# 22 · Techniques of Map Engraving, Printing, and Coloring in the European Renaissance

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## General Technological Considerations

This chapter attempts to answer several types of questions about how maps were engraved, printed, and colored in the Renaissance. It begins with a treatment of the historical development of map printing, when and why it came into being in the European context, and how this context differed from that in East Asia. It asks what made maps special when it came to printing them, and it explores the connections with other engraving and printing trades. The chapter then documents how and why certain techniques were chosen and shows how various techniques affected the cartographic content. It suggests that semantic changes in printed maps can be discerned when compared to a manuscript or painted medium. It then provides a guide to the literature and methods of coloring for printed maps in the sixteenth and early seventeenth centuries. Finally, it attempts to outline the main impact the technical developments of map printing had on the kinds of maps that appeared in the Renaissance and the structure of the trade that produced them.

Printing impressions from an uneven surface is not a particularly innovative or difficult activity that necessitated a single inventive hearth. Although the influence of China on Europe with the dissemination of paper is well documented,[1] the links between the invention of map printing in China and that in Western Europe are now considered tenuous, partly because of the different functions for which it was employed in each area. In China, the functions of taking rubbings from stones and woodblocks in the Chinese administrative and educational bureaucracies was quite different from the commercial goals of the colored block books of images of Christian saints and Bible stories that circulated the streets of Europe around 1400. An independent map trade did not grow up in China in the same way as it did in Europe because no identifiable specialized market existed. Maps in China were inextricably connected to calligraphic manuscripts, printed documents, and painting. In Yee's words, the map trade in China was a "phantom topic."[2]

In the last quarter of the fifteenth century, maps began to be printed in Europe, although the notion of the "first printed map" is not a particularly useful concept.[3] The idea of carving a map image into a surface from which to take rubbings or prints is much older, however. In China, maps were often engraved with stone steles in the Tang and Song dynasties with the intent of providing reproductions.[4] The identification of "the oldest printed map in any culture" by Needham as the *Dili zhi tu* (Geographical map), made in about 1155, is more complicated and confusing than it might sound.[5] It is instructive to see how such myths are constructed. To begin with, Needham reproduces only the western half of the map, the full title of which is *Shiwu Guofeng dili zhi tu* (Geographic map of fifteen [states] in the Guofeng [a section of the *Book of Songs*]) (fig. 22.1).[6] Second, the date of the first printing of the encyclopedia in which it is found, the *Liu jing tu* (Illustrations for the Six Classics) is normally recorded as 1165, not 1155. Third, another map is found in the same encyclopedia, the *Wen Wu Feng Hao zhi tu*

Abbreviations used in this chapter include: *Five Centuries* for David Woodward, ed., *Five Centuries of Map Printing* (Chicago: University of Chicago Press, 1975), and *Plantejaments* for David Woodward, Catherine Delano-Smith, and Cordell D. K. Yee, *Plantejaments i objectius d'una història universal de la cartografia = Approaches and Challenges in a Worldwide History of Cartography* (Barcelona: Institut Cartogràfic de Catalunya, 2001).

1. Dard Hunter, *Papermaking: The History and Technique of an Ancient Craft* (New York: A. A. Knopf, 1943).

2. Cordell D. K. Yee, "The Map Trade in China," in *Plantejaments,* 111–30.

3. Arthur Howard Robinson, "Mapmaking and Map Printing: The Evolution of a Working Relationship," in *Five Centuries,* 1–23. The choice of 19 November 1472, the date of printing the small T-O (tripartite) world map in the incunable edition of Isidore of Seville's *Etymologiae,* to introduce the symposium around the theme "Five Centuries of Map Printing" was in retrospect too contrived. Plenty of other more worthy events in map printing took place in the 1470s, including the printing of two whole copperplate atlases.

4. Cordell D. K. Yee, "Reinterpreting Traditional Chinese Geographical Maps," in *HC* 2.2:35–70, esp. 46–50.

5. Joseph Needham, *Mathematics and the Sciences of the Heavens and the Earth,* vol. 3 of *Science and Civilisation in China* (Cambridge: Cambridge University Press, 1979), 549 and fig. 227. It is also reproduced by Norman J. W. Thrower, *Maps & Civilization: Cartography in Culture and Society* (Chicago: University of Chicago Press, 1996), 31 (fig. 3.3).

6. Cao Wanru et al., eds., *Zhongguo gudai dituji* (An atlas of ancient maps in China), 3 vols. (Beijing: Wenwu Chubanshe, 1990–97), vol. 1, map 103.

FIG. 22.1. EARLY CHINESE PRINTED MAP. *Shiwu Guofeng dili zhi tu* (Geographical map of the fifteen [states] in the Guofeng [a section of the *Book of Songs*]). Song edition of the *Liu jing tu* (Illustrations for the Six Classics).
Size of the original: 10 × 13.4 cm. Permission courtesy of the Cultural Relics Publishing House, Beijing.
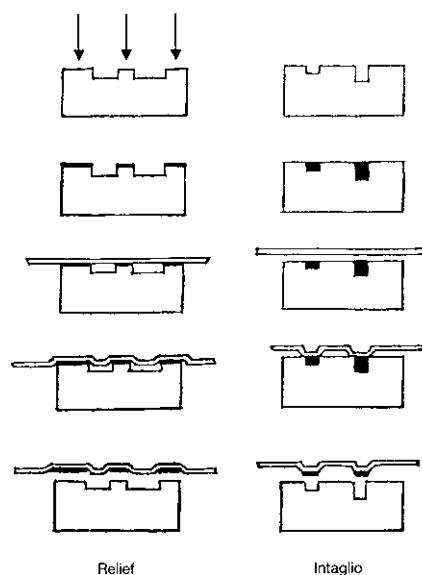


FIG. 22.2. RELIEF AND INTAGLIO. A comparison between the mechanics of relief and those of intaglio graphic printing, showing the relationship of ink, printing surface, and paper.

(Map of Feng[yi] and Hao[jing] of [Kings] Wen and Wu).[7] Both were drawn between 1131 and 1162 and first printed from woodblocks in 1165. Fourth, examples of the first printing have not survived, so the most precise statement that can be made is that the earliest surviving impression of the *Liu jing tu* is on paper made in the Song dynasty (A.D. 960–1279). Another extant artifact from this period is the *Lidai dili zhizhang tu* (Easy-to-use maps of geography through the dynasties), an atlas of forty-four maps showing the historical development of administrative districts, the astrological concept of *fenye,* and physical maps of mountains and rivers.[8] The atlas was probably compiled between 1098 and 1100, but the precise printing date of the preserved example is not known. In order to avoid confusion over the actual date of the artifacts, therefore, it is more prudent to state that many maps printed on paper made in the Song dynasty survive, all of which are clearly older than the introduction of woodcut maps in the West.

Map printing is a specialized activity with requirements that are often different from those for the printing of books. In the incunable period of map printing (technically through the end of the year 1500), the most important of these were the ease of making corrections, the ability of the medium to hold fine detail (a requirement shared by the printing of technical illustrations and prints), and the versatility in combining lettering and linework.[9] Later, these constraints were shared by the printing of music.[10]

These requirements were at the core of the competition

between the two main methods of printing maps in the period covered by this volume: relief (usually woodcut) and intaglio (copper engraving or etching or some combination) (fig. 22.2). The basic difference between relief and intaglio printing—the form and material of the printing surfaces, the specialized inks required, and the different presses employed—have often been described elsewhere.[11] Specialized works on map printing and regional descriptions can also provide an entry into the literature.[12]

Distinguishing relief and intaglio printing is usually straightforward. In a relief process, the block, usually of medium-grained well-seasoned hardwood, such as walnut, cherry, beech, ash, maple, or wild apple, but mostly pearwood, is engraved so that the areas to be printed ap-

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7. Cao et al., *Zhongguo gudai dituji*, map 1:104.
8. Cao et al., *Zhongguo gudai dituji*, maps 1:94–101.
9. Robinson, "Mapmaking and Map Printing," 1–23.
10. David Woodward, "Maps, Music, and the Printer: Graphic or Typographic?" *Printing History* 8, no. 2 (1986): 3–14.
11. Arthur Mayger Hind, *An Introduction to the History of Woodcut, with a Detailed Survey of Work Done in the Fifteenth Century,* 2 vols. (London: Constable, 1935); idem, *A History of Engraving & Etching, from the 15th Century to the Year 1914,* 3d ed. (London: Constable, 1927); Felix Brunner, *A Handbook of Graphic Reproduction Processes* (Teufen, Switz.: A. Niggli, 1962); and Bamber Gascoigne, *How to Identify Prints: A Complete Guide to Manual and Mechanical Processes from Woodcut to Ink Jet* (New York: Thames and Hudson, 1986).
12. *Five Centuries,* and Mireille Pastoureau, *Les atlas français XVIe–XVIIe siècles: Répertoire bibliographique et étude* (Paris: Bibliothèque
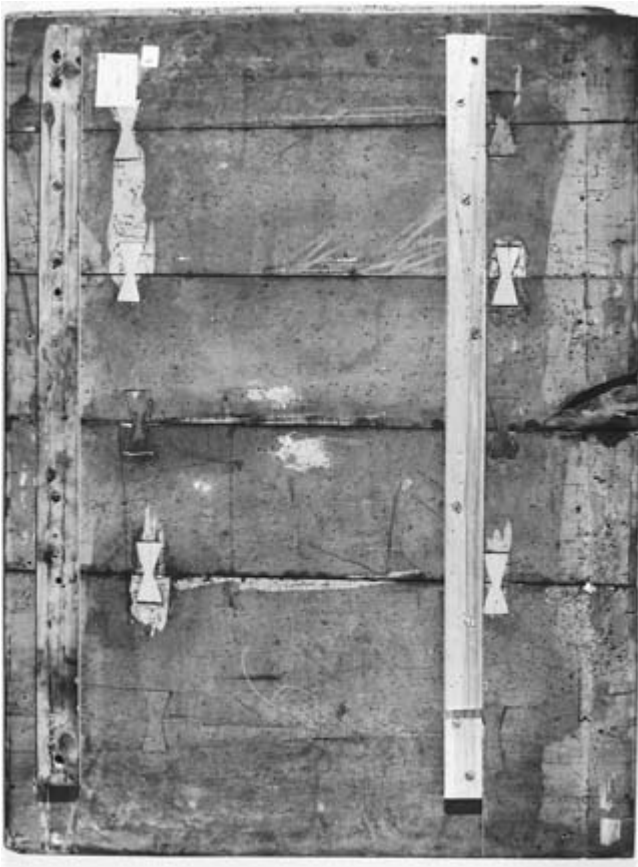
FIG. 22.3. VERSO OF BARBARI WOODBLOCK, 1500. Large woodblocks, such as those used to print Jacopo de' Barbari's six-sheet view of Venice, were composed of butterfly-mortised planks cut along the grain and stabilized with crosspieces. The joints between the sections are barely noticeable on the prints.

Size of original: ca. 66 × 99 cm. Photograph courtesy of the Museo Correr, Venice.
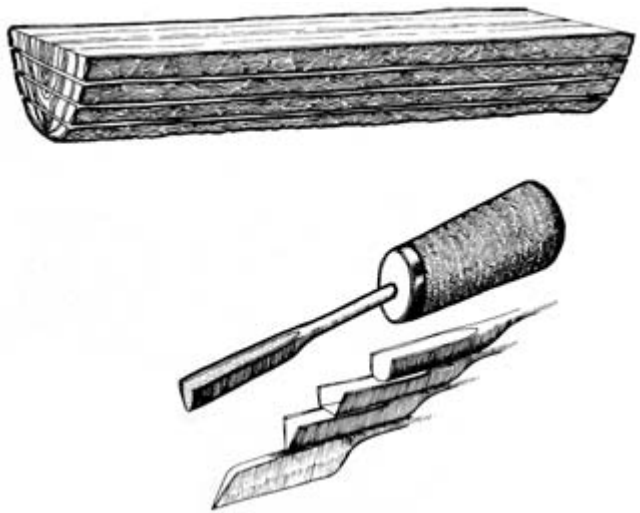


FIG. 22.4. CHISEL AND PLANK. Chisels were most commonly used on wood cut along the grain, or "on the plank." Illustration from *Van Plaat tot Prent: Grafiek uit stedelijk, technisch benaderd,* exhibition catalog (Antwerp: Stad Antwerp, 1982), 14.

pear in relief and produce lines indented in the paper. These indentations can often be felt on the back of the maps. Larger blocks were made up of mortised strips; the surviving blocks for the view of Venice drawn by Jacopo de' Barbari in 1500 provide a good example. This view was engraved on six matrices of pearwood, each composed of several pieces fixed together with butterfly mortises and glued. The pieces were cut longitudinally with the grain. Two crosspieces on the back of each matrix, screwed into the mortised sections, provided extra stability (fig. 22.3).[13]

A distinction is usually made between woodcut, in which chisels and flat knives are used on wood cut on the plank (fig. 22.4), and wood engraving, in which a burin or graver is used on the end grain of a finer-grained hardwood (fig. 22.5). In the period covered by this chapter,

the use of wood engraving for maps was uncommon, for large numbers of pieces would have needed to be mortised together for large blocks. The technique did not come into its own until the nineteenth century, when it proved a durable relief technique for printing in power presses.

The advantages of the woodcut technique were as follows: no press was necessary, for impressions could be taken as rubbings; existing common typographic printing presses could be used; blocks could be printed with type in the same form; and the block was durable, allowing many impressions to be taken before significant wear occurred. However, carving fine, curved lines in wood with a knife or chisel is inherently more difficult. The author of an early seventeenth-century manual wrote that working in wood is far more tedious and difficult than working in brass because one must cut twice to remove a piece of wood.[14] Irregularities such as inconsistent line widths and

Nationale, Département des Cartes et Plans, 1984); Günter Schilder, *Monumenta cartographica Neerlandica* (Alphen aan den Rijn: Canaletto, 1986–); David Woodward, *Maps as Prints in the Italian Renaissance: Makers, Distributors & Consumers* (London: British Library, 1996); and Mary Sponberg Pedley, *A Taste for Maps: Commerce and Cartography in Eighteenth-Century France and England* (Chicago: University of Chicago Press, 2005).

13. Giuseppe Trassari Filipetto, "Tecnica xilografica tra Quattrocento e Cinquecento: 'Il nuovo stile,'" in *"A volo d'uccello": Jacopo de' Barbari e le rappresentazioni di città nell'Europa del Rinascimento,* ed. Giandomenico Romanelli, Susanna Biadene, and Camillo Tonini, exhibition catalog (Venice: Arsenale Editrice, 1999), 53–57; see also 86 and 138.

14. John Bate, *The Mysteries of Nature and Art in Foure Severall Parts,* 2d ed. (London: Printed for Ralph Mabb, 1635), 232.
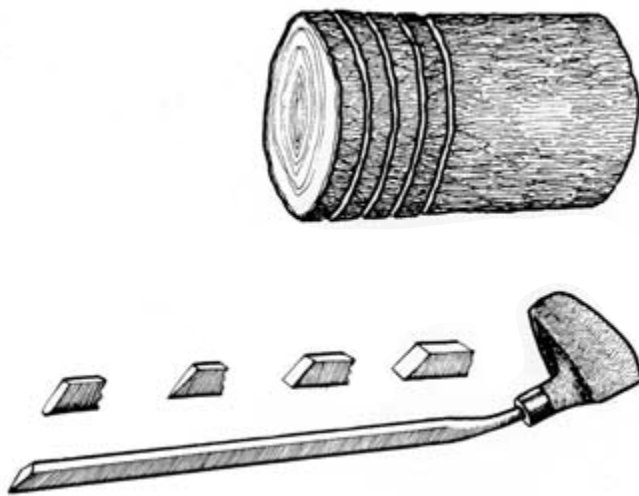
FIG. 22.5. GRAVER AND END GRAIN. Illustration from *Van Plaat tot Prent: Grafiek uit stedelijk, technisch benaderd,* exhibition catalog (Antwerp: Stad Antwerp, 1982), 16.

angularities are more likely to be seen. Because lettering is difficult to carve in such a medium, letterpress or stereotype plates were often fixed to the block.[15] The printing of graded color involved converting a flat surface to lines or dots. Flat color could be portrayed on woodcut as a solid by using the uncut surface of the block, as shown in the most prominent early example—the regional map of Lorraine in the 1513 Strassburg edition of Ptolemy's *Geography.* Although this was technically possible (as was not the case in copper engraving), this experimental technique held no competitive advantage over hand coloring (plate 15).

In the intaglio technique, lines are engraved into a plate of copper, brass, pewter, or other workable metal. The ink is forced out of the grooves in the plate to "stand up" on the paper; these lines may be felt as ridges on the face of the map. A copperplate engraving may also be identified by the indentation of the copperplate itself at its edge (the so-called plate-mark) which can often be seen on the face of the map or be felt on its back. In many cases, this plate-mark will have been trimmed off, but the other characteristics, as well as the fineness of the resulting lines, will usually distinguish it from a relief print.

The cost of copper was considerable. To save money, maps and prints were sometimes engraved on both sides of a piece of copper and the plate was often reused for other functions, such as the reproduction of paintings, or melted down to make other objects. Several works provide comparative cost data from different regions and periods, but the comparison is difficult because of the changing value of currency and wages.[16] During the early part of the sixteenth century, copper ore usually came from Hungary and the Tirol, largely under the control of the Fugger family in Augsburg. The ore was refined and

formed into ingots, rough bars, rough hammered plates, or large sheets that the engraver cut up with shears.[17] Around the middle of the century, a new method of rolling copperplates came into use that allowed the surface of the copper to be much freer from imperfections than hand-beaten material.[18]

The rolled copperplates were scraped smooth with a knife or scraper to remove the imperfections, planished, burnished, and polished. The manuals emphasize the importance of a highly polished surface, recommending the use of soft chestnut charcoal and various kinds of stones such as pumice stone, taking care to avoid scratching the copper, for every small scratch would show up in the final map. The plates were rubbed clean with olive oil, chalk, and polish.[19] A seventeenth-century manual recommends using a piece of beaver hat with sallet (saddle) oil to polish the plate, as well as a good oil stone, smoothed on one side and free from pinholes.[20] Scratches inevitably occurred as the plate was left around; the positive aspect for historians is that scratches can sometimes provide useful bibliographical evidence.[21]

To transfer the information to the plate, the engraver spread a thin layer of wax on the copperplate, often with a feather. He then took the drawing or print to be engraved, varnished it to make it transparent, and laid it face down on the waxed plate, tracing the main lines through to the wax beneath. Or the drawing might be pounced, a method by which holes were pricked along the lines and then colored chalk was rubbed through the holes. Or in-

15. David Woodward, "The Woodcut Technique," in *Five Centuries,* 25–50.

16. Pastoureau, *Les atlas français;* Woodward, *Maps as Prints;* Pedley, *Taste for Maps;* Johannes Dörflinger, "Time and Cost of Copperplate Engraving Illustrated by Early Nineteenth Century Maps from the Viennese Firm Artaria & Co.," in *Imago et Mensura Mundi: Atti del IX Congresso Internazionale di Storia della Cartografia,* 3 vols., ed. Carla Clivio Marzoli (Rome: Istituto della Enciclopedia Italiana, 1985), 1: 213–19; Francesca Consagra, "The De Rossi Family Print Publishing Shop: A Study in the History of the Print Industry in Seventeenth-Century Rome" (Ph.D. diss., Johns Hopkins University, 1992); and Markus Heinz, "A Research Paper on the Copper-Plates of the Maps of J. B. Homann's First World Atlas (1707) and a Method for Identifying Different Copper-Plates of Identical-Looking Maps," *Imago Mundi* 45 (1993): 45–58.

17. Michael Bury, *The Print in Italy, 1550–1620* (London: British Museum Press, 2001), 29.

18. Woodward, *Maps as Prints,* 24–25.

19. Schilder, *Monumenta cartographica Neerlandica,* 6:17–19. Information based on a manuscript engraving manual by Adriaen Schoonebeck (1661–1714), a Dutch engraver working in Russia, preserved in the Library of the Academy of Sciences, St. Petersburg (PIB 154).

20. Bate, *Mysteries of Nature,* 226 and 229.

21. David Woodward, "The Forlani Map of North America," *Imago Mundi* 46 (1994): 29–40, where it is shown how the two states of the Forlani map of North America (1565–66) can be identified on the basis of scratches alone.
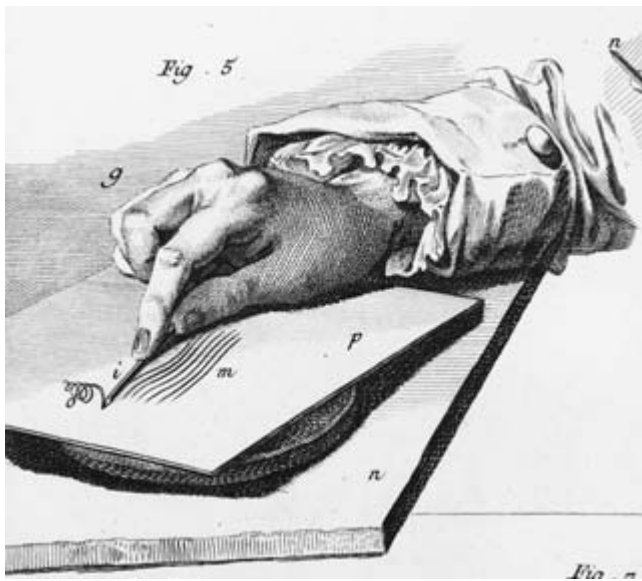
FIG. 22.6. HOLDING THE GRAVER. The tool required very little pressure, being held between the thumb and forefinger. Size of the detail: ca. 10.5 × 12.1 cm. Denis Diderot and Jean Le Rond d'Alembert, *Encyclopédie* (Paris: Briasson, 1751), tome 5, pl. III (section headed "Gravure"). Photograph courtesy of the BL (Rar 034.1, Plates, Tome 5).



FIG. 22.7. CURVED GRAVER. Specialized gravers to engrave fine curved lines and lettering could be made from crossbow steel.
Size of the detail: 7.5 × 8.5 cm. John Bate, *The Mysteries of Nature and Art in Foure Severall Parts,* 2d ed. (London: Printed for Ralph Mabb, 1635), 227. Photograph courtesy of the BL (C.122.e.18).

termediary drawings, chalked with red or black chalk on the back, could be used for tracing the image onto the plate. The meaning of the Italian verb *calcare* (to chalk) can thus be extended to making imitations; hence *calcografia* became engraving. Key lines could also be inked with ungummed ink and transferred directly onto the wax.[22] Once the main lines were in place, the detail could be copied by hand directly onto the plate. Lettering, borders, rectangular title boxes, and longitude and latitude grids could be sketched or ruled in lightly with a dry point.

Copper engraving techniques for maps have been fully described in manuals and secondary works from the seventeenth century on. The earliest and best-known comprehensive manual, by Abraham Bosse,[23] formed the basis of several translations and editions into the eighteenth century.[24] A case can be made that the technique evolved very little until the nineteenth century, except for hints on technical details.[25] The copper engraver's tool, the burin or graver, was delicate and relied on very little pressure, for it was held between the thumb and forefinger, with the handle resting lightly in the palm (fig. 22.6). It was more easily adapted to following curved lines than was the woodcutter's knife. Indeed, a curved graver or short graver made of crossbow steel was used to engrave letters and small details (fig. 22.7).[26]

The engraver held the plate on a small leather cushion filled with sand, moving it around as needed so that the trend of a line was always directly away from the engraver. An oiled sharpening stone—often of high-quality
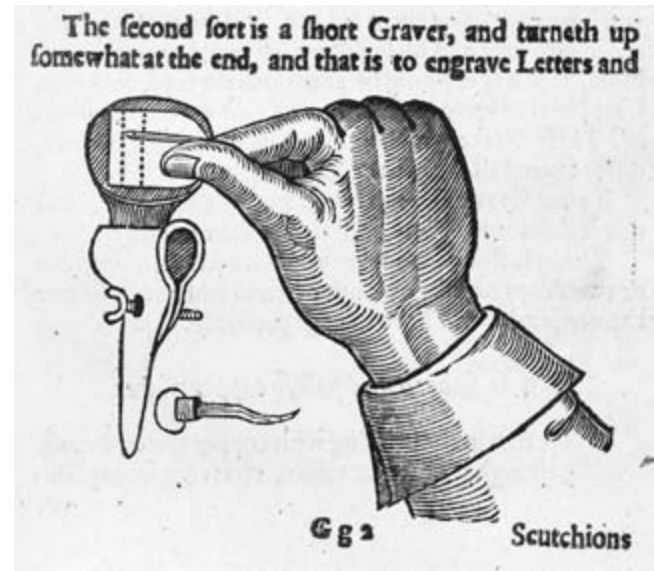
marble from the Levant—was constantly at the ready to sharpen the burin.[27] Hints in manuals included how to see the lines engraved: "When you have cut one stroke drop a little sallet oyle upon your peece of Beaver, and rub over the said stroke, for by this means you shall better see the stroke . . . but to work by a candle, you must place a glasse of faire [clean] water between the candle, and a paper between that and the plate, (which casteth a true light)."[28]

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22. Bury, *Print in Italy,* 14.

23. Abraham Bosse, *Traicté des manieres de graver en taille douce svr l'airin: Par le moyen des eaux fortes, & des vernix durs & mols* (1645; reprinted Paris: Union, 1979).

24. For example, William Faithorne, *The Art of Graveing, and Etching, Wherein Is Exprest the True Way of Graueing in Copper* (London: Willm. Faithorne, 1662); John Evelyn, *Sculptura; or, The History, and Art of Chalcography and Engraving in Copper* (London: Printed by J. C. for G. Beedle and T. Collins, 1662); and Domenico Tempesti, "I discorsi sopra l'intaglio," 1680.

25. Coolie Verner, "Copperplate Printing," in *Five Centuries,* 51–75; Leslie Gardiner, *Bartholomew: 150 Years* (Edinburgh: J. Bartholomew, 1976); Roy J. L. Cooney, "Chart Engraving at the Hydrographic Department, 1951–1981," *Cartographic Journal* 23 (1986): 91–98; and Conor Fahy, *Printing a Book at Verona in 1622: The Account Book of Francesco Calzolari Junior* (Paris: Fondation Custodia, 1993). Fahy describes an account book for the manufacture of the *Musaeum* of Francesco Calzolari Jr.

26. Bate, *Mysteries of Nature,* 228.

27. Woodward, *Maps as Prints,* 25.

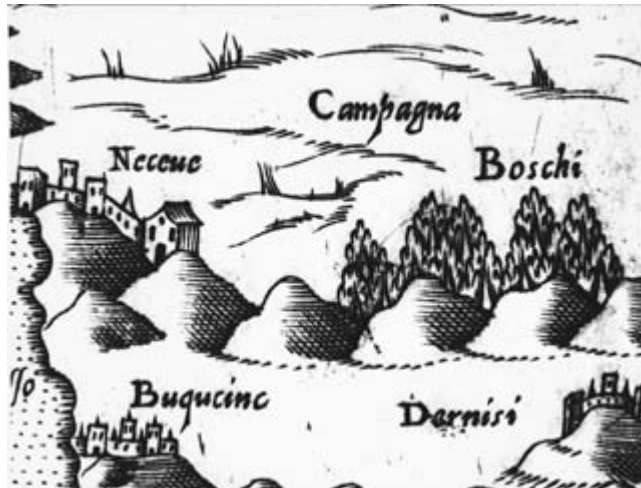28. Bate, *Mysteries of Nature,* 229–30.

FIG. 22.8. COMPARISON BETWEEN ETCHING AND ENGRAVING. Etchings and engravings may be distinguished by observing the character of lines and lettering, differences that result from the kind of tool used. In the example at the top, the lines and letters have clearly been made with a rounded stylus; the rounded character of the lowercase "g" is particularly revealing, and the short hatching marks representing the water exhibit rounded ends. In contrast, the example at the bottom has been engraved with a burin, as can be seen from the tapered ends of the lines and the lack of rounded style in the letters. The etching (top) is from Giovanni Francesco Camocio's wall map of Europe (Venice, 1573). The engraving (bottom) is from a map by Paolo Forlani of the *contado* of Zara and Sebenico (Venice, 1570).
Size of the detail (top): ca. 5 × 5.2 cm. Photograph courtesy of James Ford Bell Library, University of Minnesota, Minneapolis.
Size of the detail (bottom): ca. 5.3 × 6.0 cm. Photograph courtesy of the Newberry Library, Chicago (Novacco Collection 2F205).

A series of calculations from the output of Paolo Forlani's workshop in the 1560s allows one to estimate that about 170 square centimeters could be engraved per day.[29] The speed would obviously depend on the density and intricacy of the engraving. Bury quotes various estimates for etching, which range from 170 to 210 square centimeters per day, or, from a 1580 contract for a mixture of engraving and etching, from 52 to 65 square centimeters per day.[30] For the higher figures to be reasonably achieved, it is likely that a division of labor was in effect, with Forlani engraving the lettering but apprentices entrusted with more straightforward details. Schilder concludes from a 1630 contract between the engravers Evert Sijmonsz. Hamersveldt and Salomon Rogiers and publishers Henricus Hondius and Johannes Janssonius that a division of labor must have been operating to achieve a comparable figure of 154 square centimeters per day for engraving and etching.[31]

Etching was a specialized intaglio technique that had limited use for maps, for it lacked the finesse required for lines and lettering (fig. 22.8 compares etching with engraving). But its stylistic versatility and speed made it well adapted for decorative details, which were often etched in after the main burin work had been done.[32] Schoonebeck's treatise pays particular attention to etching. The plate was coated with a wax etching ground, which was blackened with smoke from lighted tapers to provide a contrast between the wax and the copper exposed by the etcher. Other details include the use of graded etching needles and iron chloride as an etching mordant, an improved and less toxic alternative to nitric or hydrochloric acid.[33] Tasks included at the printing stage were dampening paper, heating, inking and cleaning plates, and actual presswork. Of these, by far the most time-intensive job was inking.

Ink for woodblock printing was the same as that used for typographic printing. It consisted of some kind of oil or varnish (linseed or walnut) mixed with lampblack. The sixteenth-century author pen named "Alessio Piemontese" suggests adding the "smoke of Rosin" to make it thicker, more oil to make it more liquid.[34] Copperplate ink, on the other hand, used vine black (charcoal made from carbonized vegetable matter) instead of lampblack. This stiffened and thickened the ink and allowed the plate to be more easily cleaned. If lampblack was used on a cop-

29. Woodward, *Maps as Prints*, 24 and n. 65.
30. Bury, *Print in Italy*, 44.
31. Schilder, *Monumenta cartographica Neerlandica*, 6:25–26.
32. David Woodward, "Paolo Forlani: Compiler, Engraver, Printer, or Publisher?" *Imago Mundi* 44 (1992): 45–64.
33. Schilder, *Monumenta cartographica Neerlandica*, 6:25–26.
34. Alessio Piemontese, *The Secretes of Maister Alexis of Piemont: By Hym Collected Out of Divers Excellent Aucthors* (Oxford: Atenar, 2000), 116.

TABLE 22.1 Sizes and Costs of Paper (High Quality) per Ream (500 Sheets or 20 *Quaderni*)

| | *Imperiale* 70 × 50 cm (3700 cm²) | *Reale* 61 × 44 cm (2640 cm²) | *Mezzana* 51 × 34 cm (1734 cm²); *Communi* 53 × 35 cm (2053 cm²) | *Foolscap* 45 × 31 cm (1395 cm²) | *Piccoli* (1173 cm²) |
|---|---|---|---|---|---|
| 1476–86 | | | £6 8s | | £2 2s |
| 1476 | | £9 | £5 10s | | £3 6s–£4 |
| Ca. 1500 | £18.6 | £10.85 | | | |
| 1562 | | | | | 57 scudi £3.87 |
| 1579 | | | £4.5 | | £1.5? |
| 1589 | | | .58–.70 scudi £3.94–£4.76 | | |
| 1592 | | | .80 scudi £5.44 | | |
| 1619–22 | | | | £6.33–7.2 Venetian lire | |
| 1650–60 | 2.5 scudi? £17 | 1.5 scudi £10.2 | | | |

perplate, it resulted in gray plate tone and plate lines.[35] The costs for wood for woodcuts and ink must have been of considerably less concern than those for copperplates and ink, for they are hardly ever mentioned. Despite the approximately eighty liters of printing ink mentioned in the 1653 Rossi shop inventory, no value is given.[36]

Inking was a bottleneck, so any tasks that could have been carried out concurrently would have been advantageous. It took about twenty minutes to ink a plate of about two thousand square centimeters. So, assuming one press, it is difficult to imagine more than about thirty prints of this size being pulled in one day.[37] Small plates, such as those for the 1548 Venetian edition of Ptolemy's *Geography,* could be locked into racks of four and printed at once.[38]

The development of printing was dependent on the availability of paper, which had been increasingly used in Europe since the thirteenth century as a cheaper substitute for vellum for record keeping. Early centers of papermaking were Fabriano, the Auvergne, and southern Germany.[39] Paper for relief techniques, whether type or woodblock, could be of similar thickness. Thicker paper, such as that used for the Barbari town view of Venice, was more appropriate for larger-format sheets because it was more durable. Sizes of paper and the names for each size varied according to country and period. Table 22.1 attempts to summarize paper sizes and their costs per ream (five hundred sheets) from several sources.

Plates were usually worked in tandem on a rolling press (fig. 22.9). While the pressman was passing one plate through the press, another plate was being inked. After

printing, the sheets were hung on a line to dry and then usually placed in a standing press to flatten the creases. Drying prints and pressing them in a standing press was obviously not a time-consuming or difficult task, easily done by a minimally paid apprentice.[40] The pressing in-

35. Colin H. Bloy, *A History of Printing Ink Balls and Rollers, 1440–1850* (London: Evelyn Adams & Mackay, 1967), and Annette Manick, "A Note on Printing Inks," in *Italian Etchers of the Renaissance & Baroque,* ed. Sue Welsh Reed and Richard W. Wallace (Boston: Museum of Fine Arts, 1989), xliv–xlvii.

36. Consagra, "De Rossi Family," 533–62, esp. 558.

37. Domenico Tempesti, *Domenico Tempesti e I discorsi sopra l'intaglio ed ogni sorte d'intagliare in rame da lui provate e osservate dai più grand'huomini di tale professione,* ed. Furio de Denaro (Florence: Studio per Edizioni Scelte, 1994), 166; one could print fifty "large prints" a day.

38. Conor Fahy, "The Venetian Ptolemy of 1548," in *The Italian Book, 1465–1800: Studies Presented to Dennis E. Rhodes on His 70th Birthday,* ed. Denis V. Reidy (London: British Library, 1993), 89–115. Italian composite atlases frequently contain pages with two plates printed at once.

39. Hunter, *Papermaking;* E. J. Labarre, "The Sizes of Paper, Their Names, Origin and History," in *Buch und Papier: Buchkundliche und Papiergeschichtliche Arbeiten,* ed. Horst Kunze (Leipzig: O. Harrassowitz, 1949), 35–54; E. J. Labarre, *Dictionary and Encyclopaedia of Paper and Paper-making* (Amsterdam: Swets & Zeitlinger, 1952); G. Thomas Tanselle, "The Bibliographical Description of Paper," *Studies in Bibliography* 24 (1971): 27–67; Irving P. Leif, *An International Sourcebook of Paper History* (Hamden, Conn.: Archon, 1978); and Renzo Sabbatini, "La produzione della carta dal XIII al XVI secolo: Strutture, tecniche, maestri cartai," in *Tecnica e società nell'Italia dei secoli XII–XVI* (Pistoia: Presso la sede del Centro, 1987), 37–57.

40. Robert Dossie, *The Handmaid to the Arts,* 2 vols. (London: Printed for J. Nourse, 1758).

FIG. 22.9. INTAGLIO ROLLING PRESS. The rolling press relied on a different action than the letterpress screw press, providing intense pressure on plate and paper as they were passed through the rollers. Note the apprentice heating the copperplate before inking it.
Size of the original: ca. 25.3 × 15.5 cm. Vittorio Zonca, *Novo teatro di machine et edificii per uarie et sicure operationi* (Padua: P. Bertelli, 1607), 76. Photograph courtesy of the BL (1261.b.21).

creased the likelihood of offsets, or prints of other maps on the back, and a combination of watermark and offset evidence has been used to reconstruct which plates were printed together in the same printing shop.[41] This evidence also shows that, early in the history of Italian composite atlas printing (in the 1560s), it was common practice to print maps and atlases on demand (one impression at a time for a client) rather than to produce printing runs of maps. Inventories from the seventeenth century, however, reveal substantial stocks of prints.[42]

For estimates of how many impressions could be drawn from a copperplate, our best source is Vittorio Zonca,

who wrote forty years later: for a copperplate, the minimum was one thousand impressions, the maximum with retouching two thousand. For etching, Zonca cited five hundred as a minimum and one thousand as a maximum.[43] Later estimates show considerably higher figures than these.[44]

From a variety of figures for the capital costs, overhead, raw materials, and manual and professional labor, it is possible to estimate that the break-even point for number of impressions to be sold was on the order of 110–220. For a reasonable margin of profit, 250–300 impressions would have needed to be sold.[45] It must be stressed, however, that any attempt to produce a cost model for the map trade in this period is subject to much qualification. It was a time when a recognized value was unlikely to be placed on an object as small and ephemeral as a print.[46] Much of the economy worked on a bartering basis, particularly for apprentices and manual laborers, so the price of board and lodging might be included in their compensation. Furthermore, the owners of the print shops entered into contracts for exchanging plates and stocks of prints, or might extend credit to customers, and in that capacity might act almost as a bank.[47] Inflation during the sixteenth century also considerably devalued the buying power of employees and changed the value of local currencies against gold and silver.

## Changing Woodcut and Copperplate Styles and Their Effect on Map Printing: Line, Lettering, and Color

Maps are special kinds of graphics that rely on a combination of lines, lettering, and occasionally color that place

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41. See the following works by David Woodward: "New Tools for the Study of Watermarks on Sixteenth-Century Italian Printed Maps: Beta Radiography and Scanning Densitometry," in *Imago et Mensura Mundi: Atti del IX Congresso Internazionale di Storia della Cartografia,* 3 vols., ed. Carla Clivio Marzoli (Rome: Istituto della Enciclopedia Italiana, 1985), 2:541–52; "The Analysis of Paper and Ink in Early Maps: Opportunities and Realities," in *Essays in Paper Analysis,* ed. Stephen Spector (Washington, D.C.: Folger Shakespeare Library, 1987), 200–21; "The Correlation of Watermark and Paper Chemistry in Sixteenth Century Italian Printed Maps," *Imago Mundi* 42 (1990): 84–93; and "The Evidence of Offsets in Renaissance Italian Maps and Prints," *Print Quarterly* 8 (1991): 235–51.
42. Consagra, "De Rossi Family."
43. Vittorio Zonca, *Novo teatro di machine et edificii per uarie et sicure operationi* (Padua: P. Bertelli, 1607), 78.
44. Woodward, *Maps as Prints,* 49.
45. Woodward, *Maps as Prints,* 52.
46. David Landau and Peter W. Parshall, *The Renaissance Print: 1470–1550* (New Haven: Yale University Press, 1994).
47. Leonardas Vytautas Gerulaitis, *Printing and Publishing in Fifteenth-Century Venice* (Chicago: American Library Association, 1976), 5–6.

unique technical constraints on their manufacture. This section investigates these three elements and how the techniques changed the style of map printing in the period being studied. We have already seen how relief and intaglio techniques may be readily distinguished by their style and physical characteristics. It follows that the techniques were also partly responsible for stylistic changes in the maps.

<div style="text-align:center">LINE</div>

If the number of maps printed in the second half of the fifteenth century is a reasonable guide, relief and intaglio methods were used about equally.[48] It was not that one evolved into the other. Rather, the choice of technique depended on the availability of artisans and printing presses specialized for each. Some uses, such as smaller book illustrations, called for blocks that could be printed in a common printing press, along with book pages. Others required a larger format and an expressive drawing style that could be more easily achieved with the burin or graver. In the history of prints, there is some evidence to suggest that a style of woodcut developed in the late fifteenth century to imitate the expressive character of the copperplate engraving. The success of this stylistic transformation in general printmaking, which Panofsky called "The New Style," resulted in two outcomes: it enabled the woodcut to achieve the same level of fineness and detail possible with copper, and it blurred the distinction between the reproductive engraver and the artist-engraver. Panofsky traced this shift to the work of Albrecht Dürer, whom Desiderius Erasmus had famously exalted as being able to express a huge range of forms and natural subjects effectively in black lines, "without the blandishment of colors."[49]

Dürer's new style differed from that of previous woodcuts in its method of rendering light and shade, surface textures, and plastic form. The earlier work had expressed form in a "schematic series of stiff, indifferent strokes" or strokes that fused "into indistinct masses,"[50] while in the new style Dürer "taught woodcut lines, hatchings and contours alike, to behave like the prolonged, elastic *tailles* produced by Schongauer's burin. They were made variable in length and width, they learned to move in curves significant both from an ornamental and representational point of view, and, above all, they acquired the capacity for swelling and tapering so as to express organic tension and relaxation."[51]

This notion of changing visual syntax was developed by Ivins in his influential work *Prints and Visual Communication.*[52] Ivins identified Marcantonio Raimondi as a pioneer in a new way of expressing form based on his experience with copying (i.e., plagiarizing) Dürer's woodcuts and engravings. Ivins credits Raimondi with devising "a

kind of shading that represented not the play of light across a surface, and not the series of local textures, but the bosses and hollows made in a surface by what is under it. In a way it corresponds closely enough to the kind of drawing that is familiar in the maps of the geodetic surveys."[53]

Maps may seem to depend so much on simple lines demarcating features and areas that the issue of the expressiveness of a line might not seem to be an issue. But if this were true, we would not be able to distinguish the style of one engraver from that of another and all maps would appear generic, which is clearly not the case.

It is in the rendering of features in three dimensions that the expressiveness of line is particularly relevant. This includes not only the relief of the land surface but a host of other signs and drawings that required the illusion of depth. The difficulty in rendering the third dimension in plan view often led artists to prefer an oblique or bird's-eye view for rendering features such as towns or landscapes in a "lifelike" manner.[54] So the expressiveness of Dürer's new style was as relevant for maps as it was for other woodcuts.

The differences between the old and new styles as expressed by Panofsky are that in one the woodblock was cut with a knife, in the other with a small chisel. It is the use of the latter tool, the *Eiselein,* that Dürer may have advocated,[55] although the likelihood that Dürer cut any of his blocks himself is now in dispute. The action of the chisel had an affinity with the copper engraver's burin; the chisel could render the parallel curving hatchings necessary to represent the third dimension smoothly, whether for a building, a mountain, or a figurative element such as a windhead.

Art historians often make the conceptual distinction between a painted surface and a bounding line as fundamentally different forms of graphic representation. Medieval painting has been expressed in terms of a "narrative" in which surfaces, colors, and painted textures predominated. Some authors see a shift toward the description of landscapes in which objects are located and

48. Tony Campbell, *The Earliest Printed Maps, 1472–1500* (Berkeley: University of California Press, 1987). For the sixteenth century, see chapter 23 in this volume.

49. Erwin Panofsky, *Albrecht Dürer,* 2 vols. (London: Humphrey Milford, 1945), 1:44.

50. Panofsky, *Dürer,* 1:47.

51. Panofsky, *Dürer,* 1:47.

52. William Mills Ivins, *Prints and Visual Communication* (Cambridge: Harvard University Press, 1953).

53. Ivins, *Prints and Visual Communication,* 66. From the latter sentence I assume that he means either contours or hachures.

54. Lucia Nuti, "The Perspective Plan in the Sixteenth Century: The Invention of a Representational Language," *Art Bulletin* 76 (1994): 105–28.

55. William Mills Ivins, "Notes on Three Dürer Woodblocks," *Metropolitan Museum Studies* 2 (1929–30): 102–11.

related in an abstract-ordered space. Such a technique has been described as analogous to a "mapping impulse"[56] and implies the use of descriptive bounding lines to convey technical information.[57] A reverse shift is sometimes postulated between the Renaissance and Baroque periods in art history. Jay, summarizing the analysis of Heinrich Wölfflin, has characterized the Baroque style as a "painterly, recessional, soft-focused, multiple, and open" style rather than the "lucid, linear, solid, fixed, planimetric, closed" style of the Renaissance.[58]

The distinction between painting and drawing was also made when describing maps. In household inventories, maps that were intended to decorate houses as frescoed murals are described as "painted," while those that were drawn or engraved to convey technical information are more likely to be described using the terms *descriptio* or *tabula*.[59]

The idea can be tentatively postulated that the line became privileged as a result of the very tools and methods the copper and wood engraver employed, and that the shift was particularly noticeable in mapping. One of the functions of a map is to act as a form of technical illustration that explains how the natural world is spatially constituted with the least amount of ambiguity. The purpose of technical drawings was to explain how things worked. They relied on the drafter's skill to show the viewer what was normally hidden from sight; an excellent example is provided by the exploded diagrams developed by Leonardo da Vinci to reveal the complex interactions of parts.[60] Technical drawings relied on the generalizing power of the line and textual labels to explain what those lines meant. Measured drawings and their labels demanded a medium that was precise and simplified. Quite apart from the technical difficulties of reproduction, paintings were ill suited to the task, because patches of painted color carried a wide range of meanings that introduced ambiguity into the data they were intended to represent.

### LETTERING

The role of annotation is foremost in cartography. It is difficult to imagine maps that are either not annotated with text or that substitute a verbal expression for text. Other types of graphics, such as commemorative or didactic paintings, were annotated long before printing, but printed maps required many names, labels, titles, and expository legends, as well as text. These annotations offer many of the maps' most informative features, because labels and text had such a pervasive influence on the choice of printing methods for maps.[61] As technical illustrations of a geographical nature, maps relied on extensive labeling of place-names.

Engravers and printers developed idiosyncratic methods to solve the problems of rendering letters in both wood and copper. Their ingenious efforts often resulted in interesting curiosities and characteristic styles that can be linked to particular engravers.

The engraver's difficulty was particularly acute in woodcuts, because the small lettering needed for place-names on maps, particularly in the rounded, humanist style that was becoming fashionable in Italy in the late fifteenth century, did not lend itself to the square, straight lines of the woodcutter's knife or even a small chisel. An excellent example of this difficulty is found in the Ulm edition of Ptolemy's *Geography* (1482), where the engraver, Johann Schnitzer of Armsheim, consciously tried to imitate the rounded manuscript style of the Nicholas Germanus manuscript from which it was copied (fig. 22.10).[62]

Many engravers and printers turned to typography in some form to solve the problem of small lettering. Metal type, like the woodcut surface, was already in relief and thus could be combined with it. Three methods were in general use. Printers' type could be locked up in a form with spacing material and overprinted on the woodcut line detail as a separate plate in either black or colored ink. This technique was a forerunner of the typometric technique of the eighteenth century, in which specially cast type could be combined with letterpress type for sections of linework and map signs.[63] Or the type could be inserted into the woodblocks in specially mortised slots in what must have been an extraordinary feat of carpentry made easier in nineteenth-century wood engraving when power milling and mortising machines were available.[64]

The more ingenious solution for wood engravers was to set up the place-names in a page of type, make a mold from it, and cast a thin metal plate from the mold. The names from this stereotype, as the plate was later called, could be cut up and pieces of it glued to the woodblocks in specially carved-out hollows. This technique was

56. Svetlana Alpers, *The Art of Describing: Dutch Art in the Seventeenth Century* (Chicago: University of Chicago Press, 1983), 119–68.

57. David Woodward, "The Image of the Map in the Renaissance," in *Plantejaments*, 133–52, esp. 147.

58. Martin Jay, "Scopic Regimes of Modernity," in *Vision and Visuality,* ed. Hal Foster (Seattle: Bay Press, 1988), 3–23, esp. 16.

59. Woodward, *Maps as Prints*, 119–21 n. 12.

60. Don Ihde, *Postphenomenology: Essays in the Postmodern Context* (Evanston: Northwestern University Press, 1993).

61. David Woodward, "The Manuscript, Engraved, and Typographic Traditions of Map Lettering," in *Art and Cartography: Six Historical Essays,* ed. David Woodward (Chicago: University of Chicago Press, 1987), 174–212.

62. Martha Tedeschi, "Publish and Perish: The Career of Lienhart Holle in Ulm," in *Printing the Written Word: The Social History of Books, circa 1450–1520,* ed. Sandra Hindman (Ithaca: Cornell University Press, 1991), 41–67, esp. 45.

63. Elizabeth M. Harris, "Miscellaneous Map Printing Processes in the Nineteenth Century," in *Five Centuries,* 113–36.

64. Woodward, "Woodcut Technique," 25–50.

FIG. 22.10. WOODCUT MAP LETTERING. This example shows the difficulty of rendering small lettering on maps using a woodcutter's knife. The rounded style was intended to mimic the manuscript from which it was copied. From the uncolored world map in the Ulm edition of Ptolemy's *Geography* (1482). Size of the detail: ca. 3 × 8.8 cm. Photograph courtesy of the BL.

widely used in southern Bavaria on maps associated with Sebastian Münster and Peter and Philipp Apian from the 1530s to the 1560s, but no doubt it could be traced back earlier in the sixteenth century and even to the late fifteenth century (fig. 22.11).[65]

Lettering in intaglio was difficult, but not as intractable as in the woodcut. Lines that flowed in approximately the same direction were engraved at the same time, with the plate turned accordingly so the trend of the line would always be away from the engraver. The action of engraving was thus free-flowing, elegant, and harmonious, with the artisan working in concert with the medium. The technique appropriately lent itself to a cursive italic lettering style known as *cancellaresca* that was developed in the fifteenth-century Vatican chancery. The style became the basis of the Italian handwriting manuals of the likes of Lodovico degli Arrighi, Giovambattista Palatino, and Giovanniantonio Tagliente, and it was adopted in the Netherlands, particularly by Gerardus Mercator, who published a manual titled *Literarum latinarum* in 1540.[66] The compact, flowing, and elegant style of *cancellaresca* lent itself well to map applications and complemented the style of the linework, causing maps made using it to appear to be more of an organic whole than maps made using type-inserted woodcut.

It must have taken a more utilitarian aesthetic to use the equivalent of type on a copperplate. The practice involved the stamping of letters onto a copperplate with custom-made reverse punches. Commonly used in lettering and numbering brass astronomical and surveying instruments, the punches were exploited early in copperplate map printing. Hinks first noticed in print that the Rome edition of Ptolemy's *Geography* (1478) used punches throughout.[67] When new maps were added in the 1507 Rome edition, the punches were apparently reused, but the punch for the capital letter "O" of a certain size had by then evidently been lost, so a punch used to engrave town circles replaced it.[68]

Although punches were commonly used on Italian maps during the sixteenth century, they were not used, to my knowledge, in Flanders or the Netherlands. Either the northern engravers did not have access to similar lettering punches or their facility in hand engraving was already efficient enough. Some northern engravers used punches for signs, such as for the town circles on the maps in the *Atlas maior* of Joan Blaeu, so it is also possible that the use of punched type on engravings was not regarded as suitably elegant or was not considered a labor-saving shortcut.

As in the case of handwriting, hand-engraved lettering is an indicator of individuality in cartographic style. Its idiosyncracies make the identification of engravers possible. For example, hand-engraved lettering formed the basis of two studies of the engraver Paolo Forlani, many of whose maps were unsigned.[69] And through evidence of

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65. David Woodward, "Some Evidence for the Use of Stereotyping on Peter Apian's World Map of 1530," *Imago Mundi* 24 (1970): 43–48, esp. 46.

66. A. S. Osley, *Mercator: A Monograph on the Lettering of Maps, etc. in the 16th Century Netherlands with a Facsimile and Translation of His Treatise on the Italic Hand and a Translation of Ghim's* Vita Mercatoris (New York: Watson-Guptill, 1969).

67. A. R. Hinks, "The Lettering of the Rome Ptolemy of 1478," *Geographical Journal* 101 (1943): 188–90.

68. Tony Campbell, "Letter Punches: A Little-Known Feature of Early Engraved Maps," *Print Quarterly* 4 (1987): 151–54, and Hinks, "Lettering," 189.

69. David Woodward, *The Maps and Prints of Paolo Forlani: A Descriptive Bibliography* (Chicago: Newberry Library, 1990), and idem, "Forlani Map of North America."
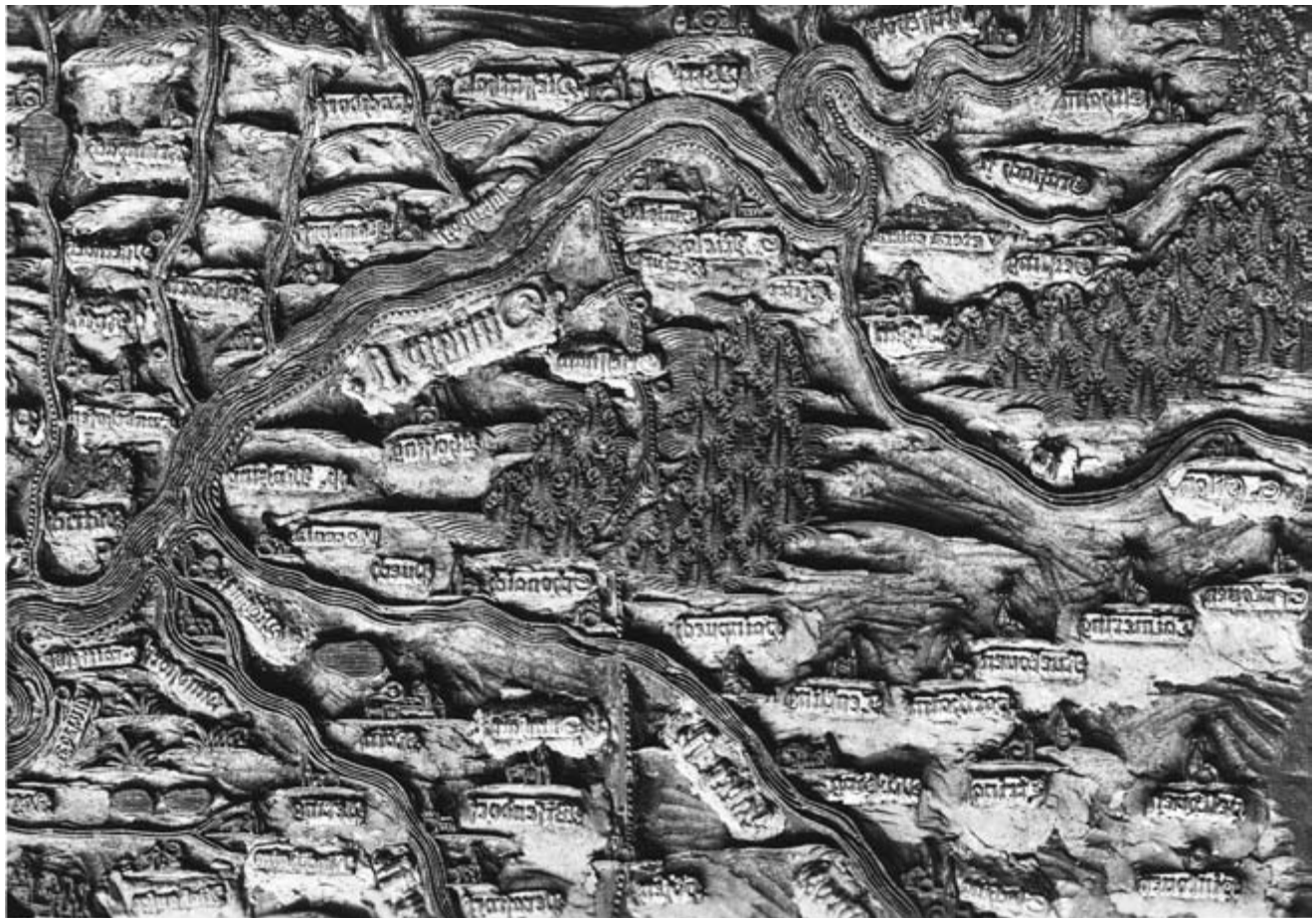
FIG. 22.11. ORIGINAL WOODBLOCK WITH STEREO-
TYPE LETTERING PLATES. The survival of the original
woodblocks used to print Philipp Apian's twenty-four-sheet
map of Bavaria (1568) allows an unusual opportunity to re-
construct the technology involved in the use of stereotyped
plates for map lettering. The plates and the mastic used to set
them in the block can be clearly seen.
Size of the detail: ca. 12.7 × 16.9 cm. Photograph courtesy of
the Bayerisches Nationalmuseum, Munich (upper left corner
of sheet 11).

lettering style, Boorsch attributed the engraving of the
maps in Francesco Berlinghieri's edition of Ptolemy's *Ge-
ography* (1482).[70] Further work could certainly be done
on cataloging the punches used for map lettering and cor-
relating them with the punches used for scientific instru-
ments to possibly establish links between the two.

### COLOR

Considering the central role of color in cartography and
the interest the subject generates among those attracted
to the aesthetic aspects of maps, it is surprising that there
is no generally informative historical account of its use on
Renaissance maps. Even Eckert, who can usually be re-
lied on for detailed technical descriptions and whose
treatment of the history of relief representation is much
more extensive, has scant historical material on the sub-
ject, even in his section on the aesthetics and logic of
maps, where he explains the logic of using "natural" col-

ors on maps.[71] We thus have to resort to quite brief and
general hints at the subject, most of which rely on John
Smith's 1705 manual of painting.[72] The fullest recent

70. Suzanne Boorsch, "Today Florence, Tomorrow the World—Or
Vice Versa: The Engravings of Francesco Rosselli" (paper presented at
the Renaissance Society of America, Scottsdale, Ariz., 2002), and idem,
"The Case for Francesco Rosselli as the Engraver of Berlinghieri's *Geo-
graphia*," *Imago Mundi* 56 (2004): 152–69.

71. Max Eckert, *Die Kartenwissenschaft: Forschungen und Grundla-
gen zu einer Kartographie als Wissenschaft,* 2 vols. (Berlin: Walter De
Gruyter, 1921–25), 2:732–41.

72. John Smith's "Art of Painting" went through several impressions
with alterations from 1676: *The Art of Painting Wherein Is Included the
Whole Art of Vulgar Painting* (London: Samuel Crouch, 1676), and *The
Art of Painting in Oyl* (London: Samuel Crouch, 1687 and 1701). But
the section on map coloring first appeared in chap. 21, 93–108, in the
fourth impression (London: Samuel Crouch, 1705), with the title *The
Art of Painting in Oyl . . . to Which Is Now Added, the Whole Art and
Mystery of Colouring Maps, and Other Prints, with Water Colours.* The
section on map coloring is quoted by Raymond Lister in *How to*

treatments from contemporary scholars include those of Ehrensvärd, Lane, Pelletier, and Karrow.[73]

These studies usually distinguish between the use of color as an aesthetic addition and its use to convey geographical information. Indeed, this distinction was made as early as John Smith's 1705 manual. It is also often argued that color was first used on maps for solely aesthetic purposes and then *progressed* into its functional use to distinguish among categories of information. A concomitant change in style from thick gouache to thin watercolor washes is usually cited. In addition, the distinction is made between the "decorative" nongeographical aspects of maps—the heraldic devices, title cartouches, or figurative scenes—and the core geographic information in the coordinate frame of the map. Henry Peacham wrote in 1634: "You may, if you list, draw naked boys riding and playing with their paper-mils or bubble-shels upon Goates, Eagles, Dolphins &c. The bones of a Rams head hung with strings of beads and Ribands, Satyres, Tritons, Apes, Cornucopia's, Dogs yoakt, &c. Drawing Cowcumbers, Cherries, and any Kind of wild traile or vinet after your owne invention, with a thousand more such idle toyes, so that herein you cannot be too fantastical."[74] The implication is that the "idle toyes" were *art* and quite different from and ancillary to the *science* of the geographic information. Harley argued for a dissolution of this dichotomy in 1989, but the feeling lingers.[75] After challenging the dichotomy in her chapter on map coloring in the Renaissance, Hofmann goes on to title the following chapter, on the Enlightenment, "Color in Search of Meaning."[76]

What some scholars might mistakenly identify as "decorative" elements on an early map are in fact an integral part of the map. Often, the coloring of these epicartographic[77] items, such as heraldic devices, relies on very precise coloring conventions in order to make them acceptable to the map's patrons. Smith underlines the importance of convention for coloring the map margent, the square stick of degrees around the map, with yellow, redlead, or crimson, "none but these three Colours serving well for this purpose."[78]

The role of coloring to show geographic information is underlined in some coloring manuals of the seventeenth century. The manuals suggest which colors could be used for various features. For example, William Salmon recommends the following as excellent colors to express roadways: "red and white lead, and for variety yellow oker; shadow it with burnt umber."[79]

The issue of whether to color a map has aesthetic as well as ethical dimensions. Some groups of maps, such as sixteenth-century Italian engraved maps, were not routinely colored. Others, such as the two Ulm editions of Ptolemy's *Geography* (1482 and 1486), are rarely found uncolored. The Italian maps, it is assumed, were uncolored so that their fine engraving would not be obliterated,

and yet at least one example of a composite atlas with contemporary color is recorded.[80] Those who produced the Ulm Ptolemy editions were trying to mimic a manuscript, so in this context the coloring in this style makes more sense.[81] On average, the cost of an uncolored map or atlas was about two-thirds that of the colored version.

Abraham Ortelius provides the most frequently cited example of the map colorist, and yet even his views on the aesthetics of color were ambivalent. From 1540 the profession of *afsetter van carten* or *caertafsetter* (map colorist) appears in the registers of the guild of Saint Luke at Antwerp. In 1547, at the age of twenty, Ortelius was listed as an "afsetter van carten" in the guild. He continued to be characterized as a "paintre de cartes" by Christoffel Plantijn. From an early age Ortelius also traded in books, prints, and maps, and perhaps (as did his father) in "antiquities."[82] Although he began his working

*Identify Old Maps and Globes* (London: G. Bell, 1965), 57–59, and is discussed by Lloyd Arnold Brown in *The Story of Maps* (Boston: Little, Brown, 1949), 178–70, quoting the 1769 edition.

73. Ulla Ehrensvärd, "Color in Cartography: A Historical Survey," in *Art and Cartography: Six Historical Essays*, ed. David Woodward (Chicago: University of Chicago Press, 1987), 123–46; Christopher Lane, "The Color of Old Maps," *Mercator's World* 1, no. 6 (1996): 50–57; Monique Pelletier, ed., *Couleurs de la terre: Des mappemondes médiévales aux images satellitales* (Paris: Seuil / Bibliothèque Nationale de France, 1998); and Robert W. Karrow, "Color in Cartography," in *Atlas sive Cosmographicae meditationes de fabrica mundi et fabricata figura, Duisberg, 1595,* by Gerardus Mercator, CD-ROM (Oakland: Octavo Editions, 2000), 24–29.

74. Henry Peacham, *The Compleat Gentleman: Fashioning Him Absolut in the Most Necessary and Commendable Qualities, concerning Minde or Body, That May Be Required in a Noble Gentleman* (London: Constable, 1634), 64.

75. J. B. Harley, "'The Myth of the Great Divide': Art, Science, and Text in the History of Cartography" (paper presented at the Thirteenth International Conference on the History of Cartography, Amsterdam, 1989); J. B. Harley and K. Zandvliet, "Art, Science, and Power in Sixteenth-Century Dutch Cartography," *Cartographica* 29, no. 2 (1992): 10–19; and David Woodward, "The 'Two Cultures' of Map History—Scientific and Humanistic Traditions: A Plea for Reintegration," in *Plantejaments,* 49–67.

76. Catherine Hofmann, "'Paincture & Imaige de la Terre': L'enluminure de cartes aux Pays-Bas," in *Couleurs de la terre: Des mappemondes médiévales aux images satellitales,* ed. Monique Pelletier (Paris: Seuil / Bibliothèque Nationale de France, 1998), 68–85.

77. David Woodward, "'Theory' and *The History of Cartography*," in *Plantejaments,* 31–48. Epicartographic items are the ancillary but essential elements not subject to graphic generalization or projection outside the graphic space of the map.

78. Smith, *Art of Painting in Oyl* (1705 ed.), 104–5.

79. William Salmon, *Polygraphice; or, The Art of Drawing, Engraving, Etching, Limning, Painting, Washing, Varnishing, Colouring, and Dying* (London: E. T. and R. H. for Richard Jones, 1672), 211.

80. Rodney W. Shirley, "A Rare Italian Atlas at Hatfield House," *Map Collector* 60 (1992): 14–21.

81. Tedeschi, "Publish and Perish."

82. Léon Voet, "Abraham Ortelius and His World," in *Abraham Ortelius and the First Atlas: Essays Commemorating the Quadricentennial of His Death, 1598–1998,* ed. M. P. R. van den Broecke, Peter van der

life as a map colorist, in 1595 Ortelius expressed a preference for uncolored maps in a letter to a nephew, Jacob Cool (Jacobus Colius Ortelianus), in London: "Salute [William] Camden for me. After a month or two he will receive my fifth 'Additamentum' to my Theatrum, and you will have the Theatrum itself, revised and augmented with seventeen maps, as a gift. You ask for a colored copy; but in my opinion an uncolored copy is better; decide yourself."[83] In the following century, Abraham Bosse described one of the qualities valued in the earliest impressions of prints as the stark contrast of distinct black lines against very white paper; he believed the absence of color enhanced this aesthetic.[84]

A comparison of colored and uncolored impressions of a single map clarifies some of the points under discussion here. Compare the three known impressions of the world map by Francesco Rosselli in figures 1.3 and plate 16. As we can see from the uncolored impression, the dominant cartographic elements of this map are made up of fine copper-engraved lines. In the case of the lightly colored impression (colored with light green and light red wash), the layer of color is so thin that it allows the linework to show through clearly beneath. The coastline of the southern continent has been extended in manuscript pen, but the color does not add any important information. In the third example (colored blue, green, gray, white, red, and gold), the gouache color has been applied so thickly that it has obliterated the linework underneath. Furthermore, colored information has been added to the engraved outline, so its use is by no means ancillary, but adds information. The tentative northern coastline of a southern continent has now been completed, making it into a full continent, and the name "Boca del drago" added. The linear syntax of the black lines in the uncolored example contrasts with the painted color surfaces in the gouache example. Their styles are so different that it is difficult to imagine they are both from the same copperplate; indeed, the gouache version has been mistaken for a manuscript.[85]

The issue of whether a historical map should or should not be colored with modern coloring is an ethical problem. The practice is currently so widespread that it has been written about openly.[86] As Lane puts it, "If a person is collecting for pleasure or decoration, maps with attractive new color would be suitable. If, however, he is pursuing a collection with a more serious historical purpose, new color could be inappropriate. If he is collecting for investment purposes, original color should certainly be sought (although in many cases new color would be acceptable)."[87]

The ethical dimension raises concerns about truth in labeling, whether a buyer should be told a map has been colored recently. For someone interested in the craft of early pigments or color schemes chosen for maps, the eth-

ical issue becomes one of historical authenticity. If good modern coloring enhances a map's salability, as Lane suggests, it makes sense that the colorist should sign and date the work or at least provide a record of this information that can be transmitted. This practice would eliminate any uncertainty if a question should arise and would save an enormous amount of time if pigment analysis were necessary to confirm the date of the color.

This leads into the third approach to color on historical maps—a paper conservator's viewpoint. Because historical pigments can adversely affect paper, studies on map coloring have sometimes focused on color as a chemical conservation problem.[88] This approach is also of great value in studies of historical authenticity, especially to establish if coloring is recent or old. Historical sources of information for such studies rely to a great extent on manuscript and printed manuals for making pigments.[89] In the Renaissance, books of "secrets" or "mysteries" containing recipes for medical ailments often included a section on the grinding of color pigments, engraving, and other graphic arts. The recipes for pigments were largely gleaned from manuscripts circulating in the Middle Ages, such as the famous "Mappae clavicula" of the twelfth century.[90] One of the earliest and most popular printed sources was the *Secretes* of "Alessio Piemontese," which

Krogt, and Peter H. Meurer ('t Goy-Houten: HES, 1998), 11–28, esp. 15.

83. Abraham Ortelius, *Abrahami Ortelii (geographi antverpiensis) et virorvm ervditorvm ad evndem et ad Jacobvm Colivm Ortelianvm . . . Epistvlae . . . (1524–1628),* ed. Jan Hendrik Hessels, Ecclesiae Londino-Batavae Archivum, vol. 1 (1887; reprinted Osnabrück: Otto Zeller, 1969), 613–14, letter 261, 4 January 1595.

84. Bosse, *Traicté.*

85. David Woodward, "Starting with the Map: The Rosselli Map of the World, ca. 1508," in *Plantejaments,* 71–90.

86. A random sample from one journal includes a description of the work of Ivan and Rosemary Deverall: "The Art of Colouring," *Map Collector* 11 (1980): 40; Clifford Stephenson, "The Mechanics of Map Collecting," *Map Collector* 22 (1983): 24–28; and Victor Edwards, letter to the editor, *Map Collector* 24 (1983): 48.

87. Lane, "Color of Old Maps," 57.

88. A sample includes: Bèla G. Nagy, "The Colorimetric Development of European Cartography" (master's thesis, Eastern Michigan University, 1983); Fei-Wen Tsai, "Sixteenth and Seventeenth Century Dutch Painted Atlases: Some Paper and Pigment Problems," in *Conference Papers, Manchester 1992,* ed. Sheila Fairbrass (London: Institute of Paper Conservation, 1992), 19–23, esp. 21; and Nancy Purinton, "Materials and Techniques Used for Eighteenth-Century English Printed Maps," in *Dear Print Fan: A Festschrift for Marjorie B. Cohn,* ed. Craigen Bowen, Susan Dackerman, and Elizabeth Mansfield (Cambridge: Harvard University Art Museums, 2001), 257–61.

89. R. D. Harley, *Artists' Pigments, c. 1600–1835: A Study in English Documentary Sources,* rev. ed. (London: Archetype, 2001), and Cassandra Bosters et al., eds., *Kunst in kaart: Decoratieve aspecten van de cartografie,* exhibition catalog (Utrecht: HES, 1989), 95–129.

90. Lynn Thorndike, "Some Medieval Texts on Colours," *Ambix: The Journal of the Society for the Study of Alchemy and Early Chemistry* 7 (1959): 1–24.

appeared in Italian in 1555 and 1556 and was edited more than twenty times and rapidly translated into other European languages.[91] The identity of Alessio has been suggested as Girolamo Ruscelli, the editor of the 1561 Venice edition of Ptolemy's *Geography,* who is acknowledged as one of the sources of the secrets and was well known in cartographic circles.[92] We know that the *Secretes* was read by Ortelius and Gerard de Jode.

Painting and illuminating manuals were particularly popular in England from the middle of the sixteenth century, and although the early manuals do not contain any direct references to map coloring, several of the applications are analogous.[93] The anonymous treatise printed for Richard Tottill in 1583 was the first printed example in England to contain instructions for emblazoning heraldic arms, the problems and techniques of which might have been viewed as analogous to those of map coloring.[94] Another was Richard Haydocke's 1598 English translation of Lomazzo's *Trattato dell'arte de la pittura,*[95] which likewise does not refer directly to map coloring.

It was in a surveying manual of 1610, William Folkingham's *Fevdigraphia,* that specific information about how to color maps was first published. Folkingham explains how to color the various elements of a survey plat:

> The Tricking of Plots consists in Complements, and Compartiments.
>
> Complements comprehende the Flie [compass rose] or Flies, Scale and Compasse, Kalender, Characters, Colours &c.
>
> The Flie is a Card divided into eight, sixteene, thirty two equall parts in the Limbe with competent extention to shew the Meridian and Coastages of the Plot. . . . [He then explains ways of finding the meridian.]
>
> The Scale and Compasse are no lesse requisite, and may be florished with Fruitage or Imagery. . . . [He lists appropriate colors for, among other things, arable land, meadows, pastures, heaths, trees, water, and seas.]
>
> Compartiments are Blankes or Figures bordered with Anticke Boscage or Crotesko-worke, wherein Evidences or other Memorables may be abreviated.
>
> And these may bee contrived in Parallelograms, Squares, Circles, Ovalls, Lunaries . . . compassed and tricked ad libitũ.
>
> Under this Title may also be rainged the Lordes Coate with Crest and Mantells. And these Compartiments with the Scale, Carde and Kalender must bee bestowed in convenient spare and voide places.[96]

The proliferation of these manuals in various editions in the seventeenth century bears witness to the importance of the craft of applying watercolor washes, known as limning (limming) or washing. Limning originally meant the illumination of manuscripts or heraldic arms (the root of the word is *lumine*), particularly with gold or silver.

But by the end of the seventeenth century, it came to mean painting with watercolor.[97]

The amateur pastime of washing maps was regarded as a more lowly occupation than that of miniature painting, as the manuscript manual of Edward Norgate reveals.[98] Norgate states: "In this Catalogue of Colours I [Norgate] doe purposely omit Brazill Verdigreece Orpiment Rosett Turnsole Litmus Logwood and others as not worthy the naming . . . being indeed fitter for those that wash prints or colour Mapps then to be admitted into our Company."[99]

The seventeenth-century manuals were intended for a wide audience in the context of education for the nobility, responding to the Renaissance Italian idea that the ability to draw and paint was essential to the ruling classes. John Smith wrote that watercolor washing was "an excellent recreation for those gentry, and others, who delight in the knowledge of maps."[100] Particularly influential in England was Henry Peacham's *The Art of Drawing with the Pen* (1606), which reappeared in 1622 as the *The Compleat Gentleman,* in which Peacham expressed his view that map coloring had an educational role in helping children remember where countries were: "For the practice of the hand, doth speedily instruct the mind, and strongly confirme the memorie beyond any

91. Piemontese, *Secretes of Maister Alexis.*

92. John Ferguson, "The Secrets of Alexis: A Sixteenth Century Collection of Medical and Technical Receipts," in *Proceedings of the Royal Society of Medicine* 24 (1931): 225-46.

93. Harley, *Artists' Pigments,* 1–14.

94. *A Very Proper Treatise, Wherein Is Breefely Set Foorth the Art of Limming* (London: Thomas Purfoote, the assigne of Richard Tottill, 1583).

95. Giovanni Paolo Lomazzo, *A Tracte Containing the Artes of Curious Paintinge, Caruinge, Buildinge, Written First in Italian,* trans. Richard Haydock (Oxford: Ioseph Barnes for R H [Richard Haydock], 1598).

96. W. Folkingham, *Fevdigraphia: The Synopsis or Epitome of Svrveying Methodized* (London: Printed for Richard Moore, 1610), 56–58. "Tricking," or "tricking out," referred to sketching an outline, often indicating by letter which color should fill the space, used particularly in heraldry.

97. Salmon, *Polygraphice; Albert Durer Revived; or, A Book of Drawing, Limning, Washing, or Colouring of Maps and Prints; and the Art of Painting, with the Names and Mixtures of Colours Used by the Picture-Drawers. With Directions How to Lay and Paint Pictures upon Glass . . . Also Mr. Hollar's Receipt for Etching, with Instructions How to Use It [etc.]* (London: H. Hills, 1675). Salmon defines limning as "an Art whereby in water Colours, we strive to resemble Nature in every thing to the life" (p. 123).

98. Edward Norgate, *Miniatura; or, the Art of Limning,* ed. Jeffrey M. Muller and Jim Murrell (New Haven: Paul Mellon Centre for British Art by Yale University Press, 1997).

99. Norgate, *Miniatura,* 59. See also R. K. R. Thornton and T. G. S. Cain, eds., *A Treatise Concerning the Arte of Limning by Nicholas Hilliard, Together with a More Compendious Discourse concerning ye Art of Liming by Edward Norgate* (Manchester: Carcanet Press, 1992).

100. Smith, *Art of Painting in Oyl* (1705 ed.), 93.

FIG. 22.12. FRONTISPIECE SHOWING MAP COLORING. The illustrations on this frontispiece show a map colorist painting a map of the world as well as a landscape artist.
Size of the original: ca. 14.8 × 8.7 cm. *The Excellency of the Pen and Pencil . . .* (London: Thomas Ratcliff and Thomas Daniel for Dorman Newman and Richard Jones, 1668). Photograph courtesy of the BL.

thing else." [101] Peacham's 1634 edition, published the year of his death, added much more information on "limming." [102] His book was copied considerably by John Bate [103] and others later in the century in such books as *The Excellency of the Pen and Pencil* (fig. 22.12), *The Complete Academy,*[104] Salmon's *Polygraphice, Albert Durer Revived,* and John Smith's *Art of Painting in Oyl.* The selling power of a book that teaches map coloring to the gentry is confirmed by the prominent inclusion of this activity in the subtitle of *Albert Durer Revived* (*A Book of Drawing, Limning, Washing, or Colouring of Maps and Prints . . .*), even though no information on the sub-

ject is found in its pages. The strength of the Continental artistic tradition is also demonstrated in the invocation of Dürer's name in the same book on coloring, even though Dürer himself never authored one.

In the Netherlands, the profession of map coloring was well established in the sixteenth century. We have already referred to Ortelius's connection with the trade, but the archives of the firm of Christoffel Plantijn reveal a dozen names of map illuminators in addition to those of Ortelius and his two sisters: Pieter Draeckx (who colored more than a hundred maps for Plantijn, mostly those of Mercator), and Mynken (diminutive of Jackomina) Liefrinck, the daughter of the engraver-printer Hans Liefrinck. As colorist, she signed the coloring on the title page of an example of the 1586 *Speculum nauticum* of Lucas Jansz. Waghenaer (plate 17).[105] But the first treatise on coloring in the Netherlands was not published until 1616 as Gerard ter Brugghen's *Verlichtery Kunst-Boeck.* Art historian Goedings identifies ter Brugghen as the painter Marcus Gheeraerts the Younger, the author of the so-called Ditchley portrait of Queen Elizabeth I.[106] The other manual that was prominent in the Low Countries in the seventeenth century was by Willem Goeree. In France, Hubert Gautier explained how maps and plans sent to the French royal court were washed.[107]

## THE IMPACT OF MAP ENGRAVING AND PRINTING

The intent of this section is to outline the effects that the techniques of map engraving and printing had on the output of map production in the Renaissance, on changes in the kinds of readership, and on the social structure of the practitioners. Before Eisenstein's breakthrough book on the printing press as an agent of change, studies on the

101. Henry Peacham, *The Compleat Gentleman: Fashioning Him Absolute in the Most Necessary & Commendable Qualities concerning Minde or Bodie That May Be Required in a Noble Gentleman* (London: Francis Constable, 1622), 65.

102. Peacham, *The Compleat Gentleman* (1634); chap. 13 is titled "Of Drawing and Painting in Oyle."

103. Bate, *Mysteries of Nature.* Because Peacham does not include a section on engraving, Bate must have gotten his information on that subject from elsewhere.

104. *The Excellency of the Pen and Pencil, Exemplifying the Uses of Them in the Most Exquisite and Mysterious Arts of Drawing, Etching, Engraving, Limning, Painting in Oyl, Washing of Maps & Pictures: Also the Way to Cleanse Any Old Painting, and Preserve the Colours* (London: Thomas Ratcliff and Thomas Daniel for Dorman Newman and Richard Jones, 1668), and *The Complete Academy; or, A Drawing Book,* 2d ed. (London: R. Battersby for J. Ruddiard, 1672).

105. Hofmann, "Paincture & Imaige de la Terre," 69.

106. See plate 18 in this volume and Bosters et al., *Kunst in kaart,* 112.

107. Henri (Hubert) Gautier, *L'art de laver; ou, Nouvelle manière de peindre sur le papier, suivant le coloris des desseins qu'on envoye à la cour* (Lyons: T. Amaulry, 1687).

impact of printing fell short of a full explanation, overemphasizing the effect of vastly increased numbers of communicative materials.[108] These earlier studies also ignored graphic printing, especially map printing, providing the historian of cartography with few guidelines. Eisenstein's book, in contrast, is essential reading for cartographic historians, especially those of the Renaissance, for it compares the impact of graphic and typographic printing throughout the period and raises important new issues for discussion. The order in which they are discussed here is based on my essay reviewing Eisenstein's book.[109]

### THE IMPACT OF PRINTING ON MAP CONTENT

Any impact on the way the content of maps was modified by printing was not immediate. In this sense, the situation is analogous to that for printed scientific books; the prime example is Nicolaus Copernicus's 1543 *De revolutionibus,* the subject of Gingerich's study.[110] Even though much has been made of Sebastian Münster's method of enlisting foreign correspondents to send him up-to-date versions of town views and regional maps for his *Cosmography,* the quality of maps and the breadth of their scope must give us pause as to the effectiveness of his system. The *Novus orbis,* from 1544, a favorite map of map collectors on account of its egregious errors, particularly in the Verrazzanian Sea, is a case in point; it surely cannot be claimed that this map incorporated up-to-date immediate information from travelers on the ground. If we are to tabulate the various sources for maps, it can be argued that from 1475 to 1525, the prime source for printed maps was Ptolemy's *Geography,* even though by the end of that period the *Victoria* of Ferdinand Magellan's circumnavigation fleet had returned to Spain, bringing knowledge of the width of the Pacific and the position of the American continent.

A second issue for discussion is the relative role of printing in secular and sacred contexts or in the scientific and scriptural traditions. Eisenstein argues that in the Protestant Reformation, the sheer volume of printed material widely disseminated to new sections of the population was a major feature of the impact of printing on religious life. On the other hand, she argues that the main impact of the printing press on the scientific revolution was not so much hastening the spread of new scientific ideas. Rather, it was increasing the ability to maintain accuracy and fidelity to the original that was the great gift of printing and engraving to the scientific and hence also the cartographic world. In this, Eisenstein followed Ivins's famous notion of the exactly repeatable pictorial statement that allowed rational comparison and classification of widely scattered objects.[111]

Although not directly engaging Ivins, Johns has recently challenged this idea of the "fixity" of print media,

at least in the book context, claiming that the influence of the book was much more fluid and idiosyncratic than an ideal model of the "scientist" acting on the ability to compare exactly similar treatises might suggest.[112] In particular, Johns questions Eisenstein's choice of Tycho Brahe as an example of the model, pointing out that Tycho, who controlled his own printing press and paper mill, was far from typical, and, in any event, was ultimately not able to completely control the timeliness and accuracy of the reports of his experiments. Much more likely, Johns suggests, is a model of piracy and usurpation in early modern printing, a model that gave the author limited control over the output and influence of his ideas.

To Eisenstein's credit, however, her work specifically uses examples of graphic and even cartographic printing, which Johns does not directly address. So do the essays of Latour, who sees the importance of map printing as residing in the vast increase in the numbers of mobile, immutable, flat artifacts that could be reproduced and distributed at modest cost. Latour specifically refers to the power of the printed map as being able to recombine images of totally different origins and drawn at different scales into a new compilation. He stresses the importance of maps in understanding the notion of scale: "Even the very notion of scale is impossible to understand without an inscription or a map in mind."[113] With a map in hand, he said, one could intellectually manipulate the geographical world because of "optical consistency."[114]

Eisenstein's proposal of Abraham Ortelius as an example of the successful iteration of feedback through his correspondence with scholars throughout Europe is also compelling. By this method Ortelius enlarged and improved—in the main—the editions of his *Theatrum orbis terrarum,* and his famous list of authors at the front of the volume underlined the explicit role of authorship in establishing the authority of the maps that he included. However, it might not be wise to generalize from this one example. Although in theory it might seem as if corruption of maps could finally be arrested by having the original available to refer to, this did not happen immediately.

108. Elizabeth L. Eisenstein, *The Printing Press as an Agent of Change: Communications and Cultural Transformations in Early-Modern Europe,* 2 vols. (Cambridge: Cambridge University Press, 1979).

109. David Woodward, Review of *The Printing Press as an Agent of Change,* by Elizabeth L. Eisenstein, *Imago Mundi* 32 (1980): 95–97.

110. Owen Gingerich, *The Book Nobody Read: Chasing the Revolution of Nicolaus Copernicus* (New York: Walker, 2004).

111. Ivins, *Prints and Visual Communication.*

112. Adrian Johns, *The Nature of the Book: Print and Knowledge in the Making* (Chicago: University of Chicago Press, 1998).

113. Bruno Latour, "Drawing Things Together," in *Representation in Scientific Practice,* ed. Michael Lynch and Steve Woolgar (Cambridge: MIT Press, 1990), 19–68, esp. 56.

114. Latour, "Drawing Things Together," 44–47.

Map printing was a trade, and the bottom line in the trade was to make a profit. Despite (or maybe because of) the constant proclamation of map publishers on their maps that this or that was the best, newest, or most accurate representation ever of such and such a region, the opposite was true in most cases; tired old plates were constantly put out with the merest change of publisher's name or date. Thus, various versions of the world attributed to Giacomo Gastaldi, often with huge discrepancies—some with Asia and Africa joined, some with or without a great southern continent—continued to pop up in various guises long after Gastaldi's death, as though he had become the new Italian "Ptolemaic" authority.

A common thread in the views of Ivins, Eisenstein, Latour, and Johns in explaining the practical effect of printing on a given problem is a belief in the power of the artisan's experience. Latour is particularly articulate about this: "It seems to me that the most powerful explanations, that is, those that generate the most out of the least, are the ones that take writing and imaging craftsmanship into account. They are both material and mundane, since they are so practical, so modest, so pervasive, so close to the hands and the eyes that they escape attention. Each of them deflates grandiose schemes and conceptual dichotomies and replaces them by simple modifications in the way in which groups of people argue with one another using paper, signs, prints and diagrams." [115]

### THE IMPACT OF PRINTING ON STYLE

Intuitively, one might assume that a graphic revolution as profound as the multiple manufacture of exactly repeatable images would have led to more standardization in the style of maps, where a specific sign stood for a particular feature. Also intuitive is the idea that the woodcut technique—because of its inherent roughness and low textural resolution—would lead to specific woodcut "styles" that would be noticeably different from the styles of the finer-resolution copperplate or intaglio.

We have to examine both these assumptions critically in the light of empirical evidence that Delano-Smith has presented in chapter 21 in this volume. Her conclusions, based on a large number of examples, suggest that the invention of printing was not immediately responsible for sign conventions, for they did not develop until long after the fifteenth century, the time when such techniques were introduced. It was not until the end of the eighteenth century and the beginning of the nineteenth, with the publication of style sheets by military cartography agencies, that the notion of standardized conventions, emerging from meetings at which the meaning of signs was specifically agreed upon, could be fully established. By that time, copper engraving had established itself as the engraving

medium of choice, a position that was soon to be challenged by lithography, which set up a whole new series of technical and stylistic complications.

The point remains, however, that those who are used to seeing a large number of antiquarian maps from the Renaissance can usually distinguish a woodcut from a copperplate map by observing clues in the line types and lettering styles. Thus, a distinction needs to be made between general graphic styles—on which printing had a direct and obvious effect—and specific influences on the standardization of cartographic signs, which appear to have been much less dramatic.

One clear effect of printing was that maps became less colorful. In the manuscript era, in which large maps were often painted, color was just as easy to apply as black ink or paint. When maps came to be printed, the woodcuts or copperplates were usually inked using black ink, and the process relied on the hand colorist for the addition of color. Many examples remained black and white, particularly in the Italian map trade, where the fineness of the engraving was thought to provide decoration enough. Color was difficult to accommodate in printing until the nineteenth century, and even then it proved very expensive because a different lithographic stone had to be prepared for each color. Examples of printed color maps before then are few and far between and are usually the result of experiments that were not widely adopted. This difficulty may partly explain the late appearance of the printed sea chart in the late sixteenth century. The color requirements of the portolan chart, which used red and black for different categories of seaport place-names, could not be easily handled by the new engraving techniques. It is perhaps in imitation of this style that the maps in the 1511 Venetian edition of Ptolemy's *Geography* were printed in red and black type. For the maps' content the book states its indebtedness to the maps of navigators; perhaps a similar influence was responsible for their style.

The effects of printing on map lettering style are in many ways counterintuitive. We might have expected the use of letterpress type styles—both in the stereotyped plates used on woodcuts and in the punches used in copper engraving—to have contributed to a lettering convention in maps. But when conventions for topographic map lettering came to be drawn up in the late eighteenth century and in the nineteenth century, one model chosen was an efficient italic developed in copper engraving, which in turn had evolved out of manuscript cursive styles. Typography became widespread on maps only in the late twentieth century, when digital methods of resizing, spacing, and placement made its cartographic application more flexible and versatile.

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115. Latour, "Drawing Things Together," 21.

## THE IMPACT OF PRINTING ON
## CHANGES IN MAP READERSHIP

A radical change in the patterns of ownership of maps and works of art took place between the fifteenth and sixteenth centuries. The modest prices of prints compared to original artworks enabled the middle classes to enjoy a consumerism in collecting that had previously been reserved for the nobility.[116] A fledgling map trade had been established in Florence at the beginning of the sixteenth century. By the mid-1560s, the printed map trade had matured and was driven by a market substantial enough to demand bound sets of maps and prints in the major map-publishing centers of Europe—Rome, Venice, Antwerp, and Amsterdam. The maps might not have been avant-garde in disseminating new information about geographical discoveries, because most of this trade was in the form of closely controlled official manuscripts. However, the largely derivative printed maps available to the public, as geographical prints, provided a source of topical and informal information that presumably had an effect in forming general worldviews, particularly at a time when the content of classical geography was being replaced with a "modern" geography that incorporated the new discoveries. The burgeoning interest in purchasing topographical and geographical prints must at least indicate that by the second half of the sixteenth century the *idea* of the map had been widely disseminated, even though it is difficult to document the extent to which its contents or meaning had been digested.

Household inventories provide a sparse and underutilized source of evidence for the kinds of social classes that bought printed maps. These were usually compiled for the estate of the owner and occasionally listed prints and maps hanging on the walls of the owner's house.[117] Devotional subjects, projecting the piety of the owner, not surprisingly overwhelm the lists, but geographical subjects often occur. A frequent subject is a "description of the world in four parts," suggesting that a display of maps of the continents perhaps projected the owner's own cosmopolitan status, *au fait* with the issues of worldwide commerce, or reflected the level of education that the owner had acquired. In general, the inventories reveal that it was the wealthy class that bought maps in sixteenth- and seventeenth-century Italy and the Netherlands, whether they were merchants, lawyers, collectors, art lovers, scholars, or, more rarely, bishops and parish priests. But the occasional reference to the possession of such artifacts by tradesmen is intriguing. Andrea Bareta, a woolworker, apparently owned maps of the four continents among representations of the more expected sacred themes, and the illuminator Gasparo Segizzi possessed twenty-four maps and prints.[118]

As if to cater to the new classes, as well as stake a claim of independence from the classical geographical authorities, map titles and legends began to use the vernacular languages rather than Latin, with the routine exceptions of world maps and maps of islands. The former were probably in Latin in order to capitalize on a market wider than a single country. The routine use of Latin for maps of islands, however, is more difficult to explain, perhaps reflecting a view that the world's islands were under papal jurisdiction.

## THE IMPACT OF PRINTING ON
## MAP PUBLISHING PRACTICE

Eisenstein argues that typographic printing had a powerful effect in breaking down social barriers. In the printer's office, she suggests, we would have found the intellectual rubbing shoulders with the practical man, so the publishing houses became a kind of scholarly community center. For map publishing, the argument needs to be nuanced a little; the practice may have varied idiosyncratically. There is evidence that the graphic print shops of Florence and Rome became foci for discussion and intellectual stimulus. Francesco Rosselli, who pioneered the map trade, certainly moved in intellectual circles and was known as a "cosmographer" during his visit to Venice. Likewise, reports of the early 1550s indicate that the shops of Michele Tramezzino, Antonio Salamanca, and Antonio Lafreri in the Parione booksellers' district of Rome were a haunt of archaeologists and antiquarians interested in the prints of ancient Rome in their stock.[119] Certainly, where cartographers and/or engravers were also clerics, antiquarians, or scholars, as in the case of Martin Waldseemüller, Gerardus Mercator, or Abraham Ortelius, the publishing office would have provided a scholarly ambience. But it is doubtful whether Paolo Forlani, Giovanni Francesco Camocio, or Domenico Zenoi, engravers in Venice in the 1560s, had the intellectual qualifications that made it comfortable for them to move in scholarly social settings. Their names almost never appear other than on their maps (not even in the Venetian state archives), except (in the cases of Camocio and Zenoi) when they ran afoul of the antipornography laws

116. Chandra Mukerji, *From Graven Images: Patterns of Modern Materialism* (New York: Columbia University Press, 1983).

117. Federica Ambrosini, "'Descrittioni del mondo' nelle case venete dei secoli XVI e XVII," *Archivio Veneto,* 5th ser., 117 (1981): 67–79; Günter Schilder, *Monumenta cartographica Neerlandica* (Alphen aan den Rijn: Canaletto, 1986–), vols. 6 and 7; and Catherine Delano-Smith, "Map Ownership in Sixteenth-Century Cambridge: The Evidence of Probate Inventories," *Imago Mundi* 47 (1995): 67–93.

118. Woodward, *Maps as Prints,* 80.

119. Woodward, *Maps as Prints,* 42–43.

policed by the Venetian senate. Nor do we know the extent to which Giacomo Gastaldi, who was a well-known member of the Venetian intellectual elite, frequented the map engraving shops, even though his name was obviously well known to the engravers from its frequent mention in the titles of their maps. One might therefore guess that the blanket image of the publishing office as a social melting pot should not always be universally applied to the map- and printseller's *bottega*.

In conclusion, the general impact of the invention of map printing on the content, style, readership, and social practices surrounding map production was not always, in practice, as immediate and dramatic as might be expected in theory. Although the new technology theoretically held the promise of new accuracy resulting from the constant feedback of far-flung informants, its effect on map content was less than expected, largely because it was easier and less expensive for publishers to reuse old plates. In terms of style, though the effect of map printing might be thought to have been considerable in view of the fundamental differences among manuscript, woodcut, and copperplate tools, printing does not seem to have resulted in the standardization that might have been expected. However, there was a considerable effect on map readership and a broadening of the social classes exposed to maps, as well as a growing role for some print and map shops as centers where information could be exchanged. In general, however, although we can always select examples to show that the general effect of map printing was considerable, it is difficult to see a sustained effect until long after the period covered by this volume had ended.

## Afterword

Since the publication of *Five Centuries of Map Printing* in 1975, several specialized studies indicated in this chapter have added to our knowledge of map engraving, printing, and coloring. These studies have been based on archival evidence and have come from both art historians and printing historians as well as historians of cartography. Although the majority of these studies deal with periods after the Renaissance, and thus are perhaps of less relevance here, the relative stability of intaglio engraving techniques between the sixteenth and nineteenth centuries allows many findings to be projected back into the period under consideration here. The main intent of this chapter has been to guide the reader to the literature that has accumulated over the last twenty-five years. The chief *desideratum* in this field is to gather more archival evidence on the costs of engraving, paper, coloring, and map publishing so that a reliable cost model can be accumulated. Table 22.1, offered here for purposes of comparing paper costs and sizes, provides a mere hint at what could be achieved.