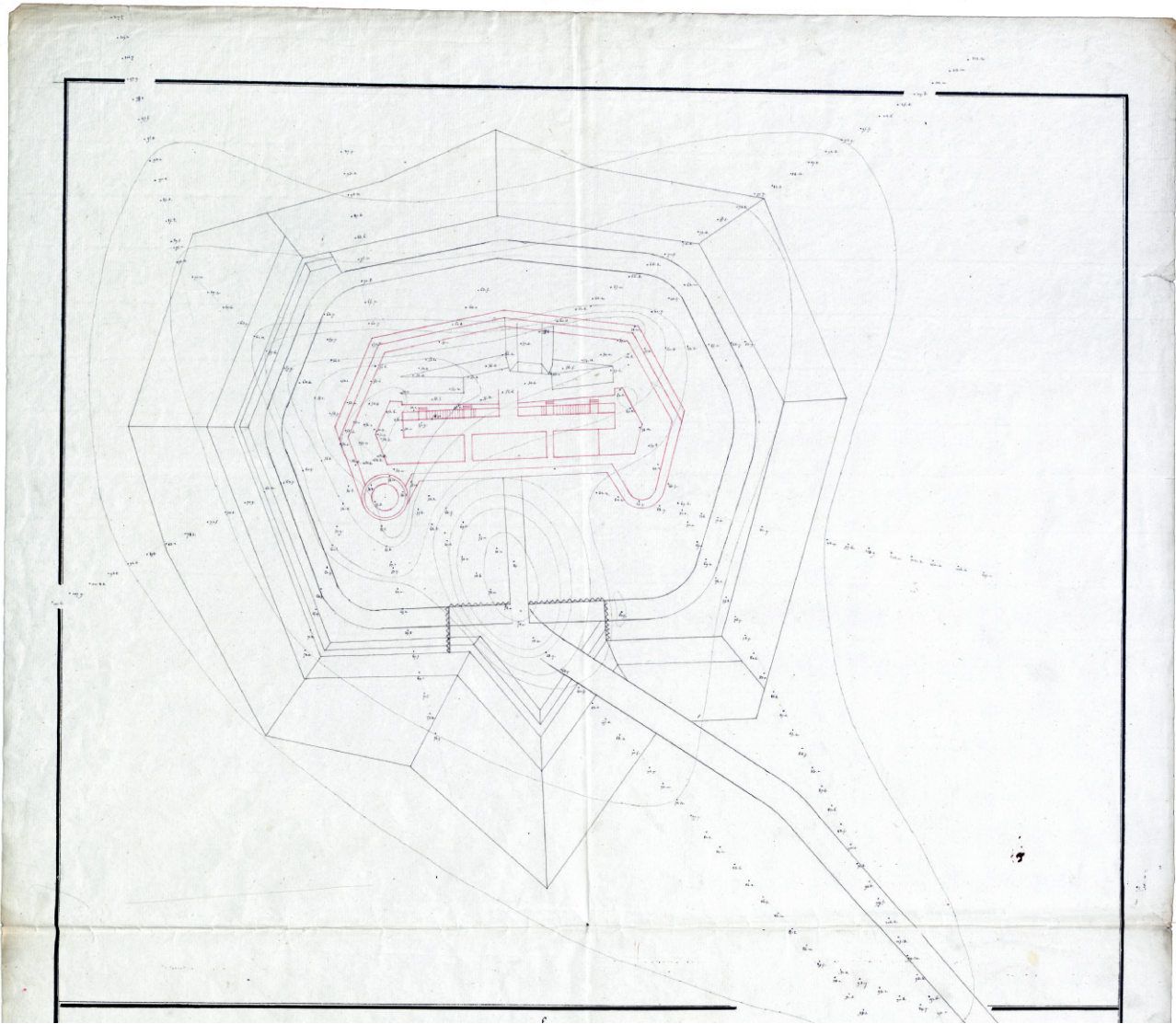


FIG. 231. ANONYMOUS, "FORT DE L'INSTITUT," CAIRO [1798–99]. A military engineer's achievement: the use of contour lines in topographical surveys for fortification planning.

© Service historique de la Défense, Vincennes (GR 1 V^m 63, tablette 42/2).

Berthaut, Henri Marie Auguste. 1902. *Les ingénieurs géographes militaires, 1624–1831: Étude historique*. 2 vols. Paris: Imprimerie du Service Géographique.

Bourcier, Sylvie. 1972. *La carte des chasses royales*. Vincennes: Service Historique de l'Armée de Terre.

Bret, Patrice. 1990–91. "Les épreuves aérostatiques de l'École polytechnique en l'an IV: De la géométrie descriptive à l'origine de l'École des géographes." *Sciences et Techniques en Perspective* 19:119–42.

———. 1991. "Le Dépôt général de la Guerre et la formation scientifique des ingénieurs-géographes militaires en France (1789–1830)." *Annals of Science* 48:113–57.

———. 2009. "Du concours de l'an II à la suppression de l'École des géographes: La quête identitaire des ingénieurs géographes du Cadastre de Prony, 1794–1802." In *Jogos de identidade profissional: Os engenheiros, a formação e a ação = Les enjeux identitaires des ingénieurs: Entre la formation et l'action = The Quest for a Professional Identity: Engineers between Training and Action*, ed. Ana

Cardoso de Matos et al., 121–54. Lisbon: Edições Colibri; Évora: CIDEHUS; CIUHCT.

Bruchet, Max. 1988. *Notice sur l'ancien cadastre de Savoie*. New ed., updated. Intro. Paul Guichonnet. Annecy: Archives de la Haute-Savoie.

Bueno, Beatriz Piccolotto Siqueira. 2011. *Desenho e designio: O Brasil dos engenheiros militares (1500–1822)*. São Paulo: Editora da Universidade de São Paulo.

Bürgi, Andreas. 2007. *Relief der Urschweiz: Entstehung und Bedeutung des Landschaftsmodells von Franz Ludwig Pfyffer*. Zurich: Verlag Neue Zürcher Zeitung.

Campbell, Alexander V. 2010. *The Royal American Regiment: An Atlantic Microcosm, 1755–1772*. Norman: University of Oklahoma Press.

Cuccoli, Lorenzo. 2012. "Le armi dotte tra Francia e Italia, 1796–1814." PhD diss., Università di Bologna.

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.
- Frœhlich, André. 1960. "The Manuscript Maps of the Pyrenees by Roussel and La Blottière." *Imago Mundi* 15:94–104.
- Galland Seguela, Martine. 2008. *Les ingénieurs militaires espagnols de 1710 à 1803*. Madrid: Casa de Velázquez.
- Grison, Emmanuel. 1996. *Du faubourg Montmartre au Corps des Mines: L'étonnant parcours du républicain J. H. Hassenfratz (1755–1827)*. Paris: Presses de l'École des Mines.
- 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.
- 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.
- Jones, Yolande. 1974. "Aspects of Relief Portrayal on 19th Century British Military Maps." *Cartographic Journal* 11:19–33.
- Konvitz, Josef W. 1987. *Cartography in France, 1660–1848: Science, Engineering, and Statecraft*. Chicago: University of Chicago Press.
- Lindgren, Uta. 2007. "Land Surveys, Instruments, and Practitioners in the Renaissance." In *HC* 3:477–508.
- Marcel, Gabriel. 1897. "A propos de la Carte des chasses." *Revue de Géographie* 41:344–56.
- Marshall, Douglas W. 1973. "The British Engineers in America: 1755–1783." *Journal of the Society for Army Historical Research* 51:155–63.
- Ortiz, Eduardo L., and Patrice Bret. 1997. "José María de Lanz and the Paris-Cadiz Axis." In *Naissance d'une communauté internationale d'ingénieurs (première moitié du XIX^e siècle)*, ed. Irina Gouzévitch and Patrice Bret, 56–77. Paris: Centre de Recherche en Histoire des Sciences et des Techniques; Cité des Sciences et de l'Industrie.
- Ozouf-Marignier, Marie-Vic. 1989. *La formation des départements: La représentation du territoire français à la fin du 18^e siècle*. Paris: École des Hautes Études en Sciences Sociales.
- Pallièrre, Johannès. 1988. "La Carte générale de la Savoie, 1737." In *La carte de Savoie: Histoire de la représentation d'un territoire*, 74–81. Chambéry: Musée Savoisien.
- Pansini, Valeria. 2002. "L'oeil du topographe et la science de la guerre: Travail scientifique et perception militaire (1760–1820)." PhD diss., École des Hautes Études en Sciences Sociales, Paris.
- Pelletier, Monique. 1990. *La carte de Cassini: L'extraordinaire aventure de la carte de France*. Paris: Presses de l'École Nationale des Ponts et Chaussées.
- Raeuber, Charles-Alphonse. 1993. *Les renseignements, la reconnaissance et les transmissions militaires du temps de Napoléon: L'exemple de la troisième invasion du Portugal, 1810*. Lisbon: Comissão Portuguesa de História Militar.
- Sargent, T. C. 1984. "Thomas Livingston Mitchell and Wyld's Atlas of the Peninsular War, 1808–1814." *Cartography* 13:253–59.
- Sereno, Paola. 2002. "Li Ingegneri Topografici di Sua Maestà': La formazione del cartografo militare negli stati sabaudi e l'istituzione dell'Ufficio di Topografia Reale." In *Rappresentare uno stato: Carte e cartografi degli stati sabaudi dal XVI al XVIII secolo*, 2 vols., ed. Rinaldo Comba and Paola Sereno, 1:61–102. Turin: Allemandi.
- . 2007. "Cartography in the Duchy of Savoy during the Renaissance." In *HC* 3:831–53.
- [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.
- Touzery, Mireille. 1995. *Atlas de la généralité de Paris au XVIII^e siècle: Un paysage retrouvé*. Paris: Comité pour l'Histoire Économique et Financière de la France.
- Virol, Michèle. 2010. "La circulation internationale des ingénieurs en Europe (années 1680–années 1780)." In *Les circulations internationales en Europe, années 1680–1780*, ed. Pierre-Yves Beaurepaire and Pierrick Pourchasse, 67–80. Rennes: Presses Universitaires de Rennes.
- Widder, Keith R. 1999. "The Cartography of Dietrich Brehm and Thomas Hutchins and the Establishment of British Authority in the Western Great Lakes Region, 1760–1763." *Cartographica* 36, no. 1:1–23.

English Pilot, The. *The English Pilot* was a series of pilot books (texts of sailing directions accompanied by nautical charts) conceived by John Seller, and published by him, his partners, and their heirs in London from 1671 until the end of the eighteenth century. The series was the first major sea atlas produced in England, thus initiating the entrance of marine chart publication into the London map trade and marking the end of Great Britain's reliance on the Dutch for marine charts.

John Seller, a London mathematical instrumentmaker and maker and seller of maps and charts, wrote about navigation and mathematics and supplied instruments, chiefly compasses, to the Admiralty (Verner 1978, 135–36). He briefly described the motivation for *The English Pilot* in the postscript to his *Practical Navigation* (1669, 310): "whereas there being frequent complaints made that the *English* hath not as yet manifested that forwardness in the promotions of things of publick concernment, for the general benefit of Navigation, as the *Hollander* hath done, in the making of *Waggoners* and *Charts* for the Sea . . . [I] am at the present upon making (at my own cost and charge) a *Sea Waggoner* for the whole World, with *Charts* and *Draughts* of particular places, and a large Description [of] all the Roads, Harbors and Havens, with the Dangers, Depths and Soundings in most parts of the World." The plan of the contents of *The English Pilot* was laid out in the preface to *The First Book, Describing . . . the Whole Northern Navigation* (1671), in which Seller described his planned four books: the first, the Northern Navigation (northern Europe, the Baltic, the coasts of England and Scotland), the second, the Southern Navigation (the Channel, the coasts of Europe from France to the Cape of Good Hope, including the Mediterranean); the third, the Oriental Navigation (the Cape of Good Hope to Japan), and the fourth, the West Indian Navigation (from Hudson's Bay to the Straits of Magellan). In its final form, *The English Pilot* expanded to six books. The following list identifies the initial title, first and last publication dates, and initial primary authors. All parts of *The English Pilot* went through multiple reprints, but the complexity of ownership and the reuse of plates make the definition of editions both difficult and mobile, especially as the charts were often supplied by one firm and the text by

another (Adams and Waters 1995, 62–67; Verner 1967, XV–XVIII; 1970, XIV; 1973, XII):

The English Pilot, the First Book, Describing . . . the Whole Northern Navigation (1671–1785, John Seller)

The English Pilot, the Second Book, Describing . . . the Southern Navigation (1672–1792, John Seller)

The English Pilot, the Second Book, The Second Part, Describing . . . the Mediterranean Sea (1677–1803, John Seller, John Thornton)

The English Pilot, the Third Book, Describing . . . the Oriental Navigation (1675, partial, John Seller; 1703–61, complete, John Thornton)

The English Pilot, the Fourth Book, Describing . . . the West-India Navigation (1689–1794, John Thornton)

The English Pilot, the Fifth Book, Describing . . . the West Coast of Africa (1701–80, Jeremiah Seller and Charles Price)

Seller was only able to prepare the first two books before he ran into financial difficulties. In 1677 he formed a partnership with four other men in the trade: John Thornton, a chartmaker; William Fisher, a printer and publisher of nautical tracts; and James Atkinson and John Colson, both teachers of navigation. Their efforts brought the book on the *Mediterranean Sea* to the public. By 1679 Fisher had acquired full rights to the *Mediterranean Sea*, and from this point on, Seller was no longer involved in the publication of new volumes of *The English Pilot* (Verner 1967, VI). After Fisher's death in 1691, the publication rights and stock passed to his son-in-law and heir Richard Mount, who had been his apprentice, and Mount's partner Thomas Page. Similarly, Thornton's interest in two books, *Oriental Navigation* and *West-India Navigation*, was transferred after his death in 1708 to his son Samuel, also a chartmaker. By 1715 the firm of Mount and Page had acquired the plates, texts, and publication rights to all the books of *The English Pilot* and through their heirs continued to publish all the books until 1803 (Verner 1973, VII–IX).

The quality of the charts throughout *The English Pilot* varied according to their authors. For the *Northern Navigation*, Seller worked from Dutch charts. He had bought sixty-three old and worn copperplates originally published by Johannes Janssonius in 1620 as a counterfeit edition of Blaeu's *Het licht der zee-vaert* (Verner 1978, 151–52). Now, as a cheap if dated shortcut, Seller reprinted some of these and supplemented them with some new charts of British waters. John Thornton may also have supplied some of the plates for the *Mediterranean Sea* (Verner 1978, 149). Thornton was an experienced chartmaker who served as hydrographer to the East India Company and supplied charts to Hudson's Bay Company (Smith 1978, 79–81, 95, 98–100). In

preparing charts for ships sailing to the East, Thornton had acquired a large collection of navigation material on which he could draw for both the *Oriental Navigation*, which he took over from Seller, and the *West-India Navigation*, for which he was solely responsible. Thornton dedicated the third book, *Oriental Navigation*, to the East India Company's Court of Managers, and several of the pilotage charts in this book reflect their source in larger-scale manuscript works signed by Thornton (Cook 1985, 66–67). He had access to manuscript charts of the Indian Ocean and the Far East, prepared by Joan Blaeu as hydrographer to the Dutch Verenigde Oost-Indische Compagnie (VOC) in 1638–73, some of which Thornton copied on vellum for the East India Company (Roncière 1965). In addition, Thornton incorporated information gleaned from the voyages of William Dampier to the coasts of New Holland (Australia) in 1699–1701 and Edmond Halley to the South Atlantic in 1699–1700. Thornton compiled the charts for the fourth book, *West-India Navigation*, while his partner William Fisher printed the sailing directions. *The English Pilot, the Fifth Book*, covering the west coast of Africa (1701), was produced by Jeremiah Seller, son of John, who continued his father's mathematical instrument business, and Charles Price, who had apprenticed as a watchmaker and probably worked in Seller's shop. Price's aptitude as a chart- and mapmaker is shown in his signing of twelve of the fifteen charts in the *West Coast of Africa* and providing original work to charts based mostly on Dutch sources (fig. 232) (Verner 1973, IX–XI).

While sales of *The English Pilot* continued throughout the eighteenth century, bringing profit to Mount and Page, later partners did little to incorporate new materials, allowing increased competition both at home and from abroad. In England by the latter half of the century, charts published by Thomas Jefferys (e.g., the *West Indian Atlas*) and Robert Sayer and John Bennett (e.g., the *North American Pilot*) as well as those found in J. F. W. Des Barres's *The Atlantic Neptune* offered alternative charts based on British surveys, with Sayer and Bennett, and William Herbert and Henry Gregory producing new charts for the East Indies (Verner 1967, IX). From the Netherlands, the sixth volume of *De nieuwe groote lichtende zee-fakkel* (1753) from the Van Keulen publishing house focused on the Asian waters based on VOC materials and, from France, Jean-Baptiste-Nicolas-Denis d'Après de Manneville's *Le Neptune orientale* (1745) also presented material for Asian navigation based on firsthand observation. Nonetheless, *The English Pilot* was the first systematic attempt by the English to publish charts and to compete against Dutch dominance.

ALISTAIR S. MAEER AND ASHLEY BAYNTON-WILLIAMS



FIG. 232. A CHART OF YE COASTS OF CIMBEBAS AND CAFFARIA FROM M^T. NEGRO TO YE C. OF GOOD HOPE, ENGRAVED BY FRANCIS LAMB, FROM THE ENGLISH PILOT, THE FIFTH BOOK, DESCRIBING . . . THE WEST COAST OF AFRICA. Various states of this particular chart appeared in printings of this book from 1701 to 1780. The chart was originally prepared by Jeremiah Seller and Charles Price, but on this impression their names have been roughly obliterated from the title cartouche and not replaced. Printings of *The English Pilot* remained uncolored, but this impression comes from a large and undated (ca. 1715) collection

of charts from several of books of *The English Pilot* published under the title *The Sea-Atlas: Containing an Hydrographical Description of Most of the Sea-Coasts of the Known Parts of the World* and probably assembled by Samuel Thornton, all of whose charts bear full, contemporary color. This particular work exemplifies the common combination of coastal charts with detailed harbor plans.

Size of the original: ca. 43 × 54 cm. Image courtesy of the Lionel Pincus and Princess Firyal Map Division, New York Public Library (02-295).

SEE ALSO: Atlas: Marine Atlas; Map Trade: Great Britain; Marine Charting: Great Britain

BIBLIOGRAPHY

- Adams, Thomas R., and David W. Waters, comps. 1995. *English Maritime Books Printed Before 1801: Relating to Ships, Their Construction and Their Operation at Sea*. Providence: John Carter Brown Library; Greenwich: Greenwich National Maritime Museum.
- Baynton-Williams, Ashley. 2005. "The English Pilot: The Fourth Book." *Mapforum* 5:26–32.
- Cook, Andrew S. 1985. "More Manuscript Charts by John Thornton

for the Oriental Navigation." In *Imago et mensura mundi: Atti del IX Congresso internazionale di storia della cartografia*, 3 vols., ed. Carla Clivio Marzoli, 1:61–69. Rome: Istituto della Enciclopedia Italiana.

Roncière, Monique de la. 1965. "Manuscript Charts by John Thornton, Hydrographer of the East India Company (1669–1701)." *Imago Mundi* 19:46–50.

Seller, John. 1669. *Practical Navigation: Or, An Introduction to that Whole Art*. London: Printed by J. Darby.

Shirley, Rodney W. 1995. "The Maritime Maps and Atlases of Seller, Thornton, and Mount & Page." *Map Collector* 73:2–9.

- Smith, Thomas R. 1978. "Manuscript and Printed Sea Charts in Seventeenth-Century London: The Case of the Thames School." In *The Compleat Plattmaker: Essays on Chart, Map, and Globe Making in England in the Seventeenth and Eighteenth Centuries*, ed. Norman J. W. Thrower, 45–100. Berkeley: University of California Press.
- Verner, Coolie. 1967. "Bibliographical Note." In *The English Pilot: The Fourth Book, London 1689*, V–XX. Amsterdam: Theatrum Orbis Terrarum.
- . 1973. "Bibliographical Note." In *The English Pilot: The Fifth Book, London 1701*, by Jeremiah Seller and Charles Price, V–XIV. Amsterdam: Theatrum Orbis Terrarum.
- . 1978. "John Seller and the Chart Trade in Seventeenth-Century England." In *The Compleat Plattmaker: Essays on Chart, Map, and Globe Making in England in the Seventeenth and Eighteenth Centuries*, ed. Norman J. W. Thrower, 127–57. Berkeley: University of California Press.
- Verner, Coolie, and R. A. Skelton. 1970. "Bibliographical Note." In *The English Pilot: The Third Book, London 1703*, by John Thornton, V–XV. Amsterdam: Theatrum Orbis Terrarum.
- Worms, Laurence, and Ashley Baynton-Williams. 2011. *British Map Engravers: A Dictionary of Engravers, Lithographers and Their Principal Employers to 1850*. London: Rare Book Society.

Engraving and Etching. See Reproduction of Maps: Engraving and Printing

Enlightenment, Cartography and the. The Enlightenment was both a historical moment—by convention, the “long” eighteenth century in Europe, ca. 1660–ca. 1815—and an intellectual movement distinguished by challenges to established authority and by new ways of critical thinking about the world. Eighteenth-century commentators considered how far public affairs should be governed by reason, the utility of science and philosophical inquiry, and the idea of human progress. Central to contemporaries’ interests and work was their belief that the application of critical reason based on careful observation of the world, not unswerving faith in ancient authority, would bring practical social benefits. Cartography or, more properly, mapping and mapmaking, was not a priority within Enlightenment philosophical and political ideals, but as a practice it was vital to knowing and shaping the Enlightenment’s social and natural worlds.

Modern interpretations of the Enlightenment agree that it was an eighteenth-century phenomenon concerned with new ways of understanding the human condition as a means to its intellectual and social improvement. Important historiographical variations exist, however, in modern scholarship. For some scholars, the Enlightenment was a philosophical phenomenon defined by the lives of great thinkers, predominantly urban, male, and French. Others have discerned a broader Enlightenment with multiple origins or have gone beyond the Enlightenment’s philosophical concerns to consider it as a movement in the social history of ideas—about political

freedom, race, science, and the environment to name but a few. Significant attention has been paid to Enlightenment as a process, even to the idea of multiple enlightenments rather than *the* Enlightenment. Further strands of Enlightenment studies are apparent in the work of those who have considered the Enlightenment’s contradictions, consequences, and continuing implications (Kors 2003). In summary, the Enlightenment has been studied in terms of its defining features and principal characters (its “what” and “who”), for its origins and motivations (its “how” and “why”), and, given the uneven results of its claims to political freedom and progress, in regard to its legacy (its “so what”). Most recently, attention has been paid to the Enlightenment as a geographical phenomenon, to its “where” (Butterwick, Davies, and Sánchez Espinosa 2008; Livingstone and Withers 1999; Withers 2007; Withers and Mayhew 2011).

While recognizing the historiographical complexities of the term Enlightenment as period, process, and place-based phenomenon, and further acknowledging that “cartography” was not understood as a coordinated endeavor of measurement and mimetic representation until after 1800 (Edney 2019), we may nevertheless distinguish two related themes connecting these terms. Under cartography *in* the Enlightenment we may consider the role that maps, mapmakers, and the processes of mapmaking had in advancing the ideas and the ideals of the Enlightenment. Attention to the cartography *of* the Enlightenment highlights how the language of mapping can help explain the nature and geographical dimensions of the Enlightenment.

The period of the Enlightenment was characterized by the appearance of a new group of cartographers. By the second half of the seventeenth century, four inter-related groups of cartographic practitioners have been identified: mariners, intellectual geographers, commercial publishers, and land measurers. “After 1660,” writes Matthew H. Edney (1998, 82), “the increased intervention of each European state in the large-scale surveying of their territories led to a fifth grouping of ‘professional geographers,’ specifically the military and state surveyors.” This group in particular drew together earlier traditions of work in maritime charting, small-scale mapping, and large-scale land surveying into a unified whole called by some “mathematical cosmography,” in which mathematics, astronomy, and geometry came together, often in particular institutional contexts, to provide epistemological foundations to Enlightenment mapmaking. Others have used “mathematical practitioners” to denote mapmakers in the seventeenth and eighteenth centuries (Taylor 1954, 1966), but this term is less precise than Edney’s fourfold distinction. Elsewhere, Edney (1999, 167) noted that “the variety and scope of technological and institutional innovations in map

making during the eighteenth century is overwhelming.” Why was this? In general terms, because the Enlightenment was the period “when natural philosophy was reconfigured with an instrumentalist, and highly empiricist, quantifying spirit”; when “European states and their landed elites began to undertake large-scale topographic and very large-scale cadastral surveys”; “when European philosophers began to use the world itself as the source of ideas and data for European science”; and “when new map projections were designed to regulate the unavoidable distortions according to mathematical rather than aesthetic principles” (Edney 1999, 168).

Cartography shared in the *esprit géométrique* that characterized the Enlightenment’s interest in situating practical reason, in delineating political space, and even in giving accurate shape to the earth through geodetic expeditions to Peru and to Lapland. Different themes in cartography—for example, mineralogical mapping in the emergent earth sciences; military mapping in European states and in their colonies, notably by the French in Egypt and Upper Canada and by the British in India and North America; or boundary surveying, as in Spanish and Portuguese America—revealed the world as never before. France led the way in Europe. Geodesists and astronomers were employed through the Académie des sciences in the first Cassini survey (1680–1744) to provide a mathematical framework for the French state. This work was extended by the *Carte de France* under the direction of César-François Cassini (III) de Thury between 1747 and 1789. Elsewhere in Europe, military surveys were undertaken of the Habsburg territories (1763–87), the Highlands of Scotland (1747–55), Saxony (1780–1825), and the Italian and German states under French occupation during the Revolutionary and Napoleonic Wars (1794–1815).

Cartography was thus a central feature in the Enlightenment, but mapping in the period was neither a simple nor a direct consequence of Enlightenment interests in reason and the authority of observation. Cartography’s visual rhetoric often depended on textual accompaniment—the association of map and memoir in what Edney has called the Enlightenment’s “geographical archive” (Edney 1999, 170–75)—in which mapmakers would indicate the difficulties associated with undertaking their maps and with the sources on which they depended. In many places, however, as the world was mapped according to European cartographic precepts, mapmakers relied on native peoples as guides, interpreters, and suppliers. Yet indigenous toponyms and native mapped knowledge—and often the peoples themselves—were commonly excluded from the resulting maps, appearing, if at all, as marginal figures ideologically and figuratively. The increasingly plain lines and form of much Enlightenment cartography and the

progressive exclusion of decoration from maps thus enshrined as much or as little symbolic significance, if differently expressed, as the ornamentation of earlier decorated maps. Mapmaking had close connections with the authority of the painterly eye in Enlightenment aesthetic traditions: surveying was a form of visual as well as of geometric and political authority. Mapping was also directed at the emerging public sphere (fig. 233), then interested in the location of current events and,

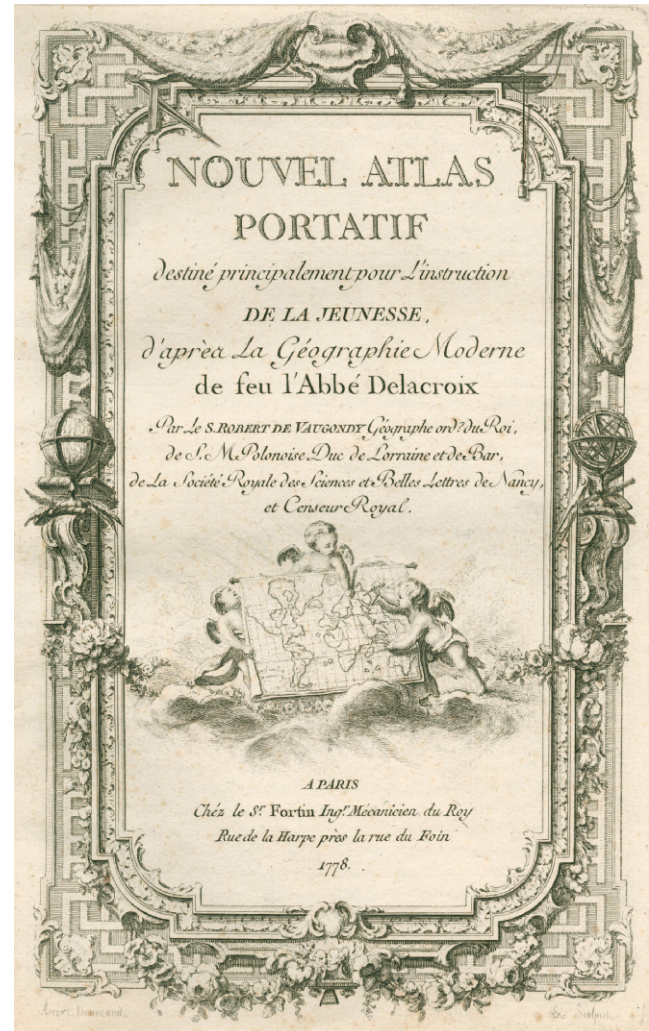


FIG. 233. FRONTISPIECE TO DIDIER ROBERT DE VAUGONDY’S *NOUVEL ATLAS PORTATIF* (PARIS: FORTIN, 1778). The full title of the atlas (“destiné principalement pour l’instruction de la jeunesse, . . .”) and the image of putti, holding a map of the world and measuring it with dividers, nicely symbolizes the educational power of the atlas. An atlas such as this one demonstrates the function of Enlightenment cartography as sociable pedagogy; the instrumentality that such education presumes for geographical maps underpins the use of maps within the public sphere of adult discourse. Size of the original: ca. 25 × 15 cm. Image courtesy of the Newberry Library, Chicago (Greenlee 4891.R64 1778).

as Brückner (2006) shows of the early United States of America, in the changing shape of the nation. Plainness was a construct designed, among other things, to make maps easier for their users. Many Enlightenment cartographers left blanks on their maps. Where earlier, uncertainty might have been illustrated with ornamentation or hypothesized geographical content, blank space did not undermine the authority of Enlightenment cartographers. The graphic and visual authority of maps, their political and administrative power, is clear by what they do not show as well as by what they do (Belyea 1996).

Cartography was used in the Enlightenment to inform audiences about their changing political world and even to instruct in political theory. In his *Atlas des enfans*, for example, Jean-Marie Bruyset used maps to illustrate the political state of Europe:

[Question]: “What are the different forms of government of the states of Europe?”

[Response]: “One distinguishes there [on it] five types of governments: despotism, monarchy, aristocracy, democracy, and a mixed form.” (Bruyset 1790, 97)

Individual nations could be graphically summarized: “How do you characterize the Scot? They are robust and warlike, civil, frank, and clever. Those who live in the mountains toward the north are nearly savages” (Bruyset 1790, 113).

Enlightenment cartography was thus a means to measure not just the physical dimensions of the world but the moral conditions of its peoples. This is evident in what we may term the cartography of human difference. A principal philosophical and historical tenet of the Enlightenment was belief in the stadial theory of social development, that is, the stage-by-stage development of human societies from savagery to pastoralism, to agrarianism, to industrial society, or, as it was also phrased, from rudeness of culture to civilized society. What contemporaries termed the “Science of Man” was motivated by a concern to bring questions of science as method, principally incorporating direct observation, to bear upon the human world as those questions were then being used to explain and map the physical realm. In charting the Enlightenment world, explorer-geographers and *voyageurs-naturalistes* everywhere encountered geographies of human difference—different human cultures, perceived to be at different stages of human “enlightenment,” existing in different parts of the globe.

Textual descriptions of geographies of human difference, often theoretically inflected, were an Enlightenment commonplace. Cartographic depictions of them were not. Didier Robert de Vaugondy did include maps of human variation by religion, skin color, and shapes

of faces in editions of his *Nouvel atlas portatif* (1762). These were all topics central to the Enlightenment writings of men such as Charles-Louis de Secondat, baron de Montesquieu, whose *De l'esprit des loix* (1748) invokes climate as a principal cause of human variation, and Georges-Louis Leclerc, comte de Buffon, whose discussions about human difference also linked variety to environment (Withers 2007). One such map was unusual in being undertaken by a woman, Marie Le Masson Le Golft, a leading Enlightenment figure in Le Havre and in Saint-Domingue (Haiti) through her connections with the short-lived academic Cercle des Philadelphes there. Le Masson Le Golft charted the geography of human cultures at the world scale by religions, mores (that is, effectively, human intellectual capacity or perceived state of social development), skin color, and bodily shape (fig. 234). Here, framed by ornamental rather than plain cartographic devices, was a worldview in which Europe positioned itself as the high point of social progress (O'Connor 2005).

The Enlightenment was, then, a period in which cartography was important to the advance of practical reason and of geographical science as a public good, expressed through mathematical cosmography, mapping, and marine charting. It is also possible to “read” the Enlightenment cartographically in seeing the phenomenon at different scales and in different locations. To do so—with regard to particular local institutions, for example, such as the Nuremberg Kosmographische Gesellschaft, or in terms of mobile practices with political consequences such as military mapping—is consistent with more recent historiographical interpretations of the Enlightenment (Livingstone and Withers 1999; Withers 2007). Enlightenment cartography did not simply inscribe a straightforward move to a more modern world or to a more modern mapped view of the world: the fact that different meridians were used, in Paris, London, and Philadelphia to name but a few, and that different indigenous units of measurement were often incorporated even as indigenous toponyms were replaced, shows that the Enlightenment did not rationalize the world consistently through cartography. Certainly, “Enlightenment science emphasized empirical observation and quantifiable measurement in mapmaking” (Delano-Smith 2001, 291). The idea of absolute mathematical precision intrinsic to modern cartography echoed Enlightenment ideals about reason and social advance. But the complexity of the human and physical geography of the Enlightenment world acted also to undermine the practice of cartography as a straightforward mirror to that world.

CHARLES W. J. WITHERS

SEE ALSO: Encyclopedias; Memoirs, Cartographic; Modes of Cartographic Practice; Public Sphere, Cartography and the; Science and Cartography



FIG. 234. MARIE LE MASSON LE GOLFET, *ESQUISSE D'UN TABLEAU GENERALE DU GENRE HUMAIN* (PARIS, 1786). This double-hemisphere world map, engraved by Marie Antoinette Moittehy, was shaded and imprinted with different symbols to distinguish between religions (Christianity, both Catholic and Protestant, Islam, and idolatry), mores (the

learned, those living in society, savages, the polygamous, the naked, human, and cruel), physical color (white, black, bronze, olive, reddish, yellowish), and physical shape (small, medium, large, very large, well built, badly built, beautiful, ugly). Size of the original: 50.7 × 68.0 cm. Image courtesy of the William L. Clements Library, University of Michigan, Ann Arbor (Maps 8-F-1786 Le).

BIBLIOGRAPHY

- Belyea, Barbara. 1996. "Inland Journeys, Native Maps." *Cartographica* 33, no. 2:1–16.
- Brückner, Martin. 2006. *The Geographic Revolution in Early America: Maps, Literacy, and National Identity*. Chapel Hill: University of North Carolina Press.
- Bruyset, Jean-Marie. 1790. *Atlas des enfans, ou Nouvelle méthode pour apprendre la géographie, avec un Nouveau traité de la sphere, et XXIV cartes enluminées*. New ed. Lyons: Bruyset.
- Butterwick, Richard, Simon Davies, and Gabriel Sánchez Espinosa, eds. 2008. *Peripheries of the Enlightenment*. Oxford: Voltaire Foundation.
- Delano-Smith, Catherine. 2001. "The Grip of the Enlightenment: The Separation of Past and Present." In *Plantejaments i objectius d'una història universal de la cartografia = Approaches and Challenges in a Worldwide History of Cartography*, by David Woodward, Catherine Delano-Smith, and Cordell D. K. Yee, 283–97. Barcelona: Institut Cartogràfic de Catalunya.
- Edney, Matthew H. 1998. "Cartography: Disciplinary History." In *Sciences of the Earth: An Encyclopedia of Events, People, and Phenomena*, 2 vols., ed. Gregory A. Good, 1:81–85. New York: Garland.
- . 1999. "Reconsidering Enlightenment Geography and Map Making: Reconnaissance, Mapping, Archive." In *Geography and Enlightenment*, ed. David N. Livingstone and Charles W. J. Withers, 165–98. Chicago: University of Chicago Press.
- . 2019. *Cartography: The Ideal and Its History*. Chicago: University of Chicago Press.
- Kors, Alan Charles, ed. 2003. *Encyclopedia of the Enlightenment*. 4 vols. Oxford: Oxford University Press.
- Livingstone, David N., and Charles W. J. Withers, eds. 1999. *Geography and Enlightenment*. Chicago: University of Chicago Press.
- Mayhew, Robert J. 2000. *Enlightenment Geography: The Political Languages of British Geography, 1650–1850*. New York: St. Martin's Press.
- O'Connor, Bridgette Byrd. 2005. "Marie Le Masson Le Goult, 1749–1826: Eighteenth-Century Educator, Historian, and Natural Philosopher." PhD diss., Wadham College, University of Oxford.
- Taylor, E. G. R. 1954. *The Mathematical Practitioners of Tudor & Stuart England*. Cambridge: For the Institute of Navigation at the University Press.
- . 1966. *The Mathematical Practitioners of Hanoverian England, 1714–1840*. Cambridge: For the Institute of Navigation at the University Press.
- Withers, Charles W. J. 2007. *Placing the Enlightenment: Thinking Geographically about the Age of Reason*. Chicago: University of Chicago Press.
- Withers, Charles W. J., and Robert J. Mayhew. 2011. "Geography: Space, Place and Intellectual History in the Eighteenth Century." *Journal for Eighteenth-Century Studies* 34:445–52.

Estate Plan. See Property Map: Estate Plan

Euler, Leonhard. Leonhard Euler, a major mathematician and scientist of the eighteenth century, was born in Basel on 15 April 1707 and died in St. Petersburg on 18 September 1783. He studied at the University of Basel under Johann Bernoulli, who recognized his brilliance. Bernoulli's son Daniel encouraged the invitation to Euler to join the Akademiya nauk, recently founded in St. Petersburg (1724). Euler joined the academy in 1726 and became professor of physics and mathematics

in 1731, succeeding Bernoulli as premier mathematician in 1733 (Calinger 1996, 125, 128–29). He assisted Joseph-Nicolas Delisle in astronomical observations, and he independently constructed meridian tables. In 1735 Euler was named director of the academy's geographical section, a position from which he proposed a plan for the mapping of the Russian Empire. Under this proposal, Delisle and others produced the *Atlas Rossiyskoy* (1745), including a general map of Russia (see fig. 316), published by the Akademiya nauk (Calinger 1996, 146–47). By 1740, Euler claimed that painstaking work correcting maps took a toll on his eyesight ("Geography is fatal to me," he wrote), though the cause of the blindness may have been the result of fever (quoted in Calinger 1996, 154–55).

Deteriorating political conditions in Russia encouraged Euler to accept the invitation of Friedrich II of Prussia to join the Königliche Akademie der Wissenschaften in Berlin; in 1744 he became the director of its mathematics class. Despite his blindness, he published more than eight hundred works on mathematics, physics, and astronomy as well as several essays on the theory of cartography. By order of the academy in Berlin, he supervised the creation of the *Atlas geographicus omnes orbis terrarum regiones* (1753), notable for its emphasis on physical geography as well as being one of the oldest school atlases in Germany (see fig. 6). Several new editions of this atlas were in common use until the end of the eighteenth century.

Euler's disappointment at his lack of advancement within the academy and the troubled conditions in Berlin during the Seven Years' War (1756–63) encouraged him to return to St. Petersburg in 1766 to a more stabilized political situation under Catherine II. Although he was almost totally blind, more than two hundred of his works were published in this second St. Petersburg period. Euler's works on cartographic theory include two essays of 1753 and 1779 on spherical trigonometry (translated as *Zwei Abhandlungen über sphärische Trigonometrie*, trans. and ed. E. Hammer, 1896) and three separate essays about map projections in 1777 that proved the mathematical impossibility of transforming the spherical surface of the earth into the flat surface of a map (translated as *Drei Abhandlungen über Kartenprojektion*, ed. A. Wangerin, 1898).

GERHARD HOLZER

SEE ALSO: Atlas: School Atlas; Academies of Science: (1) German States, (2) Akademiya nauk (Academy of Sciences; Russia); Administrative Cartography: Russia; Geographical Mapping: Russia; Projections: Geographical Maps

BIBLIOGRAPHY

- Bradley, Robert E., and C. Edward Sandifer, eds. 2007. *Leonhard Euler: Life, Work and Legacy*. Amsterdam: Elsevier.
- Calinger, Ronald. 1996. "Leonhard Euler: The First St. Petersburg Years (1727–1741)." *Historia Mathematica* 23:121–66.

———. 2016. *Leonhard Euler: Mathematical Genius in the Enlightenment*. Princeton: Princeton University Press.

Eneström, Gustaf. 1910–13. *Verzeichnis der Schriften Leonhard Eulers*, 2 vols. Leipzig: Druck und Verlag von B. G. Teubner.

Hanke, Michael, and Hermann Degner. 1934. *Die Pflege der Kartographie bei der Königlich Preussischen Akademie der Wissenschaften unter der Regierung Friedrichs des Grossen*. Berlin: Verlag der Akademie der Wissenschaften.

Penck, Albrecht. 1934. “Die ältesten deutschen Schulanatlanten.” *Forschungen und Fortschritte* 10:183–84.

Evans, Lewis. As a mapmaker and geographer, Lewis Evans (ca. 1700–1756) had few equals in eighteenth-century British America. Born in Llangwnadl, Wales, Evans had migrated to Philadelphia by 1736, when his name appears in Benjamin Franklin’s account books, possibly as his clerk. (Franklin would later print Evans’s work, both letterpress and intaglio.) Shortly thereafter, Evans produced a land survey for James Logan, provincial secretary, and became acquainted with Pennsylvanias leading political and scientific figures. In 1743, he accompanied a diplomatic mission to the vicinity of Lake Ontario in New York, mapping the route and collecting topographical and other information that would appear in his first publication, *A Map of Pensilvania, New-Jersey, New-York, and the Three Delaware Counties* (1749). In addition to depicting the region’s geography, Evans included notes regarding climate, navigation, and natural history. His theories on the creation of the Appalachian Mountains, expressed on the map, constitute some of the earliest American writings on geology (Brückner 2017, 29–31).

Evans’s greatest contribution to American cartography was his map of the middle British colonies (fig. 235). In addition to his own notes and surveys, Evans relied on other printed and manuscript cartographic sources and on the writings of others. These sources are outlined in the thirty-two-page *An Analysis of a General Map of the Middle British Colonies in America*, intended

Evans’s greatest contribution to American cartography was his map of the middle British colonies (fig. 235). In addition to his own notes and surveys, Evans relied on other printed and manuscript cartographic sources and on the writings of others. These sources are outlined in the thirty-two-page *An Analysis of a General Map of the Middle British Colonies in America*, intended

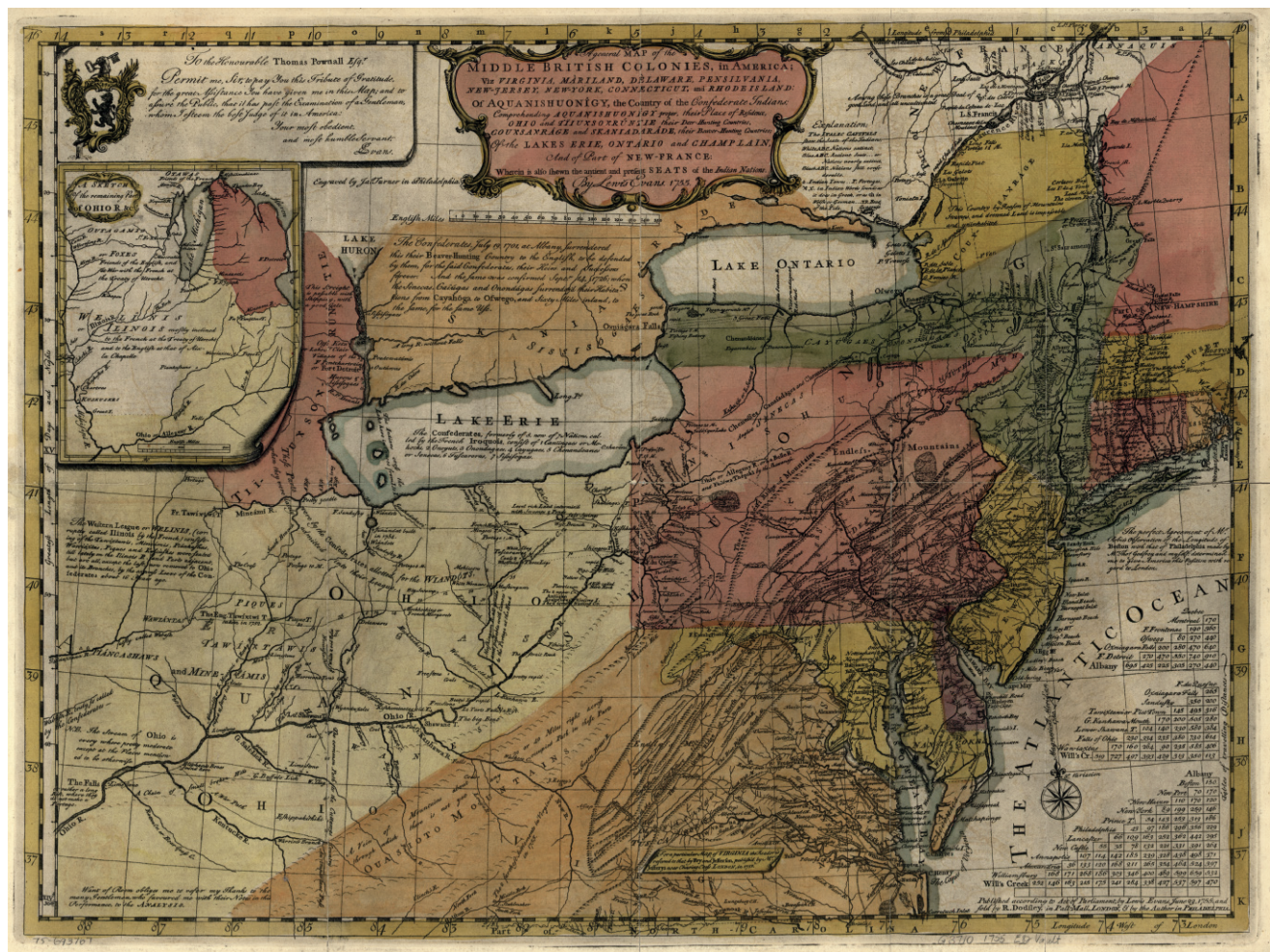


FIG. 235. LEWIS EVANS, *A GENERAL MAP OF THE MIDDLE BRITISH COLONIES, IN AMERICA* (PHILADELPHIA, 1755).

Size of the original: 49 × 67 cm. Image courtesy of the Geography and Map Division, Library of Congress, Washington, D.C. (G3710 1755 .E8 Vault).

by Evans as the first of a series of “Geographical, Historical, Political, Philosophical and Mechanical Essays” (Gipson 1939, 141–76). Copies of the map were sent to post offices from Virginia to Massachusetts to attract subscribers; Robert Dodsley also sold copies in London. As deputy postmaster general of North America, Franklin may have assisted in the map’s distribution (Brückner 2017, 30–41).

The *General Map* and *Analysis* immediately became part of the political discourse on the westward expansion of Britain’s American colonies into the disputed Ohio country (Hallock 2003). Evans advocated such a move to counter French threats, although he conceded their right to certain lands. By tempering his anti-French position, opposing the designs of land companies, and recommending a single route to the Ohio country, Evans earned political enemies. Competing factions also used his *General Map* to promote their views of the defense of the colonies at the start of the Seven Years’ War with France. When his *General Map* and *Analysis* were attacked in the press in December 1755, Evans responded with another pamphlet that critically commented on military affairs in North America (Gipson 1939, 177–218). This precipitated a charge of slander by Pennsyl-

vania governor Robert Hunter Morris, but Evans died in June 1756 before the matter could be brought to trial.

The *General Map* was the first American-made map to be widely marketed in both the colonies and England. Evans further tried to persuade Dodsley to publish an authorized British edition of the map and to split the profits. Dodsley declined, and Evans’s effort to protect his map from plagiarism failed. Pirated versions of the map immediately appeared in London and continued to be issued until 1814, attesting to the map’s significance and appeal.

DAVID BOSSE

SEE ALSO: Consumption of Maps; Geographical Mapping: British America; Map Trade: British America

BIBLIOGRAPHY

- Brückner, Martin. 2017. *The Social Life of Maps in America, 1750–1860*. Williamsburg: Omohundro Institute of Early American History and Culture; Chapel Hill: University of North Carolina Press.
- Gipson, Lawrence Henry. 1939. *Lewis Evans*. Philadelphia: Historical Society of Pennsylvania.
- Hallock, Thomas. 2003. “Between Accommodation and Usurpation: Lewis Evans, Geography, and the Iroquois-British Frontier, 1743–1784.” *American Studies* 44, no. 3:121–46.
- Klinefelter, Walter. 1971. “Lewis Evans and His Maps.” *Transactions of the American Philosophical Society*, new ser. 61, no. 7:3–65.