

THE DEVELOPMENT OF LITHOGRAPHIC CARTOGRAPHY  
AND THE  
CONSERVATION TREATMENT OF A LARGE VARNISHED MAP

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The discovery of lithography was significant to the history and development of cartography. Prior to the birth of lithography at the turn of the 19th century, most maps and atlases were produced by engraving - a technique that requires much skill and labor. Engraved maps were rare and relatively expensive. Lithography offered a cheaper and quicker way to reproduce maps and other images.<sup>1</sup>

The lithographic process was discovered in 1796 by Alois Senefelder in Munich. The development of the new technique is well documented in Senefelder's manual, A Complete Course of Lithography. This unabridged English version was published in London by R. Ackermann in 1819. The book is an encyclopedia of various materials and methods used in lithography.

In the planographic process, the image is drawn or traced on the stone with a crayon or pen and ink. The stone is then etched with a solution of nitric acid. The etch increases the contrast between the inked and uninked areas on the surface by increasing the porosity and water absorbency of the uninked areas. A wash with gum arabic following the etch protects the uninked areas from ink penetration, and thus prolongs the life of the stone. When an inked roller is passed over the moistened surface, the ink is accepted by the drawn image, and repelled by the moistened areas. As Senefelder puts it, "... the reason why the ink, prepared of a sebaceous matter, adheres only to the lines drawn on the plate, and is repelled from the rest of the wetted surface, depends entirely on the mutual chemical affinity, and not on mechanical contact alone."<sup>2</sup>

This planographic process of lithography was not used exclusively in the early years of the new art. Lithography started as a series of

imitative processes that had only the stone in common.<sup>3</sup> One of the techniques developed by Senefelder, which he calls the engraved manner of lithography, is an intaglio not planographic process. Almost all European maps printed from stone prior to 1820 were produced by this intaglio method.

In his book, Senefelder instructs the reader in the engraved manner of lithography; the woodcut manner; and the etched and aquatint manners. To imitate the look of a woodcut, Senefelder suggests that the dark areas be completely covered with ink, and the lights removed with an etching needle. This process is actually more akin to wood engraving. To make a lithograph in the engraved or etched manner, the stone is covered with a ground of gum arabic colored with lampblack or red chalk. The image is then engraved with a burin, as in engraving; or incised and etched, as in etching. None of these processes is planographic. In the woodcut technique, the image is in relief on the stone; while in the etched and engraved techniques, the image lies beneath the stone surface as in intaglio printing.

Presses with special features were designed by early lithographers to meet the demands of the new process. However, many lithographers adapted presses designed for copperplate and letterpress printing. The wooden star wheel press was popular in the 1820s. Operation of this press involves pulling the bed to which a tympan is hinged across and between two cylinders. Pressure is exerted with a treadle linked to a lever. By the middle of the 19th century, automated metal presses had replaced hand presses at most lithographic shops.<sup>4</sup>

By about 1825 the planographic method was accepted as the most natural way to print from stone. But for works requiring greater precision of line such as maps and mechanical drawings, engraving and etching in stone continued to be done.<sup>5</sup> Senefelder himself became involved in lithographic cartography in 1809 when he was appointed head of the Bavarian Cadastral Survey. He supervised the preparation of maps regulating land distribution, ownership, and taxation. The process used by the Cadastral Survey was an adaptation of stone engraving. Senefelder explains "...while the stone can be wrought rather more expeditiously and easily than copper; for fine writing and maps, it is peculiarly

well adapted as the number of lithographic maps published sufficiently prove."<sup>6</sup> Between 1809 and 1853, the Bavarian Cadastral Survey issued more than 20,000 different maps.<sup>7</sup>

This was not the case in America, however. Two decades of lithographic printing had already run their course before the process was even introduced to the United States. The period from 1818 to 1850 is characterized by America's heavy dependence on European lithographers.<sup>8</sup> The first American lithographic map was produced in 1822 by the firm of Barnet and Doolittle in New York. The map, "Barton on the Catskills" illustrates an article entitled "Notice of the Geology of the Catskills" by Barton that appeared in The American Journal of Science and Arts, 1822. Barnet and Doolittle exemplify typical American lithographers. Both were trained in Paris where they bought a supply of Bavarian limestones and other materials with which to stock their shop in New York. In general the entire practice of lithography was imported in this way to the United States. Few American contributions were made to the craft between 1820 and 1850. The thousands of Americans who were practicing lithography by 1850 used European manuals, Bavarian stones, and European presses.<sup>9</sup>

A technique developed by Senefelder that proved to be particularly useful in cartography in the 1840s was transfer lithography. In this method, the image is drawn directly on special paper rather than in reverse on stone. Prior to drawing, the paper is coated with a ground of glue, gum tragacanth, gamboge, common starch, and French chalk. The ink used, called "chemical ink" by Senefelder, is composed of tallow, soap, shellac, lampblack, and wax.<sup>10</sup> To transfer the image from the paper to the lithographic stone, the paper is dampened with dilute nitric acid, and run through a press with the image in contact with the stone surface. The stone is then etched with nitric acid, and the paper is removed. The transfer process enabled cartographers to prepare their maps on paper, sparing themselves the inconveniences of transporting cumbersome stones, and drawing in reverse. Senefelder himself, in 1818, recognized the value of the transfer technique, calling it "the principal and most important part of my discovery. In order to multiply copies of your ideas by printing, it is no longer necessary to write

in an inverted sense."<sup>11</sup>

By the middle of the 19th century, the American mapmaking industry exploded. This explosion occurred as a result of technical advances, mainly the advent of transfer lithography, and social developments. The growing railroad, canal system, and burgeoning westward movement demanded the making of maps; and the tripling of the population of the United States between 1810 and 1850 increased the pool of consumers. The aim of the typical lithographic map publisher at this time was to make good maps which would be available to potential users at a low cost.<sup>12</sup>

Robert Pearsall Smith of Philadelphia was a leading publisher of lithographic maps at this time. Between 1847 and 1864 he issued some 400-500 editions of city, town, and county maps. He supplied local surveyors with special transfer paper and ink; and then contracted with various lithographic shops in Philadelphia to print copies. Smith would retain copyright and other privileges from the surveyors in exchange for a specific number of maps.<sup>13</sup>

The large wall map treated at the Art Conservation Department was copyrighted by Robert Pearsall Smith in 1852. The map of Oneida County, New York, is based on surveys by A.E. Rogerson and E.J. Murphy. The image was produced using lithography, very likely transfer lithography, and printed on two sheets of paper joined horizontally through the center. The boundaries of townships are accentuated with watercolor, and there are pale watercolor washes within some of the boundaries. The yellow pigment used is gamboge. Views of county landmarks as well as plans of cities in the county are added near the edges. The whole composition is surrounded by a decorative border in a style somewhat reminiscent of a woodcut, while the decorative scale resembles an etching.

The poor condition of the map is typical of large lithographic wall maps of the mid-19th century. The paper support was adhered to a fabric backing with a starch-based paste, and fastened to wooden rods along the top and bottom edges. The top quarter and right edge of the map were badly stained. It appears that the map was water damaged while rolled - the top of the map being most severely affected as it

was the outermost layer of the roll. There were many tears, splits, and creases in the support that had been chiefly caused by rolling. The edges were severely damaged, and the paper there was in tiny fragments supported only by the backing fabric. The map was covered by a thick varnish film that had darkened to the point that it obscured the image. The varnish was found to be soluble in ethanol, and to fluoresce orange in ultraviolet light.

It is likely that the preparation of the paper prior to printing included a surface sizing step. The presence of a starch surface size has been confirmed on the paper supports of two other large varnished wall maps produced in the 1850s. It is possible that such a size layer might contribute to the dark appearance of these maps.

Maps like this one pose several treatment problems which will be illustrated in the following discussion of the treatment of the map of Oneida County. The obvious problems are the overall poor condition, and the large size. The Oneida County map is 54 x 42 inches. A less obvious but equally challenging problem is the safe removal of the varnish layer.

Spirit varnishes such as mastic, sandarac, and dammar were commonly used to coat maps. Shellac is found on them as well.<sup>14</sup> Since the varnish on the map of Oneida County was readily soluble in ethanol, it was decided to remove the film with swabs soaked in ethanol immediately following washing in water. The water wash was proposed as a first step so as to remove water-soluble degradation products and dirt before treatment with ethanol. It was proposed that the varnish removal be done with the map wet. This would reduce the tendency of the dissolved varnish to form tidelines as one might expect if done when the was dry.

After photography, the treatment was begun. The staples that had fastened the top and bottom edges of the map to the rods were carefully removed. The front of the map was dry cleaned with a powdered eraser (Scum-X, Dietzgen). A fixative of 10% Acryloid B 72 (Rohm & Haas) in xylene was applied in two coats with a small brush to the gamboge outlines of the townships. This was done in the hope of preventing or minimizing the solubility of the gamboge by the ethanol.

With the map face down on a sheet of 5-mil Mylar, the backing fabric was removed dry. The fabric was carefully separated in small strips from the paper. The many tears in the support were bridged with tiny mends of surgical tape (Micropore, 3M) as they were uncovered.<sup>15</sup>

A special sink was constructed as the one in the paper lab was too small. It had as a base a 5 ft<sup>2</sup> board to which four 2 x 4's were clamped to form walls. The wood structure was lined with 6-mil polyethylene sheeting.

Face down, the map was misted with water. A second sheet of 5-mil Mylar was placed on the back of the map. The Mylar-map-Mylar sandwich was placed face up in our specially constructed sink that had previously been filled with tap water (rich in dissolved carbonates). The map was bathed for one hour. It was occasionally squeegeed through the Mylar to help extract soluble degradation products from the paper. After washing, the sink was tilted slightly to make removal of the discolored water easier using siphons and sponges.

The top sheet of Mylar was carefully removed from the map. With the sink still tilted, the varnish was then removed with large cotton swabs soaked in ethanol. The swabs were gently moved over the surface in a circular pattern so as to remove the varnish and grime layers without disturbing the paper surface or media. The entire surface was swabbed with ethanol twice to ensure that all of the varnish had been removed, and then the map was given an overall rinse with the solvent. The dissolved varnish and used solvent were then siphoned from the tilted sink.

The Mylar was returned to the front of the map, and the sink was filled again with tap water. The map was bathed for another hour. Some white varnish residues could be seen in the wash water. The water was drained off as before once washing was complete.

The Mylar-map-Mylar sandwich was removed from the sink and placed image-face-down on the table. The sheet of Mylar in contact with the back was carefully rolled off. The tiny surgical mends were removed with tweezers. During this operation the map was occasionally misted with water to prevent it from drying out.

The map was then backed with two pieces of heavyweight Japanese

paper, okawara, which were positioned so that they slightly overlap where they meet at the center. The overlapping edges had been water-cut. The adhesive used was wheat starch paste (Aytex-P, General Mills). A sheet of polyester web (Hollytex 3261) was placed on the backing, and the map was turned over. The Mylar on the image side of the map was removed, and the map was allowed to air dry.

The map was stretch-pressed in order to flatten it when it was dry. Briefly this procedure entailed lightly misting the map with water from both the front and back. Strips of blotting paper and Hollytex were placed under and on top of the edges of the map. Narrow lengths of plate glass and then weights were placed on the edges of the map with the blotting paper and Hollytex strips acting as cushions. As the map dried, the paper support contracted under pressure at the edges, and this procedure helped to lessen the distortion in the support.

Losses in the map were compensated on the backing paper with colored pencils (Prismacolor, Berol). No attempt was made to recreate areas of missing image. Unfortunately, but predictably, most of the gamboge was lost during the ethanol treatment. The yellow outlines were replaced with colored pencil.

The map was encapsulated between two sheets of Mylar, 5-mil, joined at the edges with double-sided tape (#415, 3M). An inch-wide extension of the backing paper was retained at the top and bottom edges. The top extension was adhered to the Mylar with double-sided tape to keep the map from slipping within the encapsulation. The top and bottom edges of the Mylar were fastened to the original rods with brass tacks through the backing paper extensions. Strips of 6-ply mat board were placed between the Mylar and tacks to prevent tearing.

The aim of our treatment was basic preservation, and to this end it was successful. In addition the appearance of the map was greatly improved by the treatment. With the disfiguring varnish removed, and the water stains reduced, the map now approaches its original appearance. While these lithographic wall maps may not appeal to everyone's taste, their historic and graphic value makes them conservation priorities.

#### ACKNOWLEDGEMENT

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NOTES AND REFERENCES

- <sup>1</sup>Walter W. Ristow, "Lithography and Maps, 1796-1850" in David Woodward, editor, Five Centuries of Map Printing (Chicago: The University of Chicago Press, 1975 for the Hermon Dunlap Smith Center for the History of Cartography, The Newberry Library), p. 77.
- <sup>2</sup>Alois Senefelder, A Complete Course of Lithography (London: Ackermann, 1819; reprinted, New York: Da Capo Press, 1968), pp. 93-94.
- <sup>3</sup>Michael Twyman, Lithography 1800-1850, The Techniques of Drawing on Stone in England and France and Their Application in Works of Topography (London: Oxford University Press, 1970), p. 64.
- <sup>4</sup>Ibid.
- <sup>5</sup>Ristow, "Lithography and Maps", p. 79.
- <sup>6</sup>Senefelder, A Complete Course of Lithography, p. 277.
- <sup>7</sup>Ristow, "Lithography and Maps", p. 80.
- <sup>8</sup>Ibid., p. 104.
- <sup>9</sup>Peter C. Marzio, "American Lithographic Technology before the Civil War", in John D. Morse, editor, Prints in and of America to 1850 (Charlottesville: The University Press of Virginia, 1970), pp. 215-221.
- <sup>10</sup>Senefelder, A Complete Course of Lithography, p. 121.
- <sup>11</sup>Ibid., p. 256.
- <sup>12</sup>Ristow, "Lithography and Maps", p. 106.
- <sup>13</sup>Ibid., p. 112.
- <sup>14</sup>Information on the various coatings used on maps is given in an unpublished paper prepared at the New England Document Conservation Center prior to 1979.
- <sup>15</sup>The tape was tested prior to use. It was found to be insoluble in water and ethanol. There was no adhesive residue following tape removal.