CASE REPORT

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Artificial Aging of Documents

REFERENCE: Stewart, L. F., **"Artificial Aging of Documents,"** *Journal of Forensic Sciences,* JFSCA, Vol. 27, No. 2, April 1982, pp. 450-453.

ABSTRACT: A case is presented involving a number of original documents prepared by a medical doctor to authenticate claims for Medicaid reimbursement. Through an adaptation of conventional laboratory techniques, evidence was found of artificial (accelerated) aging.

KEYWORDS: questioned documents, inks, papers, artificial aging

Classical methods for detecting backdating fraud by using typewriter, printing, handwriting, and paper analyses have been known for many years [*1*]. The chemical analysis of ink and paper is a relatively new technique [*2-5*] that is still evolving.

Case Presentation

Thirty-three original letters bearing the letterhead and handwriting of a doctor were submitted to the National Laboratory Center of the Bureau of Alcohol, Tobacco, and Firearms (ATF) for ink and paper analysis. The documents were dated between January 1978 and June 1979. The pages consisted of handwritten notes dealing with Medicaid patients. The case investigator felt that the documents were actually prepared a few weeks before they were confiscated and sent to the laboratory. Proof of this would indicate Medicaid fraud.

Paper Analysis

Visual Examination

Initial observation of the 33 pages showed that one page had a different watermark. This watermark could not be clearly visualized under white or ultraviolet light. The watermarks on the remaining 32 documents were easily seen and were found to be the same. An attempt to determine the manufacturer of this watermark was unsuccessful. However, it was found that the watermark has never been manufactured in the United States.[2]

Received for publication 13 July 1981; accepted for publication 21 Sept. 1981.

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[2]Personal communications from Dandy Roll Manufacturers (Wisconsin, Massachusetts, and Maine) and the Institute of Paper Chemistry, Appleton, WI, 1981.

The letterhead on the one page was stamped; the other 32 pages had a printed letterhead. The pages were all of the same size and approximate weight. The top of each document had markings consistent with those that would be made by a paper clip. When these pages were stacked in chronological order, the markings did not line up, indicating that the pages had never been attached as a group.

Some of the pages were bright (white), while the others were of varying degrees of brownness. In paper analysis, "bright" refers to the lack of yellowing [*6*]. These differences in color did not follow a recognizable pattern. Some of the pages dated earlier were brighter than some of those dated later. The documents, except for those that were bright, were very brittle. Along folds the paper was broken and crumbled. Certain studies show that paper is the most durable and easy to use when it contains approximately 7% of its weight in water. If it contains less than 7% water, it becomes harsh and brittle [*1*].

The pages were inconsistent in the degree of brownness throughout each page. Some of the pages were darker at the corners while others were darker at the center of the page or in patches. Certain pages had a pattern of dark and light streaks. Under ultraviolet light, these documents had markings on the back in the form of parallel lines or bars. These bar markings did not consistently appear in the pages. On one document the first bar was approximately 20 mm from the left side of the page and on another page the first bar was approximately 10 mm from the left side. On most of these pages the bars ran lengthwise but on one page the bars were essentially horizontal. These inconsistencies tended to rule out the possibility that the bars resulted from a manufacturing process.

Although the earliest alleged date was January 1978, the appearance of extreme age in some of the documents indicated that the pages had been artificially aged. The bar marks on the back of the pages were similar to what would be expected to occur by heating the document on an oven rack. Studies comparing artificial aging by use of an oven with aging under normal conditions have led to the conclusion that oven aging at 100°C (212°F) for three days is approximately equal to 25 years of normal aging [*6*].

Test for Artificial Aging of Paper

To test the above theory, paper of equivalent type and quality was heated at various temperatures for different lengths of time in an attempt to duplicate the bar markings and the brownness of the pages. Steam heating was also examined. Pages were heated in a household oven for 1 to 4 h at 93 to 204°C (200 to 400°F). In every instance a pattern was produced that matched that on the questioned pages (see Fig. 1). These pages were also very brittle and crumbled upon folding. The pages wrinkled when steam heat was used. A spot check of 20 ovens at a home appliance store revealed that all had racks with equidistant bars of the same approximate distance noted on the questioned pages.

Ink Analysis

The inks used to prepare the documents were analyzed using the conventional ATF procedure [*4*]. Six different ink formulations were used to prepare the questioned documents. All were glycol-based ball-point pen inks. The inks found on the bright sheets, although glycol-based, had the spreading appearance of the old oil-based inks. This suggested the possibility of induced aging through wet heat.

After attempting to match the six questioned inks to formulations from the standard ink library, it was found that five of the formulas were available at the alleged dates of writing. The remaining formula, found among the nonbright documents only, did not match any ink in the library, although it closely resembled one particular ink formula, Formulation A. The questioned ink had all the thin-layer chromatographic characteristics of Formulation A plus others. The manufacturer of Formulation A (a unique two-dye component system) claimed

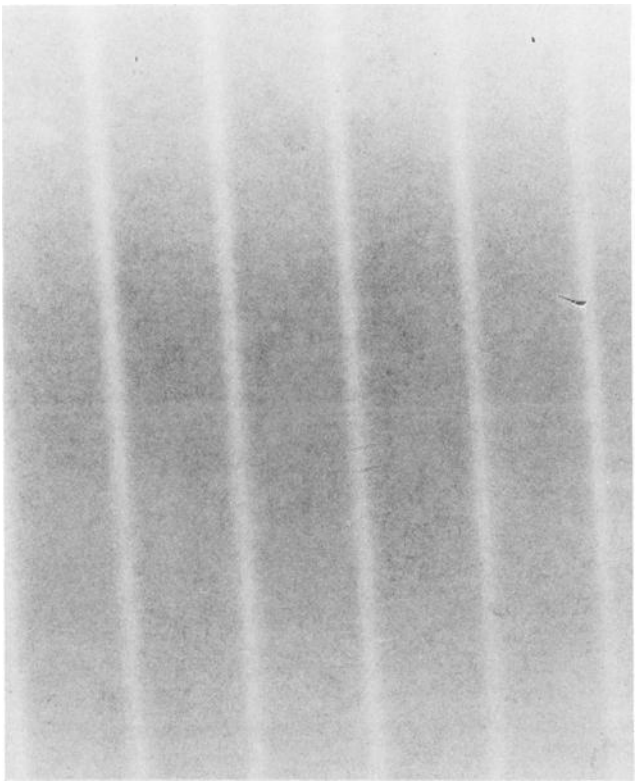

FIG. 1—*Known bond-type paper heated 1 h in a 204°C (400°F) oven.*

that the components of the ink are sold to that company only for use in their ink. If the questioned ink did match Formulation A, backdating would be shown, since the formula was not available at the alleged dates of writing.

Because evidence had been found to suggest that the documents had been artificially aged by using heat, Formulation A was subjected to heat to determine whether it thermodegrades into an ink similar to the unmatched questioned ink. Using the standard procedure, a Merck thin-layer chromatographic plate was used to chromatograph the questioned ink versus the standard Formulation A, unheated as well as artificially aged at 204°C (400°F) for 1, 2, and 3 h (see Fig. 2). Formulation A changed when subjected to heat. Each of the heated inks resulted in a different chromatogram from the unheated standard ink. The questioned ink matched the standard Formulation A that was heated at 204°C (400°F) for 1 h.

Conclusions

On the basis of the accelerated aging tests of both ink and paper, it was concluded that the doctor had artificially aged the 33 pages in question. This could have been accomplished as follows: The documents were first heated with steam in one of two ways. Either they were hung on a line and steam heated (for example, in a large autoclave), or they were steam heated by use of a steam iron and hung up to dry. This could account for the spreading of some of the inks. Ink spreading as a result of water or heat is formula-dependent and thus certain inks are resistant. The paper clip markings could have been caused by the hanging

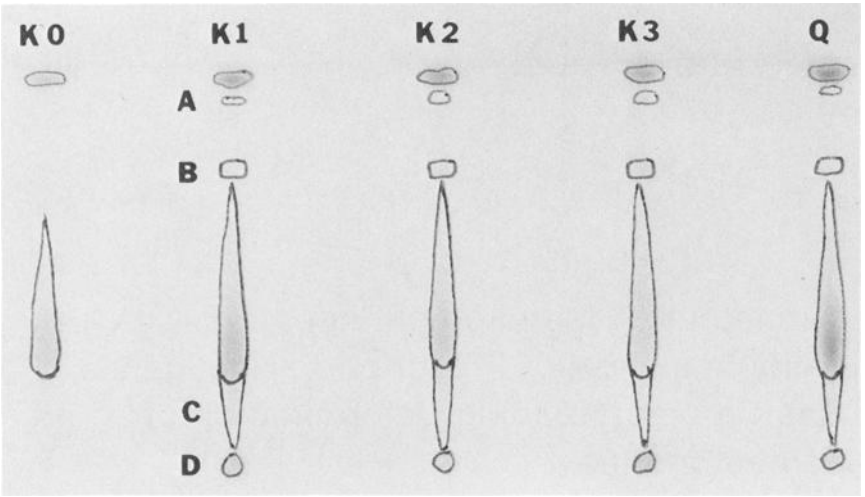

FIG. 2—*This chromatogram was enhanced for clarity. K0–K3 correspond to standard Formulation A that was heated for 0, 1, 2, and 3 h, respectively. Q corresponds to the questioned ink. A–D are points of differentiation between the chromatogram of K0 and those of K1, K2, K3, and Q.*

process. Next, those pages that did not appear old enough were probably placed in an oven for additional heating. This would explain the bar markings, variations in the brownness, loss of water (brittleness), and degradation of the ball pen ink.

Acknowledgments

This work was greatly assisted by the ink and paper manufacturers and Antonio A. Cantu and Claude E. Eaton of the ATF laboratory.

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