TECHNICAL NOTE

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Methylene Blue Revisited: The Search for a Trouble-Free Erasure Sensitive Powder

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ABSTRACT: It is well recognized that the powdered mixture of methylene blue and starch is highly sensitive for the purpose of detecting physical erasure sites which are virtually undetectable by other methods. Also well known are the problems associated with this method, for example, permanent discoloration of the document upon assimilation of moisture. This paper details the successful search for a formula possessing the sensitivity of the methylene blue/starch mixture minus its disadvantages.

KEYWORDS: questioned documents, erasures, methylene blue

It has been noted by a number of researchers [*1-7*] that various powdered materials can effectively reveal rubber erasure sites. Most of these powders were found to be sensitive to erasure sites that were not disclosed through the conventional methods of detection, that is, examination by oblique, transmitted, infrared, and ultraviolet light; naked eye; microscope; and electrostatic detection (ESDA).

The authors recently examined a series of checks on which the original endorsements were alleged to have been erased. The conventional methods of detection showed no evidence of an erasure on any of the checks. The methylene blue/potato starch combination, in the recommended proportion [*5*], was tried with very dramatic, positive results (Fig. 1). The exact erasure sites were clearly visible. After photographs were taken, the mixture was easily removed using a glass filament fingerprint brush (Fig. 2). To the naked eye, the checks appeared completely clean.

It was disclosed, however, that minute traces of the dye remained in the checks. Given the properties of methylene blue, this posed a very real potential for defacement. Methylene blue is an intense dye which is soluble in fluids that commonly come in contact with a document: perspiration, ambient humidity, and latent fingerprint development solutions.

This paper presents the results of the authors' search for an alternative powder formulation that would satisfy the criteria of being visibly sensitive to physical erasure sites, satisfac-

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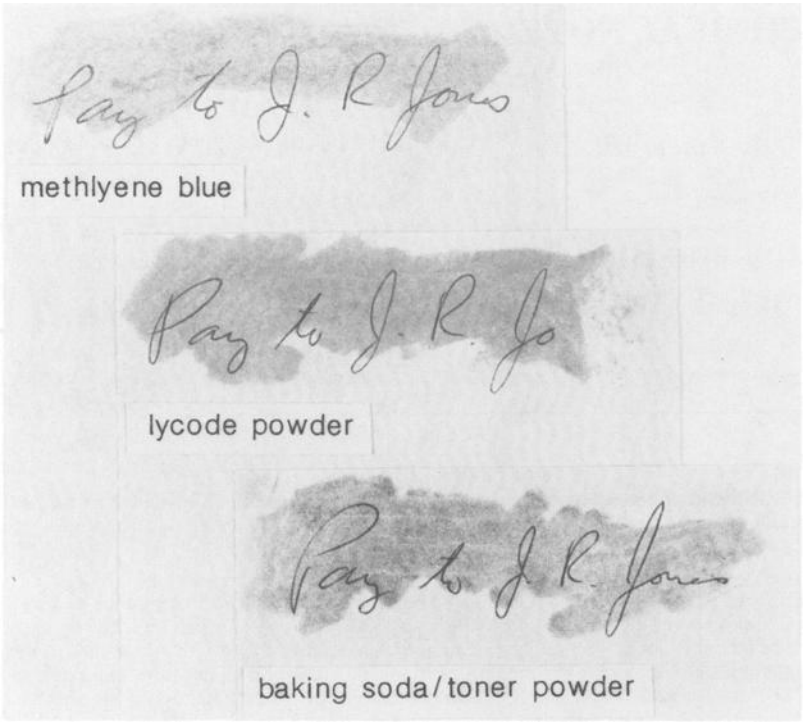

FIG. 1—*The detection of erasure sites using the powders discussed.*

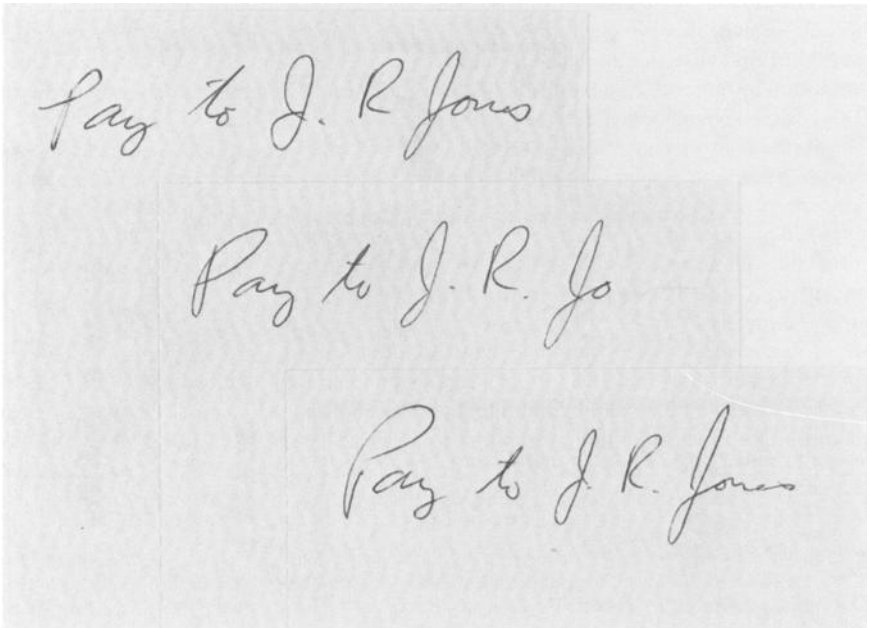

FIG. 2—*The powders are removed by brushing.*

torily removable, nondefacing, and made of reasonably priced materials which are readily available in all parts of the country.

Research of Available Alternatives

Alternative erasure-sensitive powders, that have been reported in forensic science publications as currently useful, were evaluated. In addition to the methylene blue/starch mixture, there were two: a combination of ultraviolet powder and talc [*1,3*] and colored lycode powder [*4*]. The ultraviolet/talc combination was not found to be effectively sensitive, using the brands available. The ultraviolet powder in combination with other bases was more sensitive but was not equal to the methylene blue/starch mixture. In addition, the erasure site, so treated, must be viewed with the aid of an ultraviolet light source.

The lycode powder is commendable in the areas of visible sensitivity and removability. It is completely removable, and thus is recoverable for future use and poses no potential for defacement. However, this powder is available only through the patent holder, Stuart Kind of Great Britain. It is presently packaged in a set of five colors (5 mL each).

It seemed desirable to continue the search for a substance that was visibly sensitive, readily available in this country, and inexpensive enough to use in quantity without thought as to recovery.

Criteria

Specific criteria of the "ideal" erasure sensitive powder were proposed. The ideal powder would be:

1. *Sensitive*—It would visibly adhere to physical erasure sites made by both rubber and vinyl erasers on a variety of papers. It would not adhere to another site in any manner that might result in a "false positive." It would be sensitive to old erasure sites as well as fresh ones.
2. *Removable*—It would be either completely removable or sufficiently removable to render the document clean to the naked eye. If not completely removable, the particles remaining would cause no subsequent defacement of the document via moisture or subsequent application of latent fingerprint solutions.
3. *Available*—The substance would ideally be composed of components readily available throughout the country.
4. *Inexpensive*—It would be reasonable enough so that it could be "broadcast" generously over pages of a ledger and discarded with no need to recover for future use.

With the criteria for the ideal powder established, the search continued for feasible components.

Colorants

The authors returned to the methylene blue/potato starch mixture with an eye towards improving it by changing the colorant.

The premise was tentatively adopted that the starch possessed the ability to adhere to erasure sites and the blue dye simply rendered the starch readily visible. Many other colorants, available in the authors' laboratories, were combined with the starch in varying proportions. Among them: activated charcoal (very fine mesh), 1-methylaminoanthraquione (a red dye used in smoke grenades and money-packet exploding devices), cupric acetate, and toner powders (Xerox 2400, Hunt T-2, and ESDA). Many common substances found in the home and in the shop were also tested.

Most of these were satisfactorily sensitive but were wanting in other areas, most notably in the area of removability.

Of those colorants tested, the toner powders (both copy machine and ESDA) satisfied every criterion except sensitivity to vinyl erasure sites. The toner powder/potato starch mixture was sensitive, in a 1/5 proportion, to both recent and older rubber erasure sites. (Sites as old as twelve years were tested). A greater concentration of toner powder did not result in a more sensitive mixture but only one which was less satisfactorily removable.

The powder had a tendency to cling to very fresh fingerprint impressions. Although these sites were quite unlikely to be incorrectly read as erasure sites, indiscriminate handling should be avoided.

Although not completely removable, the particles of toner remaining did not alter the appearance of the document and were not soluble in moisture or any latent fingerprint development solution commonly in use (Fig. 3).

Copy machine toner powder is reasonable in price and is widely available. The ESDA toner is at hand in most questioned document sections.

While toner was acceptable as a colorant, the potato starch base was not as widely available as desired.

Bases

The other bases tested were bicarbonate of soda (common baking soda), cornstarch, arrowroot, and polyvinylchloride. These were narrowed down to cornstarch and bicarbonate of soda because these are effective, inexpensive, and readily available. Both, in combination with the toner powders, are effective, but the bicarbonate of soda has the preferred texture

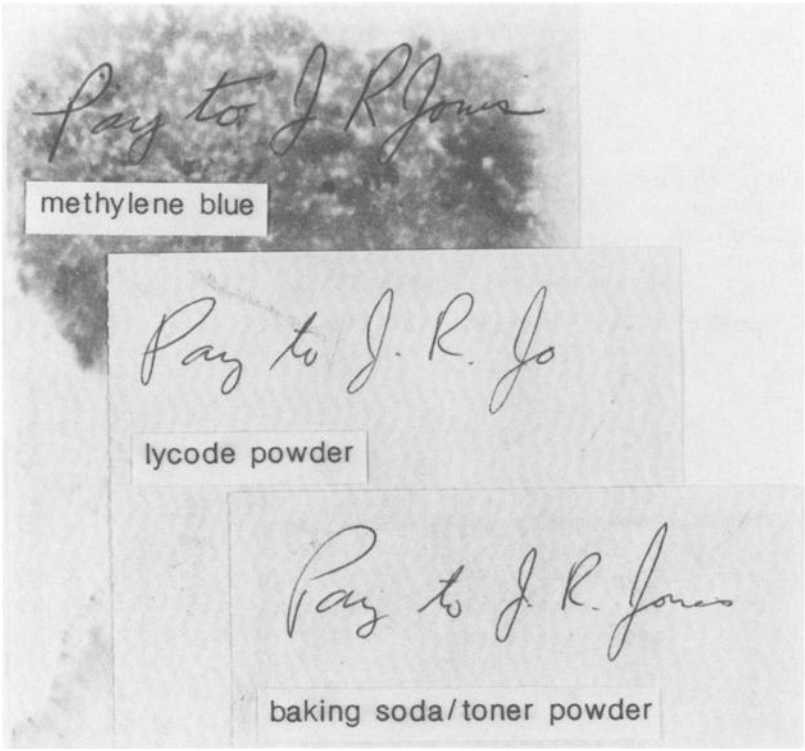

FIG. 3—*Subsequent application of ninhydrin.*

(easier to mix and more uniform in application). As an added plus, it was even more sensitive to rubber erasure sites than was the potato starch.

The original premise was confirmed. It was the base that provided the sensitivity. The colorant provided the visibility. (On colored paper, the bicarbonate of soda alone was satisfactory.) The colorant, however, did need to blend thoroughly with the base to render it satisfactorily visible. For example, cupric acetate was not as evenly sensitive when used in its standard particle size as when it was more finely ground before mixing with the base. It blended more thoroughly with the base powder in its finer state.

Papers and Erasers Used

The toner/bicarbonate of soda mixture was tested on erasure sites made by a variety of commonly available erasers, vinyl as well as rubber containing. The papers tested included bond, machine copy, tablet, graph, ledger, check, envelope, and calendar. In general, the various types of papers tested did not differ markedly in their response.

Writing Instruments Used

It was determined that on common paper surfaces, it was the erasing of a lightly drawn pencil line that posed the greatest challenge. Some testing was done with pen erasures, including those executed by the erasable pen, but the emphasis was on the erased pencil line.

Method

The same method was followed with all powder formulations tested. The colorants and the bases were mixed thoroughly in varying proportions and combinations. A sample of the powdered combination was sprinkled onto the test document. The paper was shaken gently back and forth, to distribute the mixture over the entire surface of the document, and the excess powder was tipped off sideways. A few additional taps on the edges of the paper were employed to remove the majority of the remaining powder excepting that portion clinging to the erasure site. After observation, it was brushed out with a clean glass filament-type fingerprint brush. (The authors obtained very satisfactory results using this type of brush. However, any soft, clean brush would probably yield acceptable results.) Brushing seemed to be a more effective method of removal than use of a compressed gas.

Summary

The authors' objective was realized. The toner powder/bicarbonate of soda combination equals or surpasses the sensitivity of the methylene blue/starch mixture and that of the other powders tested. It is satisfactorily removable, nondefacing, and made of inexpensive materials which are readily available in all parts of the country.

The "ideal" criteria were satisfied with one significant exception—the vinyl erasure. The mixture did not adhere to any but extremely fresh vinyl erasure sites. The methylene blue/starch combination as well as all of the other powders tested were also ineffective in this area.

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