Color and cartography

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Color has long played a significant role in cartography. Manuscript mapmaking has always included color as one of its basic tools in the form of pigments, leads, and inks, lending meaning and clarity to the map. Printed maps have employed added color to decorate, to emphasize, and to signify; experiments with color printing have furthered these trends. This essay explores the relationship between color on manuscript maps (usually prepared at large scale for purposes of property delineation, military objectives, or administrative projects) and color applied to printed maps (usually medium to small scale geographic maps prepared for a commercial market), with which most people are familiar.

Printed Maps and Color

Consideration of the question of color on printed maps during the period from 1650 to 1800 discerns three patterns. The first is a shift from a clear domination by printed Dutch cartography in the 17th century to the dissemination of a more generally European cartographic production, in which Germany, France, and Great Britain played increasingly important roles. Testifying to this shift are the copying and sales of maps of French mapmakers Sanson, Jaillot, de Fer and Delisle in the Netherlands and the establishment of solid editorial houses such as Seutter (qv) or Homann (qv) in Germany (Woodward, 1978, 159-193; Hofmann 1998). The second pattern was the technical innovation of copperplate engraving, using both the engraving burin and acid etching needle. While woodcut printing insured a very large diffusion of maps, engraving on copper allowed for an ever larger number of impressions which usually left the printer's shop in black and white. Except for the few experiments in color printing from copper, color was applied by hand after printing in most cases. The third pattern centers on the evolutions in the aesthetics of the map. Slowly the Dutch aesthetic which emphasized decoration and iconography was succeeded by a more spare aesthetic of exactitude and verifiability: the passage from the monster-filled map to the blank spaces on maps, as expressed by Jean-Loup Rivière (*Cartes et figures de la terre***,** 1980, 135).

Styles of coloring

In the middle of the 17th century two forms of printed map coloring or illumination existed side by side. The first, known as Flemish style, used pigments mixed with white in order to obtain an opaque color which resulted in lively shades of color, sometimes varnished, but which risked covering up printed details of the maps. (Ehrensvärd, 1987) and which aged badly. The second method, the Dutch manner ("*à la manière hollandaise*") used less pigment and no white in order to obtain a transparent color, whose delicate shades allowed the engraving to show through the color in all its detail.

During the 18th century two opposing types of applied color to maps developed: illumination (*enluminure)* and water color wash (*le lavis).* Illumination was used to emphasize a pre-existing design already printed on the map, not to add information to the map, while water color washes were used to add information to the plan or the map. **(Ill. 1)** However, this distinction was very theoretical and in practice these two types of map coloring rested on national traditions. Full color or full map illumination corresponded to German practices which consisted of coloring in full the various zones of a map (administrative regions, religious areas, countries, empires). **(Ill. 2)** This principle may have been fixed by the introduction to the *Museum Geographicum* (Hamburg, 1726) of Johann Hübner (1668-1731) [(Hübner, 1726, "Vorbericht" [12-14]]. Hübner specified outright that the use of color should be limited to significant elements on the map, explicitly excluding the cartouches and other ornaments. Coloring along the lines, which was very much in the French tradition, consisted of avoiding any color in full and only outlining the limits or boundaries with colored lines of various widths. These distinctions, though useful for making general statements, were not always clear among the mapmakers of the day, yet it provided the vocabulary used to discuss and advertise maps when they were produced.

Prices and participants

In 1662 the Latin edition of Joan Blaeu's *Atlas Major,* eleven volumes and 593 maps, one of the most expensive printed works of the 17th century, was offered in black and white for 350 florins and in color for 450, that is, a 30% mark up in price (Pedley, 2005; Hofmann, 1998) One hundred years later, the *Petit Atlas maritime* of Bellin (Paris, 1764) sold for 96 *livres* in black and white, 120 *livres* in color, or a 25% increase. For atlases and books, the difference between black and white and color depended upon the question of what constituted a beautiful book and the quality of its binding. Thus in 1762, Jean Lattré, geographic engraver and publisher sold an *Atlas Maritime,* which he offered "bound in morocco and watercolored, 15 *livres;* bound in calf, without color, 9 *livres."* [« Avertissement" *Atlas*

Moderne). Similarly in Amsterdam, the firm of Covens and Mortier offered its *Atlas Nouveau* comprising 166 Sanson/Jaillot maps in the following range: uncolored, 103 florins; illuminated, 117 fl.; doubly illuminated, 130 fl.; with cartouches and ornaments illuminated, 164 fl.; very beautifully illuminated with additional gold, 195 fl.) (Egmond, 2009, 230).

For single maps, one must rely on contemporary advertising for the price differences between color and black and white. Georges Le Rouge in Paris sold four maps in July 1756, the price for which in color (*lavée)* was 40-50% more expensive. There were other variables in the materiality of the map that also explain these differences: the application of color could require a different sort of paper. In 1749, Pierre Jandeau, Géographe du roi, sold a map entitled *Attaques, Plan & environs de la Ville d'Ypres, assiégée par le Roi le 6 juin 1744 & prise le 25 suivant.* « The price is 35 *sous* printed on paper prepared and beaten for watercolor wash; 30 *sous* on ordinary paper." (*Mercure de France*, sept. 1749, 173). Jandeau thus did not need to propose the separate application of color; the paper allowed the owner to apply color.

The price differences between the printed map and application of color to the map emphasizes two separate phases of map production. Coloring was carried out by an *enlumineur* or a *laveur,* who was not necessarily specifically trained but often a private person, dependant upon or independent of the map producer. As with the illumination of art engravings, certain authors perceived this as an amateur activity, as demonstrated by *A book of dravving, limning, vvashing or colouring of maps and prints, and the art of painting,…. Or, The young-mans time well spent* (London: 1660). The *Ecole de la mignature* (Paris, 1676, regularly re-edited until 1817) described illumination as carried out by "**religieuses (nun ?)"** or "persons of quality" living far from the Capital and desiring a useful activity. Its translation into Dutch by P.J. Verly in 1744 (Utrecht; Amsterdam, 1759) under the title *Verhandeling van de Schiderkonst in Miniatur,* contained a supplement relative to illumination of plans which the first French edition did not contain: "De maniere van de plans te Wassen" (130-138; Bosters et al., 1989, 108), giving specific instructions for map coloring. Such manuals were aimed at this genteel market. John Smith had similarly added a chapter for map coloring ("The Discovery of the Mystery of Back Painting Maps or prints…") to his popular title, *The art of painting in oyl* (London, 1687, 2nd edition). The art of "limning" or illuminating by outline and color, encouraged a continuous flow of instruction manuals throughout the long 18th century, with titles such as William Salmon's *Polygraphice, or, The arts of drawing, engraving, etching, limning, painting, washing, varnishing, gilding, colouring, dying, beautifying, and perfuming…, washing of maps, globes or pictures*, (London: 1672), William Goeree's *Verlichterie-Kunde, of Recht gebruyck der water-verven* (Amsterdam, 1668; re-

edited 1670, 1697, 1705), which attributes a color to every sort of object to be represented on the map (Bosters et al., 1989, 104-108). All these books bolstered amateur practice in map and print coloring.

Yet not all maps were colored by members of the reclusive gentry; the Homann firm in Nuremburg employed as many as 30 colorists to illuminate their map products, which were never sold uncolored (Diefenbacker, Heinz, 2002, 102). In London, the mapmaker Thomas Jefferys' apprentice, John Lodge, established himself specifically as a map colorist (*Public Advertiser*, 21 May 1761)), an occupation otherwise filled by fan-sellers, as well as printers and engravers themselves. (Clayton, 1997, 130). Even in North America, some specialization in map coloring was apparent from the accounts of Philadelphia mapmaker Mathew Carey, who employed colorists for his cartographic productions (Bosse, 2012, 32) Thus the "business" of color varied in nature and price from place to place.

The separation between engraving and the application of color could lead to a loss of control by the author of a map; after the map was sold, he could only complain about the results. These complaints reflect the tension between techniques of *lavis* and *enluminure.* Pierre Duval, nephew of **Nicolas** Sanson, denounced illuminators "who divide the Maps according to the dotted lines that they find one them and who often place the color against the rules of Geographie, as when they sometimes don't find any dotted lines but paint their brushes along the widest rivers or follow their own caprice and thus distribute large and small regions to Sovereigns of State based on their own whim." (*Traité de Géographie*, Paris, 1672, 58). Errors could also come from the bad choice of colors, as specified in *The handmaid to the arts teaching* (London 1758):

> "There is indeed one thing in particular…should be always avoided : it is, the laying those colours, that have any affinity or likeness, close to each other : for by an error in this particular, they will be rendered much less effectual with respect to the purpose they have to serve; … more difficult to the eye, to distinguish the limits and bounds they are intended to mark out : and indeed, besides, for want of due apposition, the diversification of the colours is made less pleasing, when they are seen at a distance and considered only with respect to their ornamental appearance." *(*329-330)

Such difficulty was not just hypothetical; two years earlier the *Gentleman's Magazine* published a discussion of the errors of John Mitchell's *A Map of the British and French Dominions in North America* (London, 1755):

> "We observe that you have drawn a line from Rockland in latitude 40 deg. On *Hudson's* River to the mouth of the *Lecba* branch of *Delaware* river in the latitude of 40 deg. 37 m. and call it *Limits claimed by New York*. This line is put upon an equal footing with the line called in your map, *Limits claimed by New Jersey*. Nay, if regard be had to the colouring of your map, greater credits is given to the line to the *Lecba* than to the latter line…" (*Gentleman's Magazine*, vol. XXVI, year MDCCLVI, pp. 287-288*)*

The numerous manuals of the period attempted to limit these difficulties as well as respond to the demand of "persons of quality." However, for a more detailed notice of the preparation and costs of color, a deeper apprehension of how color could create meaning on a map, one turns to the instruction manuals written for the large scale mapmakers.

Manuscript maps and Color

Parallel with the growth of manuals and instructions for map coloring in the printed commercial market was the publication of written directions for large scale mapmaking, for both private (property mapping, architectural drawing, civil engineering) and specialized public (military and administrative mapping) audiences. These manuals may be divided into two types: those which emphasize technique as much as the choice of colors, and those which attempt to normalize the use of color in order to simplify and clarify map use. An example of the first sort, concentrating on technical aspects of coloring, may be found in the work of Thomas Breaks, with instructions for manuscript large scale estate plans:

> "Having the Plan of a Gentleman's Estate, &c to wash, first begin with one of the Fields, and dipping your Pencil in the Colour you design to use, draw it along the Inside of the Lines, making the couloured Part of an equal Breadth ; you make it either broader or narrower, according to the Size of the Field ; then a dip a clean Pencil in a fait Water, and Draw it along on the inside of the couloured Part, washing down the Edge that the Colour may fade or die away down to the Paper, and appear strong next the lines. It is customary with Surveyors to wash each Filed with one intire Colour : This is left to the Discretion of the Surveyor." (Breaks, 1771, 446)

The second category of manual generally concerning manuscript maps and plans offered instruction for the coloring of three types of manuscript map: the *plan terriers* (cadastral or property maps), military maps, and large scale maps prepared for the engineering works in a region. The rule here was: "When time allows one to make an accurate drawing one should use colors to render the subjects of the map more distinct." (Ecole de l'officier contenant une méthode facile & abrégée de lever un plan sans l'usage de la géométrie ordinaire, un petit traité de

la fortification passagère, Paris, Claude Antoine Jombert, 1770, p. 9) The manuals also often provided instructions for fabricating colors. The manuals written for military personnel multiplied the methods of fabrication of color while taking into account the conditions of the terrain. And most especially these manuals aimed to codify the use of color.

Military mapping and color: imitation and meaning

In both the printed and manuscript instruction manuals aimed at military engineers, two important principles established certain typologies. One was the principle of imitation of an idealized nature, which cartography helped to delineate. The other was the principle of **normalization and codification** of color in order to lock the meaning of color into the map, and avoid the dangers of misinterpretation. The process of simplification by looking for the ideal color, which would sacrifice variability to the advantage of a type, allowed the establishment of a limited spectrum of colors within which each hue signified a particular meaning.

Thus Buchotte, an *ingénieur du Roi* proposed to imitate "natural color as much as possible, both in military and civil architecture, that is, the grassy areas in greenish-brown; water in sky blue; sandy areas in reddish yellow, framework structures the color of wood, tile roofs, red tinged with yellow; slate, a grey with a slight blue element…." (Buchotte, 1722, 45) Yet at the same time, a more abstract codification was becoming equally apparent, one which defined certain colors, like red and yellow, with specific roles. From 1680, in the "Instruction pour ordre à tenir pour les ouvrages par ceux qui y sont employés » the maréchal Vauban specified that « the engineer will prepare at the end of the year a rather large plan on which all the elements which compose it can be clearly distinguished: on this plan he will make sure to color with red all those projects which have been completed. Elements which remain only projected and for which work has not yet begun, will be colored with yellow, in order to distinguish them from the other, and the elements of the old plan or the old works which will be effaced by the new design, will be simply represented by dotted lines. This is a rule which one must follow exactly in order to avoid confusion that can be caused when the coloring of plans is done indifferently, with all sorts of colors, and one color could be taken to mean something else."

In 1722 Buchotte, followed by Louis Charles Dupain de Montesson in 1750 (*Le dessinateur au cabinet et à l'armée)*, reinforced the idea that repetition can become a rule. « It is not enough to know how to set down a line on plans and maps to have tried to manage the paintbrush ; one must understand the colors and what it is agreed that they signify in terms

of the different parts of a fortification, a landscape, etc." So again the color vermillion red was used for constructed buildings; "works projected or newly made are colored with *gomme gutte* or another shade of yellow," with each color being distinct enough to tell one color from another. These texts also offered in the form of a dictionary the link between an object to be represented on the map and the color to be associated with it, as in this example:

« Abbaye. Color the bell tower blue and the roof of the church in red with vermillion.

Arbre de remarque. Draw it a little larger than the others, observing its actual shape more precisely and give it a little brush of greenish-brown with the brush on the side of the shadow and with clear yellowish green on the side of the light.

Bourg. Design it in plan and color it with carmine, such as it will be and fill in any buildings with a half-shade, making sure to put a little cross on the church." (Buchotte, 1754, 173)"

In this same edition Buchotte also supplied the prices of colors and offered advice on where to purchase them (193-196).

Dupain de Montesson went further in the S*pectacle de la Campagne* (Part II, *La Science de l'arpenteur* (Paris, Jombert, 1775), offering a work in which all the colors and the natural and man-made forms they represented were displayed. (**Ill. 3)**

Towards normalization

The growing role of these dictionaries and manuals of colors extended beyond the domain of military engineers to the civil engineers of the Ponts et Chaussées (QV) in France. The contrôleur-général Orry, who helped establish the corps, in a circular memo of 1738 reiterated: "the parts of the roads which are paved should be colored in red, those which are metaled with stones in yellow, those of loose gravel in gray, and the parts of the natural terrain which has been left untouched by roadworks should be left blanc, whether these latter sections have been aligned or not. The copy of this map thus colored, with titles, legends and the usual significations, will be remitted to MM. the Intendants and sent on by them." (*Mémoire instructif sur la réparation des chemins,* par Orry, Versailles, 13 juin 1738, article 21, Paris : l'Institut de France, Ms 489/Fol 415:.)

In the same way, property mapping efforts throughout Europe worked towards a codification of color. In northern Europe from the early 17th century, the question of color

was considered important enough that in 1636, surveyors were given instructions for standardizing colors: "Cultivated fields were to be colored gray, meadows green, mosses yellow, fences back, lakes light blue, rivers dark blue, boundaries red, forest dark green, and stony slopes white." (Kain et Baigent 1992, 52). In Great Britain, where property surveyors were producing plans from the end of the 16th century, the same sort of codification was being set in place, as demonstrated by *Albert Durer Revived* (London, 1697, 12): "Red-lead is the nearest to an Orange colour, and putting a little yellow berries into some of it, it will make a perfect Orange colour, but if you mean to make flesh colour of it, you must put no yellow, but only then when you would make an Orange colour. This colour is used for colouring of Buildings, or High-ways in Landskips, being mixed with a little white."

By the 18th century, the standardization of color became normative practice in the creation of large scale manuscript maps made for specific purposes. Codified color increased legibility and understanding on the part of the map reader and thus facilitated decision making and planning. Color, in its tangible forms of pigments, water, and brush, was a technical tool for the map maker along with paper, pencil, pen, and ink, brush and water for grey washes. Each tool was employed to create meaning for every element of the map.

By contrast, the printed map, which was dominated by maps created at medium to small scale and designed to meet the needs of a much more general audience, did not employ color as part of the map-making apparatus but rather as an additional enhancement of meaning which had already been signified by the use of font, line (dotted, solid, stippled), and symbol, all of which were engraved on the copperplate with burin or needle, inked with black, printed on white. Color served essentially to highlight printed meaning, until the last quarter of the 18th century when thematic mapping made greater demands on the palette.

Between expansion and limitation

The eighteenth century closed with two paradoxical developments in the use of color on printed maps: an increasing use of color on thematic maps and an absence of color on printed military maps. Only during the latter part of the 18th century, when various forms of thematic mapping (qv) were becoming more common with the growing interest in the distribution of natural and man-made phenomena in space, was color employed in a meaningful way, a way in which color signified something beyond what was already printed, a use of color also helped by early experimentation in color printing. In general, thematic maps printed in the last quarter of the century continued to add color, often according printed

keys or legends on the map, to the black and white outline of the map. In the *Esquisse du genre humain…"* by Marie Le Masson Le Golft (Paris, 1787) leans towards the use of color in imitation of nature by coloring different regions of the world according to the skin color of the inhabitants. Yet leaving areas white on this map does not signify a lack of information, as it did on earlier maps, but reflects the color of the skin of European inhabitants, thus giving white a "natural" meaning. **(Ill. 4)**

Similar maps employing added color to emphasize spatial distribution of phenomena may be found in other map publications in Europe, as in Italy for the distribution of doctors around Pavia (1782, Giuseppe Cicognini), in Austria for the distribution of ethnic groups and language (1791, Johann Matthias Korabinsky). Color could dramatize political themes and nationalist aspirations, as with the multi-colored "New and Accurate Map of the English Empire in North America Representing….the Encroachments of the French with the several Forts they have unjustly erected" (London 1755), which displayed the French forts as white pockmarks on the vividly hued English claims. **(Ill. 5)** Growing interest in geology and the spatial distribution rock formations also focused attention on color and its deployment as a meaningful cartographic symbol. Initially, the principle of imitation of nature was employed in the earliest of geological maps, produced primarily in the German states (QV Thematic Mapping in the German States) on which colors signified types of rock by imitating the shade of the rock itself. Professor A.G. Werner of the Freiburg Mining Academy produced an unpublished *FarbenTafel* for his students to use based on imitation; it contrasted with the more theoretical proposal of Johann Wolfgang von Goethe (1749-1832) whose amateur enthusiasm for geology led him to develop a theory of color (*Farbenlehre)* which based the colors of rocks not as much on their appearance but on their origins and the harmonic arrangement of colors, thus pointing towards a stratigraphic color scheme based on age. Goethe's theoretical work strongly influenced the coloring on Christian Keferstein's *General Charte von Teutschland* (1821) (Schäffer-Weiss and Versemann, 2005)

By contrast both to the use of thematic color added to printed maps and to the long tradition of color use on manuscript military maps, especially in France, color was denied a role on large scale printed military maps known as the *Carte d'état major.* In 1801 the Commission de topographie (QV) which oversaw the production of this new map ruled out color as an element on the map of France. The debates concerning this question were published in the *Mémorial topographique et militaire* (1801), in which the argument is clear:

> "They say that colors make clear what lines leave in doubt. Is color necessary? The line alone is insufficient; it deceives [the eye]: a missing color allows the error to stand. The horizontal line, by contrast, done in full or **dotted** never deceives the eye: it is sufficient for rendering escarpments, for the overhangs of routes through hollows, for ravines… "

The relationship of color to cartography permeated different aspects of map production throughout the period of the Enlightenment. From the most material aspects of the map (paper, manuscript tools, engraving procedures, costs, workshops and artisans) to the consideration of question of which colors, what they represent, and their **normalizatio**n, to the construction of the meaning white or blank space as nothing (a lack of information) or something (significant information for which no color is required).