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RECENT SCRIBING DEVELOPMENTS IN MAPMAKING

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Agenda Item 13

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Introduction: The development of scale-stable films, good scribable coatings, and reliable scribing instruments has firmly established the scribing process as an important working tool in mapmaking. Since its introduction in the United States, about 1945, the process has continued to make progress. It has been adopted by the Geological Survey and by most other government mapmaking agencies, in all phases of mapmaking, and is also finding favor as an efficient tool in private industry. Experience has shown it results in time savings up to 30 percent over conventional drafting methods for preparing map copy. Scribing gives sharper, cleaner lines than can be obtained by drafting with pen and ink; new employees are more easily trained to scribe, and mapmaking processes have been simplified.

Scribing Publications: Many articles have been written which cover scribing rather thoroughly. Foremost among these is the U. S. Government publication "Report on Scribing." Part I of this report describes the process in general terms; Part II describes the process in more detail as it is practiced in various Government agencies, and Part III is a glossary of scribing terms. The agencies that contributed to the interagency report and that have published Part II sections on their scribing practice are Aeronautical Chart and Information Center, Army Map Service, Forest Service, Tennessee Valley Authority, and Geological Survey. This paper will discuss the Geological Survey report. Because there are numerous publications on the subject, most of you are somewhat familiar with the basic scribing process. However, a brief review of materials, instruments, and techniques currently in use in the Geological Survey may be of interest in clarifying the current development status.

Base Materials: Various base materials have been used including glass, vinyl, Homalite CR-39 (a clear, hard, almost colorless, thermally set plastic), and the currently used base material, Mylar polyester film. Mylar has natural dimensional stability, great tearing strength and good transparency; it is resistant to both age and heat, nonsoluble, and waterproof. A wide variety of Mylar products are now available from commercial sources and are being used to varying degrees by Government mapmakers, as well as by others.

The film is obtainable in various thicknesses, but the 0.0075-inch thickness has been selected as being suitable for most scribing operations. With this thickness it has been found that uneven working surface and small particles of dirt under the material do not materially affect the scribing of lines and the control of scribing instruments.

Base Material Coatings: The various Mylar surfaces now available include: clear Mylar with an ink surface; matte-surface sheets for pencil and ink; rust, yellow, green, white, or clear scribe-coated sheets; and a white scribe-coated sheet with a black undercoating to permit scribing without a light table. Peel coats are available that can be etched and peeled or cut out and peeled. Several kinds of presensitized Mylar are available with a pencil-and-ink or scribing surface. Emulsions include the wash-off type blue, black, and sepia Diazo emulsions, and photographic-contact, reflex, and projection-type emulsions. A clear, or a pencil-and-ink surface Mylar sheet is used for lettering overlays depending on whether a guide image is to be processed on the surface. Rust and yellow scribe-coated sheets are used for compilation and at the map-finishing stages. These colors give sufficient opacity for plate making, so that the color to be used is a matter of personal preference. Yellow, rust, and white scribe-coated sheets are used in the field, the color also depending on the preference of the user. When scribing was first adopted, the Geological Survey coated its own sheets because a suitable commercial product was not available, but now it is possible to purchase sheets already coated. Geological Survey offices are equipped with modern photographic laboratories and it is still considered advantageous to sensitize our own sheets by whirler or wipe-on methods. Originally, for finished scribing the scriber was furnished a coated sheet with a negative image (clear lines with a dark background), but the current practice is to furnish a positive image. Such an image is easier on the eyes when viewed over a light table and many scribers believe it makes scribing easier. Color proofs are made on white scribe-coated Mylar or on white vinyl plastic. Better proofs are obtained on the vinyl sheet if it is grained. The sheets can be grained in a tub grainer using wooden balls and a slurry of pumice powder in water to which a small quantity of trisodium phosphate is added, to give a cleaner background. Grained vinyl sheets may be obtained commercially if graining facilities are not available. Both whirler and wipe-on color-proving methods are used.

Register Techniques: To maintain register of the various color-separation plates, the Geological Survey has developed and constructed a register punch which punches two, three, or four $\frac{1}{4}$-inch holes in the margins of the sheet, depending on the size of the sheet. The punch incorporates a pressure plate which assures that the Mylar film will be perfectly flat before punching. Sheets are secured in correct register by metal or plastic studs inserted in the holes. The register system is used throughout the various phases of the scribing process including the preparation of the pressplate, and is responsible to a great extent for the success of the scribing process. A picture of the punch appears in the Geological Survey "Report on Scribing," Part II.

Peel coats for tint areas: Mylar peel-coated sheets are used to prepare woodland, open-water, and urban-tint color-separation plates. Peel-coated sheets are available in two basic types--one with a coating that can be etched and peeled and the other with a coating that is cut and peeled. When the etch coating is used the scribing guide image is processed on the sheet. The image is then etched, after which the sheet is dyed to prevent lines from printing in areas that are not to be peeled, or as an alternative method, unwanted lines can be opaqued. The coating is then peeled from the areas that are to be printed in a tint color. The cut-and-peel coat is a transparent coating which is placed over the scribed image where outlines of areas to be peeled are cut with a swivel knife or other scribing instrument.

Some difficulty has been experienced with small areas of peel coat dropping off in handling. To prevent this when tints are broken up into many small areas and there is a possibility of the peel-coat film separating from the base sheet the sheet is coated after etching and before peeling with a layer of Flopaque or Stay-Flex paint. This seals the edges of the etched lines but does not affect the peeling qualities of the coating. A recent development in peel coats provides a red scribe-coat layer on top of a colorless peel-coat layer on a Mylar base. The scribing image is processed on this coating unless the sheet is used as an overlay. The outlines of the areas to be peeled are then scribed. The scribed outlines are moistened with a solution that is 80 percent water and 20 percent Solox, a wood alcohol solvent. The solution penetrates the peel-coat layer permitting the peeling of the coating from the desired areas. Prior to this time (1963) peel coats that could be satisfactorily scribed have not been available.

Etching: Some scribe coatings have been developed to the point where they can be etched to produce duplicates of scribe-coated sheets or other drawings with a fidelity that is about as good as the original. This process is used in map-revision work, along with the technique of etching contour numbers as well as red-road-plate information and lettering. A recent development in this field is a light-sensitive scribable Diazo coating on a clear Mylar base. Exposure to the coating is made through the master or scribed plate. The exposed areas bleach or decompose and the unexposed areas become a reddish brown which is actinically opaque. Additional information can then be scribed.

Lettering: Marginal and interior lettering for scribed topographic maps is prepared for reproduction in essentially the same way that it was prepared in drafting. Lettering is cut from a stickup film copy and placed in its proper position on a clear or pencil-and-ink surface Mylar overlay. In the Geological Survey lettering is prepared on Intertype Fotosetter photographic line-composing machines. The machine uses the time-proven circulating matrix-assembled-and-distributed principle as is used in line casting machines. In place of the metal pot, a camera is used. The camera operates on a letter-by-letter principle of photographing each character individually. It is operated by means of a mechanical typewriter keyboard. By using two basic fonts and suitable lenses, 15 sizes can be obtained from 4 point to 36 point. The photo-matrix character is a negative, thus its exposure produces a positive; however, by special processing the film can be developed as a negative. Thus, whether a positive or negative is needed or whether copy is required to read from left to right or from right to left, the Fotosetter camera can produce it for emulsion-to-emulsion contact.

From the film, stickup copy is prepared on stripping film which is coated with a wax adhesive. In the past some trouble has been experienced with the stripping and processing qualities of the various films that have been used. However, the film now being used-Dinolith Hi-speed stripping film with wet or dry release, (Di-Noc Chemical Arts Inc.) is proving quite satisfactory after undergoing research to improve its deficiencies for use in stickup work. The film is coated with a wax adhesive (Flexo Wax C, a light cream-colored dull wax purchased from Glyco Products Co.).

Also of interest is the Hadego Photocompositor, a photographic process machine which can produce type copy in sizes from 4 point to 115 point, as well as fractional point sizes. A complete layout can be composed in any size up to 11 inches by 14 inches in a mixture of faces and a variety of sizes, and in multiple lines without stripping. The product of the Hadego can be used for any photomechanical process:right-reading or laterally reversed film positives or negatives can be prepared. The type is lightweight and large enough for easy handling. It is hand set in a composing stick in much the same way as conventional foundry type. The stick is then placed in the lineholder on the Photocompositor where it is photographed.

Instruments: Various instruments have been developed by the Geological Survey for use in the scribing process. The current models represent considerable improvement over previous ones. When additional instruments are needed, a thorough evaluation is made of the size, shape, weight, ease of handling, construction costs, and appearance of the existing instruments to determine whether improvements can be made in the design. Changes are incorporated in the new instruments if instrument operation can be improved. Pictures of current models of scribing instruments and scribing accessories are shown in the Geological Survey Manual of Topographic Instructions, in Chapter titled "Color-Separation Scribing." They include the fineline graver, rigid graver, building graver, swivel graver, sharpeners, electric and mechanical dotter, building and rigid-graver guides, and other miscellaneous scribing accessories.

The swivel graver which scribes two lines at one time uses either needle scribing points or blade-type cutters. Other features of this graver are the ballbearing races which permit smooth action and good instrument control. This smooth action is necessary for the very thin die coatings that are now available for special types of scribing tasks. Another special feature of this graver is the graver head which is made in two sections. Both head sections and the shaft to which they are attached are grooved, thus, when needle points are once sharpened, space between the points can be varied without disturbing the head alinement because movement of the head sections is controlled by the mating grooves on the head and shaft. Prior to the development of this feature needles had to be resharpened each time the space between the points was varied. This Survey-developed instrument, as well as the Survey building graver and rigid graver, can now be obtained from a commercial source. Another Survey-developed instrument is a swivel graver that can scribe four lines at one time at variable spacings. This instrument incorporates the same features as the standard swivel graver previously described. The modified building graver and building graver guide permit the scribing of row houses at predetermined spacings.

Instrument Development: Although good basic instruments are now available the search is continuing for new and improved tools ana scribing equipment. Instruments that are available from other sources are purchased and evaluated. If preliminary evaluation shows they offer advantages over our own equipment, small quantities are purchased for trial use in our regional mapping centers.

For instance, two instruments were accepted as having advantages over Survey-developed instruments. One of these instruments is a spring-loaded rigid graver. Some of our personnel prefer it to the Survey type. With the spring-loaded graver the cutting pressure is controlled by spring action. The other commercial instrument in use is an electric dotter. The dotter is reasonably priced and is efficient, but heats to an uncomfortable operating temperature after about a half hour of continuous use. The Survey-developed dotter can be operated all day without overheating, but it is considerably more expensive. Approximately 15 of the Survey type are in use and 32 of the commercial type.

Considerable effort has been expended on mechanical lettering devices. Two types have been developed and used in reproduction work: A LeRoy type device and a pantograph scriber. More development work is needed on these instruments before they can be used efficiently by the average scriber.

Experiments have been conducted with Rayescent light panels as a replacement for conventional light tables. These panels, about 3/8-inch thick, generate light by electroluminescence. The light output is uniform over the entire surface and intensity can be regulated by varying the voltage or frequency. Green, blue, yellow, and white panels are now being produced. The panels, which can be obtained in various sizes, are quite expensive, and the light intensity is insufficient for some scribers; however, we can assume that as demand increases for this type of light source prices will drop and light intensity will be increased. When these developments materialize, this type of light will no doubt be adopted for light table use.

<u>Symbol Templets</u>: Templets for scribing the various map symbols have been developed by the Survey and have become a very important factor contributing to the success of the scribing process. Our present cartographic green plastic templet (a few of which have been distributed here together with instructions for use), is the result of considerable research and development. The templet is made by a punch-and-die process. The green color was selected after trial of templets of various colors. It was also found that the plastic templet was preferred to the metal type because of its transparency. We have also had templets made of glass by a process developed by the Corning Glass Works. The advantage of this type of templet is that intricacy of design is no problem. All that is needed to make this templet is a film negative of the desired design. On the debit side, the glass templet is thick and fragile, and therefore requires careful handling and a careful scribing technique.

<u>Points and Sharpening Techniques</u>: It should be emphasized that extreme care must be used in sharpening scribing points because this too is a very important part of the scribing process. Properly sharpened points make the scribing task easier, and they produce cleaner and sharper scribed lines. Considerable time has been spent determining the proper cutting angles for the points. The Survey has developed an efficient sharpener, which can be obtained commercially, that gives the proper scribing angles and simplifies the time-consuming sharpening task. The sharpener is designed for the Survey-type instruments and some modification may be necessary if it is used to sharpen instruments that vary from the Survey instrument in size and shape. The instrument and the sharpening procedures for the various gravers are illustrated in the Survey publications mentioned. It should be stressed that the sharpening and shape of the point have much to do with the quality and efficiency of

scribing. Scribing points have also received their share of attention. Various types have been used: jewel points, blade-type cutters, osmium-tipped points, carboloy points, special steel points with various types of tips, and a variety of shapes and kinds of phonograph needles. Most of our scribing is now done with the Duotone phonograph needle. We also use blades and a few osmium-tipped points of special design for certain scribing tasks. Although the steel phonograph needle requires more frequent sharpening than the osmium, carboloy, or jewel-type points, it is much cheaper and does not require special handling to avoid damage to the point. The more frequent sharpening that is required has not proved to be a handicap because of the efficient sharpener we have developed. The abrasive quality of the scribe coat is a major factor in the need for point sharpening. We have found that a steel point will require sharpening after scribing only 500 inches of line on some coatings whereas on other coatings as much as 2,400 inches of line have been scribed with the same type of point without any noticeable wear. We are therefore careful to select the least abrasive coating we can obtain, if other scribing qualities are acceptable.

Future Trends: Despite the continued development, the evolution of scribing on plastic has reached a relatively static situation. Coatings will continue to be improved, better plastics may be forthcoming, and techniques will no doubt continue to get better, but the overall process, we believe, will remain essentially unchanged for some time to come. Any notable advance in this field will probably be in the direction of practical automation. The extent to which automation will enter the field of scribing at the map-compilation stage, where the product is primarily one of human skill and judgment, may be difficult to contemplate at this time; but we can speculate regarding automation in final color separation which is the physical means of preparing map copy for reproduction. One step in this direction has been the development of an automatic type-placement system through the efforts of the Army Map Service. When fully developed, the system, which is now partially operational at AMS, will eliminate the duplication of locating the feature to which the type pertains. It will eliminate the time required to cut out strip film, the positioning and alinement of the film, and the editorial review and correction of type alinement as well as most of the manual positioning of the final type image.

Conclusion: This brief review of scribing as it is practiced in the Geological Survey covers only the general procedures that are applicable to all mapping phases. Specialized techniques have been used for mapping projects requiring special treatments. Undoubtedly, many other uses for scribing can be envisioned; however, it would be misleading to suggest that scribing offers answers to all cartographic problems. It will be found that, as with any other process, problems will arise that can be solved only by experience. It is certain nevertheless that good results can be obtained, and at less cost than by drafting methods, if scribers use the instruments properly and if the work is planned intelligently.