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M. Edwin O'Neill

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## THE RESTORATION OF OBLITERATED INK WRITING

M. EDWIN O'NEILL<sup>†</sup>

Methods utilized by document examiners for the restoration of ink writing obliterated by mechanical or chemical means are based upon reactions of certain agents with residual salts in the document which have remained unaffected by the erasing process. The present paper is concerned with a brief outline of these methods, and with a suggested procedure to be used in place of the ammonium sulphide fuming process, which is generally considered the most satisfactory so far developed.<sup>1</sup>

In erasing by abrasion, it is of course possible to remove the paper fibers to such a depth that little or no inorganic residues remain, making it practically impossible to recover the original writing, but when erasures are carefully and neatly produced, usually only the surface fibers are taken away, with the inorganic materials left undisturbed and decipherable by chemical treatment. In erasing by chemical means, solutions are applied which bleach or decolorize the pigment, thus rendering it invisible. Since the appearance on the market of so-called "ink-eradicators," very skillfully executed erasures can be easily produced by anyone. However, the invisible residues in the paper are usually not affected by the process, so that the original writing in many instances can be restored.

With present methods, restorations are most successful in instances where the original writing was made with inks containing an appreciable amount of iron—as in the common "iron-gall" inks—the erased area being subjected to the action of some reagent which will form a dark-colored compound with the invisible ferric salt in the paper. In recent years reactions with other inorganic components of inks have been utilized,<sup>2</sup> but these seem to possess a number of disadvantages and are not generally used.

<sup>†</sup> Instructor of Police Science, Scientific Crime Detection Laboratory of Northwestern University School of Law.

<sup>1</sup> In addition to the chemical methods of restoring erasures, faded or partly effaced writing frequently can be deciphered with the aid of ultra-violet light and also with various photographic procedures. These are so well known that no discussion of them is included here.

<sup>2</sup> Söderman, H. and O'Connell, J. J., *Modern Criminal Investigation*, pp. 410-412 (1935).

The common methods for restoring effaced ink writing may be outlined as follows:

I. Methods involving application of liquids:

A. Reactions with chlorides or sulphates:

(1) Treatment with silver nitrate, which reacts with chloride residues to form silver chloride, which in turn is reduced to metallic silver with alkaline formaldehyde or alkaline sodium bisulphate.

(2) Treatment with lead perchlorate, which produces lead sulphate from the sulphuric acid remaining in the paper; the invisible sulphate is then converted into lead sulphide by the application of sodium sulphide and potassium hydroxide.

B. Reactions with iron:

(1) Addition of ammonium or potassium hydroxide, which precipitates the ferric iron as reddish-brown ferric hydroxide.

(2) Treatment with acidified potassium ferrocyanide, which forms a precipitate of blue ferric ferrocyanide ("Prussian-blue").

(3) Application of dilute tannic or gallic acids which form blue-black compounds with iron salts.

II. Methods involving application of vapors:

(1) Ammonium hydroxide vapor method.

(2) Application of hydrogen sulphide, or the vapor of ammonium sulphide, forming brown or black iron sulphide.

The liquid reagents are seldom used in every day practice by document examiners, principally because they stain or discolor the document, a very undesirable feature in the handling of most legal papers. A reagent which can be applied in the form of a vapor is desirable in most cases, because the application can be controlled, and objectionable alterations in the document reduced to a minimum.

The "fuming" of documents bearing erasures with the vapors obtained from ammonium sulphide seems to be the standard procedure employed by document examiners at the present time. The technique of the method is described elsewhere<sup>3</sup> and need not be

<sup>3</sup> Osborn, A. S., *Questioned Documents*, pp. 547-549 (1929).

considered here. Ammonium sulphide has been used successfully for many years, but the reagent possesses a number of disadvantages, the more important of which are the following: (1) The reaction is extremely slow, so that difficult cases necessitate the application of the vapor for several hours; (2) The reagent is not particularly sensitive, and therefore is restricted in its application almost exclusively to erasures of so-called "iron-nutgall inks" which contain a considerable quantity of iron salt, one of the principal ingredients of inks of the "blue-black" type; (3) The resultant coloration is frequently a weak bluish or greenish brown, not contrasting strongly with over-writing in blue or black ink or with the brown coloration of the paper, making decipherment somewhat difficult; (4) The apparatus used cannot be carried conveniently, and, together with the disagreeable odor of the sulphide, the method is rather difficult and unpleasant to use.

#### *The Sulphocyanic Acid Method*

Although sulphocyanic acid has long been known to chemists as a sensitive reagent in testing for iron, its application as a useful agent for restoring erasures seems to have been overlooked by investigators.

The writer has made extensive tests of this reagent, and has developed a simple applicator for using it in the form of a vapor which is both convenient and efficient. The method has none of the objectionable features of ammonium sulphide, since it is extremely rapid in reaction, unusually sensitive, and produces a blood-red coloration contrasting strongly with overwriting or alteration.

Crystalline potassium sulphocyanate is placed between wads of cotton and glass wool in a Gooch funnel,<sup>4</sup> and moistened with a few drops of dilute hydrochloric acid (10%). The document bearing the erasure is held before the mouth of the funnel, and the operator blows through the stem causing the vapor of the sulphocyanic acid generated in the tube to be sprayed over the surface of the paper.<sup>5</sup> If iron is present in the erasure it will react with the vapor, forming blood-red ferric sulphocyanate:



Because of the extreme sensitivity of the reagent the method

<sup>4</sup> A glass funnel with a cylindrical body.

<sup>5</sup> The sulphocyanates should not be confused with the *cyanides*, which are extremely poisonous substances. With reasonable care in handling, the apparatus can be used with absolute safety.

is especially useful in dealing with not only the blue-black inks, but also with the inks containing very small amounts of iron, such as certain blue and jet black inks. Samples of chemically erased writing in the following common types of inks were successfully restored with sulphocyanic acid: Parker Blue black, Washable blue (Quink) and Royal blue; Sheaffer Royal blue (Skrip) and Washable blue; Sanford Blue-black, Jet black, and Royal blue; Carter Midnite Blue black, Ryto Blue black, and Midnite Blue; Waterman Blue black, Blue, and Jet black. (Negative results were obtained in all tests on violet, red, and green inks, and on eradicated typewriting.) No analyses of the inks were made and it is possible that the results in some cases were due to contaminations, but the restorations in all cases were sufficiently distinct to be easily legible.<sup>6</sup> The coloration obtained is not permanent, but is quite persistent, remaining for a period of from two days to several weeks. Even though fading should occur the restoration can be made repeatedly by fresh application of the vapor. If it is desirable to cause the recovered writing to disappear, this can be accomplished by fuming with ammonium hydroxide vapor.

A stoppered applicator can be conveniently carried on the person and is admirably adapted for field work in cases involving impounded or unremovable documents. It is especially valuable for use in the courtroom for bringing out writing before judge or jury.

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<sup>6</sup> The effect of possible contamination in various types of ink through the use of steel pens is the subject of a study now in progress.