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Evaluation of a Method Using Powder to Detect the Site of Rubber Erasures

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ABSTRACT: Detecting the site of an erasure on a questioned document may ultimately lead to the discovery of a theft involving millions of dollars. Document examiners, particularly those who evaluate evidence in criminal matters, are frequently faced with problems involving erasures. A method of detecting the site of a mechanical abrasion made by a rubber-type eraser was tested and evaluated in comparison with the success of other methods. The method uses a chemical powder and is extremely sensitive in detecting rubber erasures even in cases where more frequently used methods had failed. Several shortcomings of the powder method were discovered during the period of evaluation and these disadvantages are discussed.

KEYWORDS: questioned documents, erasures, alterations, rubber erasure detection powder

The questioned document examiner is frequently faced with the problem of detecting the site of an erasure on a questioned document. To detect that an erasure has been made and certain entries have been removed, altered, or added to a document may ultimately determine the outcome of a contested civil matter or may even directly determine guilt or innocence in a criminal trial.

Fraudulent documents to which alterations and additions have been made by erasing the original entries are frequently produced by unscrupulous persons in an effort to prove an unjust claim. The erasure of but a single entry from a will or monetary instrument may completely alter the meaning or liability of that document. And, if the erasure were to remain undetected, an irreparable wrong might be done to an innocent party.

Background of Problem

Document examiners have long recognized the importance of detecting the site of an erasure. A. S. Osborn devoted an entire chapter in his major work, *Questioned Documents* [*1*], to the subject of erasures. Other books [*2-5*] also contain specific chapters or make many references to the importance of erasures and their detection in the examination of questioned documents. Likewise, these authors mention the difficulties sometimes encountered in the successful recognition and demonstration of specific erasure sites on documents.

Several methods are employed by document examiners to detect erasure sites. Some of the most frequently used methods are oblique, reflected, and transmitted lighting;

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measurements of paper thickness and variations of light transmission; ultraviolet and infrared light examinations; photographic methods and techniques; various chemical examinations, including iodine fuming; and detecting powders.

While erasures are categorized as either physical or chemical, many of the physical erasures that come to the attention of the document examiner are the result of a rubber erasure. If the utmost care has been taken with a rubber erasure, then the location of the erasure site can sometimes be difficult to detect and even more difficult to demonstrate. It is also true that many of the above-mentioned methods employed by the examiner may not successfully locate the site of such an erasure. It is imperative, therefore, that if a rubber erasure is suspected on a particular document a method be found that is extremely sensitive and successful in detecting it.

Mathyer, in an informative paper [*6*] presented at the 1971 Annual Meeting of the American Society of Questioned Document Examiners, mentioned his use of a powdered mixture in a case involving rubber erasures to an artist's pencil drawings. This compound consisted of "a mixture of starch and methylene blue (about 5–10% methylene blue and 90–95% starch)" [*6*]. Mathyer reported that this powder was very sensitive in detecting the site of rubber erasures.

The available literature contains several references to specific powders employed for the detection of rubber erasures, including Harrison's use of graphite powder [*5*] and the Fargo Company's BB 25 ultraviolet fluorescent powder employed by Chowdry et al [*7*] in their research into the detection of erasures.

Experimental Procedure, Methods, and Materials

It was Mathyer's claim [*6*] that his powder mixture was very sensitive to the detection of rubber erasures coupled with an actual case in this writer's laboratory in which a rubber eraser was used to remove entries from a student's test paper that lead to this research project.

Mathyer's powder mixture adheres to the places where an alteration has been made to the paper surface by the action of a rubber eraser. A small amount of the powdered mixture is first sprinkled onto the paper surface on or near the suspected erasure site. The document is shaken back and forth to distribute the mixture over the paper surface and then the excess powder is tapped off the document sideways. The powder adheres to the roughened surface of the paper and the affected area is stained blue. The stain can be easily removed by brushing or by gently dabbing the area with a softened piece of Plasticine®, Figures 1 through 4 depict an erasure to a document, the application and removal of the powder, and the resultant stain.

Attempts were made to evaluate Mathyer's detecting powder in relation to other variables that interacted with the powder to yield acceptable or unacceptable results. Some of these variables were (1) the ratio of methylene blue to starch in the powder mixture, (2) the types of erasers, (3) the types of paper and paper surfaces, (4) the passage of time, (5) the amount of pressure used to make the erasure, and (6) the storage conditions of the document after the erasure.

Two formulations of Mathyer's powder were evaluated to determine whether either offered a distinct advantage over the other. One mixture was prepared with 5% methylene blue and 95% potato starch and a second mixture was prepared with 10% methylene blue and 90% potato starch. These mixtures were then applied to various erasure sites and evaluated.

Several erasers were evaluated to determine whether the type of quality of the eraser played an important part in the results obtained with the application of the powder. Fourteen different erasers were selected from among the available retail stocks of the firm of Eberhard Faber, Inc., of Crestwood, Wilkes-Barre, Pa. These specific erasers were selected

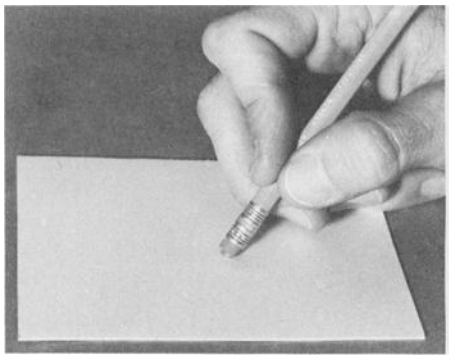

FIG. 1—*A document is erased with a rubber eraser.*

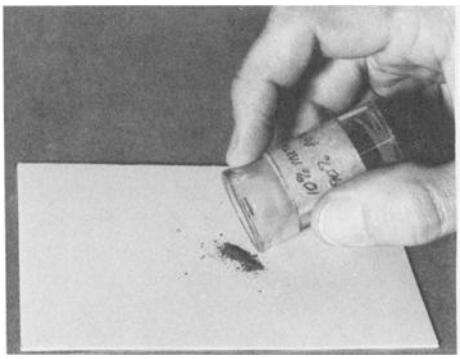

FIG. 2—*Powder is sprinkled onto the paper surface in the area of the suspected erasure.*

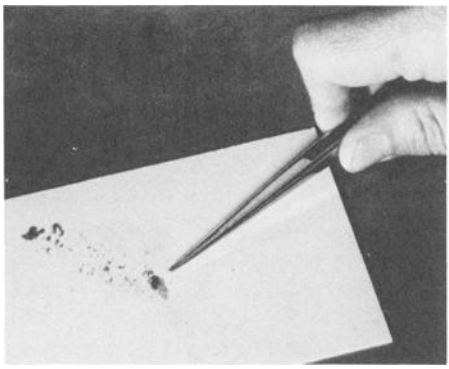

FIG. 3—*Excess powder is shaken off.*

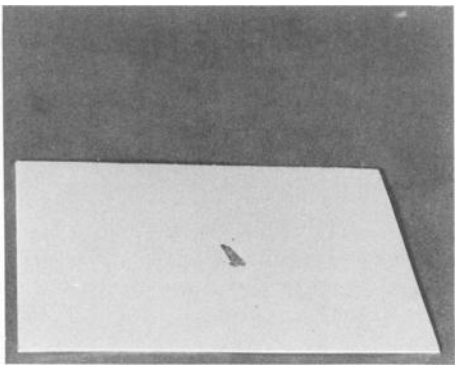

FIG. 4—*Stained area highlights actual site of erasure.*

both because of local availability and because they were assumed to be representative of the types of erasers found in retail markets throughout the country and, therefore, likely to be used in erasures encountered by document examiners. Table 1 lists the various types of erasers evaluated and the purpose for which they were manufactured.

Various types of paper were evaluated to determine the relationship played by the writing surface in the overall quality of the detection of the erasure site by the powder. A number of locally available papers were considered, such as ordinary and superior quality typing and writing papers, mimeograph papers, "Copysette" onion skin papers, numerous military forms and papers, index-type cards, cardboard, office machine copier papers, and various coated papers.

The effect of the passage of time on the detection of erasure sites was also evaluated. Erasures were made with a variety of erasers on paper surfaces and powder was applied to these sites at the specific time intervals of one day, one week, one month, six months, one year, 1½ years, and two years. The documents to which the erasures were made were stored under "file storage" conditions, that is, they were placed within file folders and not subjected to excessive handling until tested with the powder. Other tests were conducted in which the erasure site was subjected to handling and rubbing.

Different amounts of pressure in making the erasures were evaluated—from the very lightest stroke of the eraser (far too light to actually remove any mark made on the surface of

TABLE 1—*Type of eraser and purpose of manufacture.*

Number and Name of Eraser	Purpose of Manufacture
No. 212, "Ruby"	pencil
No. 300, "Pink Pearl"	pencil
No. 400, "Pink Pearl"	pencil
No. 712, "White Pearl"	ball-point pen
No. 310, "Union"	ink and pencil
No. 1907, "Stenorace"	typewriter, originals and carbons
No. 10, "Singlex"	typewriter, originals and carbons
No. 1087, "Comet"	typewriter and ink
No. 12, "Singlex"	typewriter, originals and carbons
No. 6587, "Van Dyke"	typewriter, originals and carbons
No. 4823, "Star"	art-gum-type cleaner
No. 6006, "RubKleen"	drawing boards, tracing cloth, and books
No. 1224, "Kneaded Rubber"	chalks, charcoals, and Nupastels®
No. 1960, "Peel-off Majic-Rub"	drafting films and "lithoplate" masters

a document) to very heavy erasures (that could be easily detected by the more conventional methods of locating erasures).

Results and Discussion

The percentage of the mixture of methylene blue to starch was generally found to have little difference in the results obtained. Both the 5:95 and the 10:90 methylene blue/potato starch mixtures gave good results. The only discernible difference was in the darkness of the stain adhering to the erasure site; the 10:90 mixture was a darker blue than the weaker mixture and, hence, might be preferred by the examiner if the powder were being used for demonstration purposes. Actually, both mixtures yielded acceptable results. It was also discovered that if care were taken to remove the powder from the erasure site then the application could be repeated again and again. This research additionally disclosed that extreme care should be taken with respect to the powder and its proximity to moisture. Methylene blue is a dye in powder form and when it comes in contact with any form of liquid it turns into a bright, deep-colored stain. If care is not taken to insure that the document is protected from moisture, a permanent staining of the area may result.

All erasers with the exception of the No. 1960 "Peel-off Majic-Rub" eraser (see Table 1) gave acceptable results. The No. 1960 eraser is made of vinyl and does not contain rubber. In general, it was found that the better the quality and the softer the eraser, the better the results at detecting the erasure site with the powder. Erasers Nos. 212, 300, 712, 310, 4823, 6006, and 1224 gave excellent results and were the most easily detected. Erasers Nos. 400, 1087, and 6587 gave good results, and Nos. 1907, 10, and 12 gave fair results. It must be added, however, that these gradings are all relative and all erasers, with the one exception, were clearly detectable with the powder.

All writing and typing papers tested proved acceptable in the detection of erasure sites with the powder. In general, the better the quality of the paper, the better the results. Paper with rough surfaces, such as cardboard, did not accept the powder as well as better grades and made the detection quite difficult in some instances. Paper with coated surfaces, such as the zinc-oxide-coated office copier papers and wax papers, did not accept the powder at all and proved unacceptable. Erasures to these documents, however, proved readily detectable with other methods of erasure site detection.

Erasure sites were clearly detected on documents that had been in files for several years. The oldest document to be tested that yielded acceptable results was $5\frac{1}{2}$ years old. It was

also discovered, however, that in general the older the document, the poorer the results. Quite acceptable results were obtained from all documents stored within the file folders for up to two years. When documents were subjected to handling and rubbing, they generally gave poorer results and, if rubbed excessively, the erasure site could frequently not be located at all.

During the testing procedures it was also discovered that the powder would adhere to several other areas not necessarily associated with erasures. For example, if adhesive tape had been applied to the paper surface and then removed, the trace amounts of adhesive remaining would readily accept the powder. Also, when the sealing mucilage used on envelope flaps was wet the powder would adhere. Neither of these situations, however, were assumed to create confusion with erasure site detection: the straightedged outlines of the adhesive tapes were easily differentiated from the more diffuse outline of the typical erasure site, and the obvious outline of the mucilage on the envelope flap was also easily identified.

The amount of pressure used to make an erasure proved to be a variable that made an obvious difference in the results obtained in erasure site detection. The heavier the pressure in an erasure, the more easily detectable the erasure site. However, even when the utmost of care was taken to leave no trace of an erasure, the site was still clearly detected. The slightest touch of a rubber eraser to the paper surface was frequently sufficient to be detected. This great sensitivity of the powder to adhere to the site of a rubber erasure appears to be the distinct advantage of this method over other methods more frequently employed by document examiners. A number of tests were made in which the erasure could not be detected by other methods and yet the powder was successful.

Mechanical abrasions were made to paper surfaces with a number of instruments that did not contain rubber, such as a knife edge, a vinyl eraser, and a fiberglass eraser. In no instance did the powder adhere to the erasure site, regardless of the amount of fiber disturbance to the paper surface. These results indicate the powder would work only when a "rubber" eraser was employed to effect the mechanical erasure.

Summary

The results of these experiments appear to give high marks to Mayther's powder mixture to detect rubber erasures on documents. In general, it was found that rubber erasure sites were readily detected on those types of documents that would be frequently altered. If the document is protected from moisture and the powder is applied sparingly and carefully, this method can be extremely effective at not only detecting but also demonstrating an erasure site made by a rubber eraser. The great value of this particular method lies in its ability to detect very carefully made erasures that might otherwise go undetected with other, more frequently used methods.

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