Reproducing Watermarks for Study

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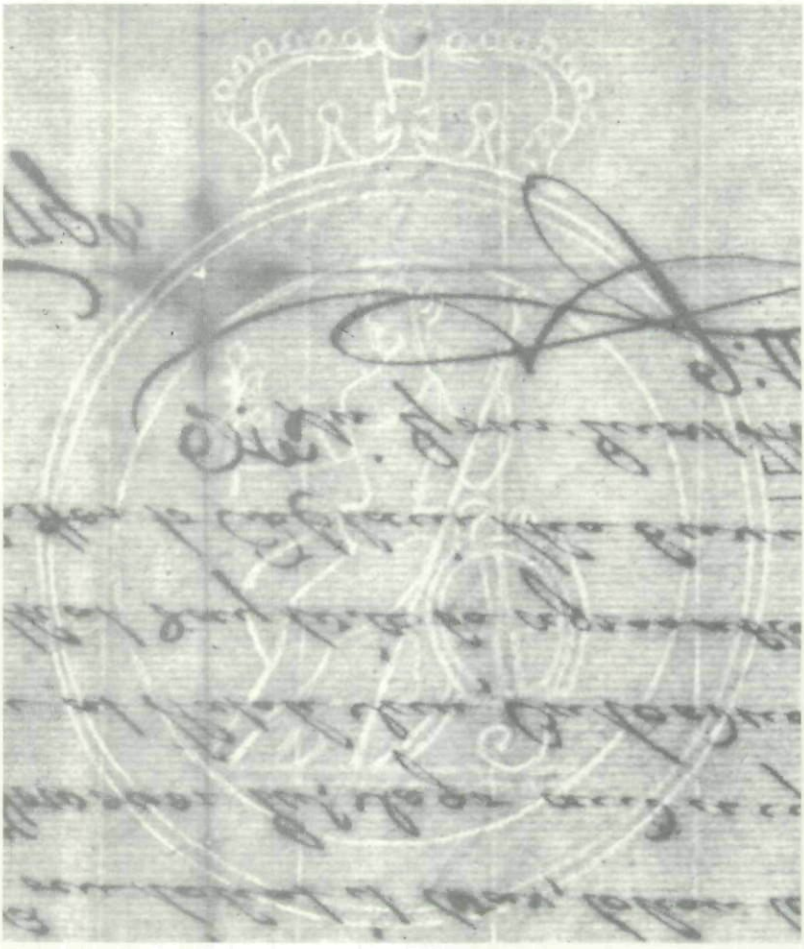
THERE HAS always been a scholarly interest in paper watermarks, but the difficulty of reproducing them clearly and accurately has been a hindrance to their study. The value of a watermark is realized when something about the history of papermaking is known. Dard Hunter in his standard text points out that the art of paper manufacture was brought to Spain by the Moors in the twelfth century.[1] The first European watermarks appeared about 1150. These were the marks left in the paper by the chain and laid lines of the mold.[2] After Gutenberg published his Bible in 1455 and 1456 on movable type, the demand for paper led to an increase in the number of mills throughout Europe and, along with them, their identifying marks. At first these marks were thought to be a means of communication between the paper workers; others believed them to have a religious significance.[3] But since a different watermark was used by each papermaker, the identity of his product and often the dates of its production became known.

A similar though shorter article on this subject appeared in the October 1972 issue of the *Journal of the International Association of Paper Historians* erroneously entered over the name of James L. Anderson.

[1] Dard Hunter, *Papermaking* (New York: A.A. Knopf. 1943).

[2] Allen Stevenson, *The Problem of the Missale Speciale* (Pittsburgh: Thos. C. Pears, Davis & Warde, Inc. 1967), pp. 49, 245 ff.

[3] Hunter, *Papermaking*, Chapter IX, p. 188.



The first of the fifteenth-century marks was made by hand-bending the wire and sewing it to the mold. In the next century watermarking became a trade and advanced to the point of having the designs traced on wooden blocks and the wire bent around pins set in the angles.[4] The changing shapes of watermarks due to wear, loose and broken wires, broken stitch-

[4]Stevenson, *Missale*, p. 246.

es, and the movement of the watermark between the chain lines are all clues to be used in modern-day research into the history of a book and its paper.

The reproduction of paper watermarks for research and bibliographical purposes has always been a costly and time-consuming task, with the images produced often lacking clarity and, in the case of traced watermarks, accuracy. The tracing of a watermark from the page of a bound book is difficult and can cause irreversible damage to the original. The photographing of a watermark is often impossible by ordinary means and in most cases requires expensive and elaborate equipment. The use of Beta rays gives the best watermark images but here again the cost in both the time required (up to twenty hours) and the necessary carbon-14 sheets put this method out of the reach of most collectors and researchers.

In experiments dealing with the reproduction of the watermark of a stamp while it is still attached to the envelope, a surprising amount of success was achieved by using a recently marketed photosensitive paper and ultraviolet light. This new type of paper is called Dylux 503 paper by the manufacturer, DuPont.[5] This yellow paper is very sensitive to both visible light in the 400-500 nm range and to ultraviolet light in the 200-400 nm range. The visible light deactivates the coating so that the yellow coating loses its color, becomes white, and no longer reacts to ultraviolet light. The ultraviolet light causes the coating to become a bright blue; the depth of the color depends on the length of exposure to the ultraviolet rays.

The ability of Dylux 503 paper to react as it does is the reason for its success in printing watermarks. Since watermarks are a thinness created in the paper as it was made, light will pass through these places with greater intensity than through the balance of the sheet. Ink creates a barrier which tends to reduce and in some cases prevent for all practical purposes the passage of light. Many inks are opaque and some have become

[5]See article by Rolf Dessauer in *Image Technology*, XII (Feb.-March 1970), 27-32.

more so with age. Thus the thickness of the paper and the opacity of the ink used in the writing or printing are the two main factors which affect the ability of Dylux 503 paper to capture a good watermark image.

The equipment necessary is of the simplest and most inexpensive nature: 1) a hinged frame with a glass front similar to a picture frame to hold the item to be printed and the Dylux 503 paper close together so they will not shift during the printing process, since any light which reaches the coating without passing through the original will ruin the result; 2) a source of visible light; 3) a source of ultraviolet light—this can be supplied by a 6-watt hand-held lamp or by a 15-watt fluorescent tube (this ultraviolet light must be from a source which emits very little or no visible light).

The time required to print the watermark depends entirely on the ability of the light rays to penetrate the object and reach the photosensitive paper below. Most of the papers, letters, and book pages that I have experimented with have taken from one to five minutes under the visible light in the first step of printing. In developing the blue color to complete the image, the exposed Dylux paper is held under ultraviolet light. This is a very rapid process and, in order to control the speed of the formation of color so that the contrast between the blue and white is not lost, a 15-watt ultraviolet tube which is rather slow in bringing out the blue is most effective.

The handling of Dylux 503 paper requires some care. Sunlight or bright lights will nullify its ability to react. In preparing an object for printing, this paper may be exposed to ordinary room light up to fifteen minutes. This is a very important factor as it allows the handling of fragile items in sufficient light so that the danger of damage is largely eliminated.

The actual printing method is very simple: the Dylux 503 paper is placed yellow side up in the hinged frame; the original is laid over it and the frame is then closed and put under the visible light source. There is a high output fluorescent tube

made by the Sylvania General Telephone and Electronics Company of Danvers, Massachusetts, called Super Diazo Fluorescent Lamp which gives excellent results. These lamps do not spread visible light over a large area and so have to be used in a bank of several tubes so that the printing area is uniformly illuminated. A pair of 15-watt Super Diazo fluorescent lamps, when mounted four inches apart under a reflective hood or shield, will illuminate effectively an area approximately twenty inches long by seven inches wide. The light source should be three to four inches away from the watermarked paper. Paper watermarks usually cover an area of only four-by-six inches (of course there are exceptions) which means two or three lamps mounted parallel will be sufficient for all but the very large land deeds, maps, and prints. The above mentioned fluorescent lamps emit visible light just above the ultraviolet range and cut off before the infrared range is reached.

In printing the watermarks found on book pages, I did not use the frame but placed the Dylux 503 paper under the watermarked page and laid a small square of glass on top to hold them close together during exposure. This can be done without having the book fully opened.

The second step—imaging or printing—is done by removing the paper from the frame or book and holding it under the ultraviolet light until the blue color is formed. There are different ways of doing this but the one which worked best was to hold the exposed paper about a foot away from the ultraviolet light. A 40-watt incandescent bulb behind my head supplied sufficient light (without affecting the print) to allow me to watch the watermark develop and thus enable me to remove the paper at the right moment for a good image. Should one remove the print from under the ultraviolet light too soon with the resulting loss of color, one can always put it back under for a deeper color and greater contrast between the blue background and white lines which will form the watermark. It will be noted that there are great variations in the time required to make

prints. This is due once again to the different materials used by the various papermakers.

Many libraries and museums will not permit the use of ultraviolet light near their valuable papers. In such cases, a different technique is required—one in which the original and the Dylux 503 paper are exposed only to the visible light. The Dylux paper is then encased in a lightproof envelope and removed to a distant work area for the final exposure to ultraviolet light. The ability of this special paper to retain a latent image for quite some time has proven to be a distinct advantage; however, it is best to make several exposures to be sure of obtaining the best watermark print.

The cost of an 8½″x 11″ sheet of Dylux 503 paper runs approximately eight cents. The paper can be purchased in large sizes should they be needed. This low cost allows many experiments and trials, as practice is required before good prints are obtained.

Since the entire process is a dry one, there is no paper shrinkage as with wet prints; nor are there any distortions as might be expected from some camera work. The Dylux 503 coating is very thin and thus allows the watermark print to be folded in half without peeling or cracking, thus measurements and comparisons can be made one against another.

The life of the prints is still undetermined since these experiments of mine were started only in the spring of 1970. Original prints made at that time have retained their readability and clarity. When necessary, black and white photographs can be made from these prints using a Wratten No. 25 (red) filter and high contrast paper.

A few of the results and observations which I have obtained from my experiments are exact copies of watermarks and of the spacings of the laid and chain lines. In the case of wove paper, careful handling and exposure timing will show the weave of the mold screen. Water splatters from the vatman's hands show up as round spots. In the few cases where paper has been

pasted-up, the joining appears as a stripe or band across the print. In the event a repair has been made, such as filling a hole, the repair shows either a dark outline or, in the laid papers, the lines do not match. Often the early printers used their waste paper by pasting it together for use as stiffeners for the book covers. In the event that these paste-ups will allow the light to penetrate, prints can be had which show printing that is not visible otherwise.

The small marks left by broken sewing wires show up as round white dots and are an indication of the amount of usage of a mold. This, in turn, is a clue to the age of the paper.

Antique laid paper is readily identified by the shadows which appear on each side of the chain wire. When the paper has been made on a mold with double chain wires, the distance between them can be measured with accuracy. The portion of writing ink or printing ink which shows up has a very definite value, for as Allen Stevenson states on pages 67-68 of his *Missale*, the experts and students alike should not ignore these reference points, for they are a positive means of locating the watermark position on a page and also the exact page of the book.

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