

TOPOGRAPHIC MAP REPRODUCTION TECHNIQUES *

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TOPOGRAPHIC map reproduction techniques have shown a tremendous advance as regards our efforts here in the R.P.C. of the Metropolitan District from a lowly beginning in the middle 1930's down to the present day production type programs. The reproduction of topographic maps as well as street maps is of course an integral part of cartography and the cartographer spends many hours collecting data such as property information, building classifications, street layouts, highway lines, drainage pipe sizes and many other details. His efforts will be of little avail if the map is not representative or fails to meet critical deadlines.

It is the purpose of this paper to describe the reproduction techniques and by that, of course, I mean the four color topographic map sheets, the original of which in the early 1930's was on double elephant drawing paper glued to a thin aluminum sheet for stability and the map was drawn in the field by plane table methods.

It was decided then to reproduce these finished contour maps in color as had been done previously by the R. H. Randall Company for the town of West Hartford. Quarters for our newly formed organization (R.P.C.) were limited but we were fortunate to have allocated to us a small area adjacent to the laboratory used by the city chemist. This gave us an opportunity from time-to-time to test out some of our theories as to emulsions, and also gave us access to a large sink in which we developed our proof prints — but more of that a little later.

Being a municipal corporation type of organization, we were beholden to the taxpayers for whatever monies were allotted to us for salaries, expenses, etc., so that we developed, from necessity, a do-it-yourself attitude, some of which has carried over to the present day.

After the decision was made to use glass as a base for the scribing media, we designed and had made up by one of our more versatile rodmen, several light tables using incandescent bulbs for illumination and several scribing tools made by another employee adept at whittling. These holders were made from survey stakes and inserted in the ends were phonograph

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needles some of which were ground to a chisel edge for heavier line widths to show street lines and buildings. The fine pointed tools we used for property lines, water lining and 2-foot contours. The tool that gave me the most trouble at that time was a contour pen with a phonograph needle ground to a chisel edge and held in place between the nibs of the contour pen by a heavy elastic rubber band. This we used for scribing the heavier 10-foot contours. Many times I can remember starting a 10-foot contour making sure that my angle of projection was correct only to have it skid off the plate after completing one curve of the contour.

We were fortunate at this time to have available the services of an off-set lithographic printing plant whose personnel were interested in our problems and whose advice and cooperation were extremely instrumental in bringing about a successful solution to the problem of producing 4-color (or three colors and black) topographic map sheets in numbers. Incidentally, these maps are on a scale of 1 in 2400 with one and two-foot contours.

After we had mapped a sheet in the field by plane table showing contours and physical features and had located on it many of the critical points such as highway bounds, property corners, etc., in order to aid us in plotting property lines, highway lines, etc., on the field sheet itself, we set out to prepare the sheet for photography. The first thing that we had to do was to clean off some of the grime that had accumulated in the field, then to heavy up some of the contour lines, etc., which might have faded or might have been the result of reluctance on the part of the plane table operator to bear down on his 8H drawing pencil.

The editing of the map was the next procedure and for street names, border printing, house classifications, contour numbers, etc., we went to a local printer and ordered different pre-determined type sizes to be printed on glossy white paper for contrast using paper cement to adhere the printing to the original. Finding this a rather tedious job, we decided to have the next lot printed on gum backed paper. A wood symbol was drafted on an $8\frac{1}{2}'' \times 11''$ sheet and these were then printed in quantity for future use. An aluminum sheet was coated with enamel paint and after the topographic sheet perimeter was projected on it the wooded areas were then traced off in their proper positions on this enameled sheet and the wood symbol sheets were cut out and fitted to these areas giving the lithographer an original "green" sheet to photograph. The press plate being made from the negative meant that no scribing was involved here.

The next step was to ship the "hardback" which had been readied for photography to the lithographer. They would then prepare $3(\frac{1}{4}'')$ glass

plates size 24" × 30" for photography using the wet plate process which necessitated the following steps:

The glass was first washed with a powdered cleanser, then flowed with albumen and set to dry. After drying, the glass was flowed with a solution of iodized collodion. When the collodion had set, it was submerged in a silver bath to make it light sensitive and the plate was then placed in the camera for exposure. The exposed plate was flowed with iron sulphate developer and developed for 20 seconds. The plate was then washed thoroughly in running water and fixed with a solution of sodium cyanide. After washing, it was intensified with copper sulphate. After washing, it was blackened with silver nitrate. Again washed and blackened with sodium sulphate. After another washing, it was flowed with a 20% solution of gum arabic and set to dry.

Upon receiving these three glass negatives, we then brushed on an opaque composed of asphaltum, bee's wax, castor oil, gum arabic and turpentine. We then chose one negative for the black color, that is, border printing, street lines and names, house classifications, property lines, culvert sizes, manholes, catchbasins, fences and power lines. One negative for the brown color which would include contours only and one negative for the blue color on which we indicated water courses, swamps, culverts, water lining of rivers and ponds.

Using turpentine and a thin brush, we then dissolved out the opaque which covered the printing for whatever color we had designated for the glass negative.

We were now ready for scribing and in order to insure the best accuracy possible, Beebe Binocular Loupes were used originally by our scribes and were non-adjustable, being later replaced by a Bausch and Lomb Dualoupe binocular magnifier which was designed to eliminate, insofar as possible, the difficulties previously encountered. The Dualoupe was made so that it could be adjusted for any individual using it, and could be used as an ordinary pair of spectacles during the part of the procedure where a magnified view was unnecessary. At the time the Dualoupe was purchased, the user could have his regular ophthalmic correction mounted in the eyewires and the interpupillary distance and bridge adjustments made.

The Dualoupe gave magnification of about three times at the focal distance of the lenses, which is approximately 140 mm. from the eyewires and 65 mm. from the front lenses.

After scribing with the tools which have already been mentioned we set about to find ways and means to obtain a proofprint of the three negatives combined to show whether or not it contained omissions or showed

bad register in areas inside the border, the photography being so carefully done that we nearly always found the corners to be nearly perfect. Using a piece of unexposed blue print paper, we exposed each of the three negatives for about 40 minutes, using incandescent bulbs and we finally cut it down, as I remember it, to about one-half that time using photographer's flood lamp bulbs. We then washed the exposed blue print paper and came up with a reasonably good blue line proof print.

As time went on, it became more and more apparent that storage of the glass plate negatives was becoming a major problem. It was thought originally that we might make revisions on the negatives by opaquing out the areas to be changed and re-scribing these changes. This did not prove to be practical.

After World War II, with its resulting building boom and the gradual move to suburban areas, the demand for topographic maps and up-dated street maps became increasingly apparent. Thus the need arose for a suitable engraving medium to be placed on a flexible material which would minimize the problem of breakage and storage and yet provide the desirable qualities of definition and precision offered by a dimensionally stable base such as glass.

Then, in order to increase the pace and lower the costs of topographic mapping, we finally went to aerial photography and found the answer. This skill was developed rapidly during World War II and after.

The original manuscript which we now receive from our aerial survey contractor and compiled by photogrammetric methods is on .007" Cronaflex Drafting Film, matte both sides, compiled with red, blue, green and black Mars J. S. Staedler lead pencils. From this original is made an autopositive on .004" sensitized (silver emulsion) Cronaflex Drafting Film, matte both sides. Black line Ozalid preliminary copies are made from this autopositive.

Register tabs are taped to the original manuscript using fibre alignment tabs "K" controlled by two alignment pins base No. 2 pin letter D. All other negatives or positives are registered to the original manuscript insuring perfect register.

A right reading image transfer of the manuscript is then made on to a piece of K and E Stabilene Polyester Film coated with a .0006" scribe surface sensitized for Helios Dry Diazo Black Line Reproductions, K and E No. 45 3067, rust colored, 21" \times 27" \times .0075. This image is transferred by exposing for four minutes in a 30" \times 32" contact pressure frame called a "Direct Blacklite Printer" with twelve, 20-watt, ultraviolet, fluorescent tubes and developed in ammonia vapor fumes for about five minutes.

Property research is made and all the information is scribed directly on this right reading image Scribecoat, providing a dimensionally stable permanent, reproducible record of all lines and their dimensions. Blue line copies can be made by exposing to blueprint paper.

The scribed properties are transferred to sensitized Scribecoat, reverse reading by exposing fifteen minutes in the Blacklite printer, resulting in white lines. A second exposure is made on to the same piece of Scribecoat with the original manuscript resulting in black lines (contours, buildings, etc.) this is used for the black negative.

The black negative is scribed using "Astrascibers". All fine lines are .003", all buildings .0125" and all street lines are .0125" Special Templates, curves and guides are used uniformly throughout.

On overlay using clear Stabilene Polyester Base Film (.0075") is placed over the black scribed negative and on it in proper position is placed Mosen Map Type black ink, matte finish transadhesive printing. A similar clear film is placed over the original manuscript and transadhesive printing is applied for the contour numbers.

Then in order to get a reverse image of the contour numbers and the original manuscript, they are placed together in the light box for six minutes. Developing in ammonia fumes takes about five minutes.

This brown negative is then scribed using a .003" Sapphire Astrascribe Free Hand Cutter held in a pencil chuck for the 2' contours and an "Astrascriber" (rigid or swivel) with a .012" sapphire cutter for the 10 contours.

The reverse image of the manuscript is transferred to sensitized Scribecoat for the blue negative. A sapphire .003" cutter is used to scribe the blue.

The clear overlays or "Stick-Ups" as we call them are sent to the printers to be contacted with a very sensitive high contrast, dimensionally stable photographic film (.003" Ansco). The resulting high gamma negatives are opaqued with K and E "No-Rinkle-Black" a suspension of carbon particles in an alcohol base.

A piece of Stabilene Polyester Base Film with a .0006" peel coat surface is used as an overlay with the original manuscript for the green negative. The outline of the wooded areas is then cut with a swivel knife and peeled from the surface. A tree symbol negative is placed with the peel coat by the lithographer in order to obtain the press plate.

To proof the negatives before reproduction, a color composite is made. Sensitized color emulsions are used called "Wipe-On Kwik-Cote". The proof is made on a dimensionally stable sheet of white plastic called "Kwik-Cote" Base No. 5 with a specially treated matte surface. The sheet is

taped to a flat surface and 20 c.c. of green sensitizer is applied first with a cotton pad on a sponge block, then after drying, the green negative is exposed in the black light printer for 15 minutes. As the next color is applied, it removes or develops the previous color. The sequence of color applications runs from the light to the dark (i. e. green, brown, blue and black). After all the colors have been applied and exposed to their respective negatives, the sheet is sprayed with water. Any exposed areas have hardened and adhere to the plastic. All other unexposed colors wash away. Stubborn smears are removed with a 1% ammonia water solution or "brightener". The proof is then checked, the negatives corrected and sent to the lithographer for reproduction.

We have on hand at the present time 242 4-color topographic maps covering about 140 square miles and it just about covers the complete area of the MDC member towns. As a matter of fact, we are now re-flying many of our out-dated sheets and believe me, it doesn't take long before they are in need of being remapped. I might say in closing that we also have scribed and reproduced by the methods already described a 5-color and black map of the Metropolitan District and in which we are in the process of up-dating at the present time.