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The Wax Engraving Print-Making Process: A Commercial Success

The name wax *engraving* is misleading, because this is a relief printing process. David Woodward's book, *The All-American Map: Wax Engraving and Its Influence on Cartography,* is a wonderful record of the technique and the most important source of information for this article. This technique was an important American commercial map printing technique for nearly a century, from the mid-1800s to the 1960s.

Sidney Morse patented wax engraving in the United States and called the technique "cerography." This is sometimes spelled with a *k,* "kerography." In England the process was called "glyphography." Other terms for this process include: "electrotint," "galvanoglyphy," and "typographic etching."

Although most often used for map printing in the United States, it is important to note that this technique was originally intended to be for artists. It was supposed to offer great freedom to the artist because it allowed the drawing on the plate to be a positive image, not the negative image made in the intaglio process. It never did become popular with fine artists, however. Only one famous artist, George Cruikshank, used wax engraving, for an edition of prints called *The Bottle.* The technique was used for illustrations and technical drawings and was more popular in Europe than in the U.S. for those purposes.

In his book on wax engraving, Woodward expressed his opinion that wax engraving was especially successful for maps because the technique easily combined line and text in the same image. The map of Minnesota example (fig. 1) was wax engraved by Emery Walker, a member of the British Arts and Crafts Movement and the man who did all of the maps for the eleventh edition of the *Encyclopedia Britannica.* Only one square inch of the map is in the illustration.

The complete wax engraving process included drawing the positive image on a wax-covered plate and then casting the master printing plate from that electrolytically. The diagram in figure 2 shows the relationship between the waxed drawing plate and the electrotype. The process

Fig. 1. Map of Minnesota engraved by Emery Walker for the *Encyclopedia Britannica.*

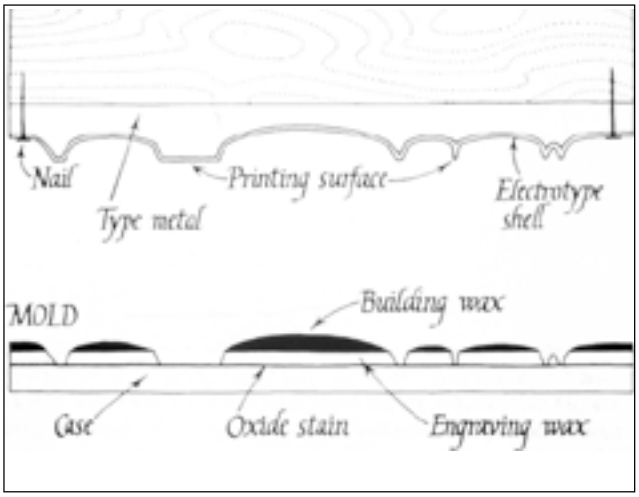

Fig. 2. Diagram showing electrotype (top) and wax engraving (bottom). From Woodward.

started with a clean, polished copper plate, called the case. The first step was making the surface of the copper plate black. Sometimes this was done by converting it to copper sulfate. The black surface had two purposes. One was to facilitate the drawing process by making the image more visible. The second was to keep the electrotype, formed later in the process, from bonding directly to this copper plate.

Next, a thin coat of engraving wax, a white-colored material, was put over the blackened surface. The recipes for this engraving wax were kept secret. Each engraving company had its own recipes and different formulas would be used for summer and winter. This was a crucial element in the process. It needed to adhere very well to the plate and it couldn't be so brittle that it chipped when cut. The basic ingredients were beeswax, Burgundy pitch from Norway spruce bark, and zinc oxide. The waxing was done by advanced, skilled workers because the coating had to be very thin and uniform. The engraving wax layer could be as thin as 1/250 inch thick.

Fig. 3. Partly built up plate.

Images could be drawn directly onto the plate or could be transferred to this white layer by tracing, or later by photography. Different materials were used in the tracing/transfer process including carbon paper and red chalk. Prints could be transferred to the plate by pressing them while wet onto the wax surface.

The image was cut into the wax layer without disturbing the black layer. Gravers of varying widths were used and were fashioned to make a variety of thin, thick and double parallel lines. The handles of these gravers were thin and delicate because very little pressure was required to engrave wax. Tools similar to etching needles could also be used. Wheels with various symbols in them were used to make boundary lines. The plate was kept warm while the engraver worked. Straight lines could be hand ruled but were usually done on a ruling machine. Parallel lines could be made very fine and close to make tinted areas. Usually 100-150 lines per inch were done for this purpose. Broken and dotted lines could also be done on this machine.

In the early maps of Sidney Morse, lettering was hand engraved. Later, type was done by stamping into the wax with commercially produced tools. In fact, the biggest competitive edge for wax engraving was that line and type could be combined in the same relief printing plate. The type used was sometimes as small as three points. Even a square inch of map could hold a tremendous amount of information, as seen in the detail of a map with stamped type in figure 1.

When the image was engraved through the wax layer on the plate, that layer was not deep enough to cast a functional printing plate so the wax was *built up,* or additional wax was added between the engraved lines. Building wax was used as sticks that were melted with a building iron in minute amounts onto the plate. This would result in hollows in the electrotype, cast from this waxed plate, deep enough to make inking the printing plate easy. Small spaces, less than a few hundredths of an inch wide, were not built up. Figure 3 shows a partially built up plate; the wax is thicker in the upper right corner. The verso and sides of the copper plate were also coated with wax.

The engraved and built-up plate was then covered with a dusting of graphite. A thin layer of copper was chemically applied. Then the plate was ready for the electrodepositing tank. The plate was the negative electrode and bars of pure copper were the anodes. The solution was dilute sulfuric acid. A copper shell was slowly built on top of the wax image.

The cast copper shell was separated from the wax plate mold using hot water and then the copper casting was backed with type metal and wood. Figure 4 shows the cast copper plate of the image prepared in figure 3. A large wall map could consist of up to 125 pieces attached to separate wooden bases. This was the master plate from which subsequent printing plates were made. In colored images each color would have a separate plate.

Fig. 4. Cast copper plate of the image in figure 3.

How does one identify a wax engraving? One characteristic is that the lines in a wax engraving do not vary. A line remains the same thickness throughout the length because of the tools and light pressure used in making it. Double lines remain parallel because of the double graver. If a line varies in width, it is intentional—as the diminishing lines for rivers in figure 5.

Point symbols, like state capital and county seat marks, are sharply defined and regular in shape because they are always made with the same tool. Wax engraving could be the source of this cartographic convention and the reason we recognize the symbols so easily today. The same symbols were continued into lithographic maps. Lines that were a series of symbols such as dots, dashes, and crosses were made using tools with wheels of those symbols.

Color was made in large tinted areas by using series of parallel thin lines. These were accomplished on the ruling machine. Wax-engraved ruled tints usually have a wide band surrounding them. This band helped protect the fragile ends of the lines, even in the final printing plate (fig. 6).

In the earliest wax engraved maps hand lettering was done but gave way to printer's type. If there is one characteristic that wax engraved maps gave to cartography, it could be the preponderance of names on these maps. The minute type possible in wax engraving made the inclusion of more names easier. Many comparisons between early offset lithography and letterpress work contain the word "sharp" to describe the relief process. Another characteristic for identification is that this is a relief process, so the squeeze of ink at the edges of the type will be there.

Registration in multiple-plate wax engraved images, such as colored maps, was a problem. Figure 6 is an example. This could be blamed on the printer or it could happen because slight shrinkage occurred when the electrolyte shell was backed with molten metal. The plate would shrink when it cooled, a process difficult to control.

Another characteristic of relief printing techniques is that they emboss the paper. Wax engraving was used primarily for commercially printed images so the paper is often not good quality. The print paper will have this characteristic impression if the printing force was great enough to emboss the paper. This will be more apparent where

Fig. 5. The diminishing lines representing rivers are intentional; the lines of a wax engraving do not naturally vary in width.

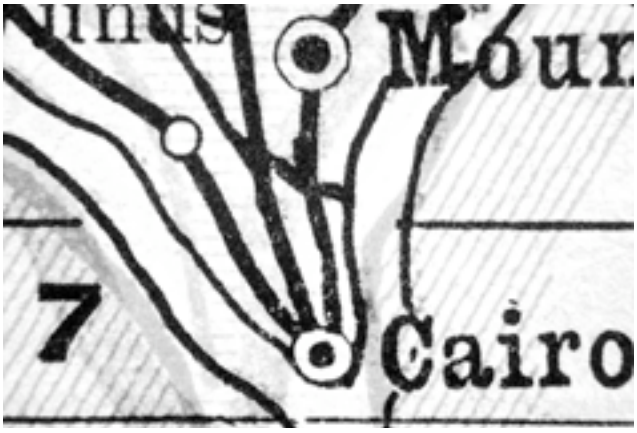

Fig. 6. Ruled tints in a wax engraving usually have a wide band around them.

more than one plate has been used to make the image, as in a color map. The corners where the paper was pressed multiple times will be embossed. Of course, to the publisher, one of the advantages of wax engraving was that it could be printed on poor quality paper. Ink squash, paper indentation, consistent symbols, regularity of lines, and line tint colors (both dots and solid lines) are all characteristic of wax engravings.

With regard to treatment, one concern is that the relief plate used for wax engraving is so shallow, the plate impression could easily be reduced or destroyed in treatment. Any pressure used should be minimal. This is problematic in light of the fact that these prints are often on poor quality paper. The amount of pressure required to flatten the paper will need to be carefully balanced against the amount of pressure that will obliterate the plate indentation.

The inks are very unpredictable. In general, the inks seemed to be stable in water, but one black ink tested did lift when water was applied. "Lift," in this context, means particles lifted onto the test blotter when the ink was wet. The black inks did not bleed into the paper. As expected, many of the colored inks were affected by organic solvents. Ethanol and acetone caused several colors to lift or bleed, but this was not predictable. Some colored inks were stable in water, ethanol, and acetone.

Many wax engraved maps were printed on cheap paper. That could mean, very hard finished, glossy, or filled papers that do not absorb water readily. This combination of paper that will not absorb water, and inks that could be soluble in ethanol, can make these maps challenging to treat.

REFERENCE

Woodward, David. 1977. *The all-American map: wax engraving and its influence on cartography.* Chicago: University of Chicago Press.

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