William M. Riordan,[1] *B.A.*

Detection of Nonvisible Writings by Infrared Luminescence and Ultraviolet Fluorescence

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ABSTRACT: The presence of nonvisible written material was detected on documents during an examination for infrared luminescence. An experiment was conducted to examine absorption by paper of noncolor ink components from documents bearing written material. Various inks were used to prepare sample writings. Each sample writing was prepared on an original sheet of paper with a corresponding undersheet. These sheets were then placed between upper and lower protective sheets. Each four-sheet sample was left intact for a 72-h period. The presence of nonvisible writing resulting from the absorption by paper of noncolor ink components was detected on particular sample sheets when examined for ultraviolet fluorescence and infrared luminescence. The methods used and the results are discussed.

KEYWORDS: questioned documents, inks, nonvisible writing, infrared luminescence, ultraviolet fluorescence, absorption, noncolor ink components

Just as the detection and decipherment of indented impressions on questioned documents are often helpful in linking a questioned document with an individual or a source, the detection of nonvisible written material may prove equally valuable.

Although no extraneous indented impressions were found during a routine examination of fraudulent tax documents, the presence of nonvisible written material was observed during an examination for infrared luminescence (Figs. 1 and 2).

An experiment using various ball-point and fluid inks was conducted to examine the absorption by paper of noncolor components of inks from documents bearing written material.

Materials and Methods

Standards were prepared using 100 pens equally divided into four categories by the type of ink: blue ball-point, black ball-point, blue fluid, and black fluid ink. Each pen was assigned a number for differentiation purposes. The sample writings were prepared on nonfluorescent paper. A standard No. 2 filter paper was used in this experiment because it contains no additives that might interact with the ink components to cause fluorescence. The writing was executed on an original sheet of paper with a corresponding sheet underneath.

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[1]Senior document examiner, Internal Revenue Service, National Forensic Laboratory, Chicago, IL.

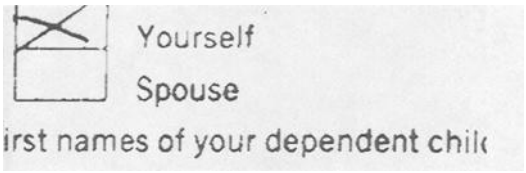

FIG. 1—*Portion of a tax document bearing nonvisible writing.*

FIG. 2—*Infrared luminescence of nonvisible writing.*

Immediately after the preparation of the standards, each undersheet was examined for infrared luminescence and ultraviolet fluorescence of any nonvisible writing. The results of this preliminary examination were negative.

Each sample (consisting of an original sheet and a corresponding undersheet) was then placed between two additional sheets of nonfluorescent paper for protection, forming a four-sheet set. The samples were then left intact for a 24-h period. After the 24-h period, the samples were again examined for infrared luminescence and ultraviolet fluorescence of any nonvisible writing, with negative results.

The samples were then left intact for an additional 48 h. At the end of this 72-h period, the samples were again examined. The presence of nonvisible written material resulting from absorption of noncolor components of particular sample inks was detected by infrared luminescence and ultraviolet fluorescence (Figs. 3, 4, and 5).

Results and Discussion

Absorption of noncolor ink components occurred in more instances on the top protective sheets, placed over the original sheets bearing the sample writing, and in fewer instances on the corresponding undersheets. The absorption occurred within all four categories of ink (blue ball-point, black ball-point, blue fluid, and black fluid ink).

Absorption of noncolor ink components was detected by infrared luminescence in only 2 of the 100 samples. These same 2 samples also fluoresced under ultraviolet light. Detection of absorption of noncolor components by ultraviolet fluorescence occurred with 49 of the 100 samples.

Of the 25 samples in which blue ball-point ink was used, nonvisible writing was detected in 16 of the samples. Absorption of noncolor ink components occurred on the top protective sheet placed over the original sheet bearing the sample writing on 16 of the samples, and on the corresponding undersheet of 7 of these 16 samples.

Of the 25 samples in which black ball-point ink was used, 14 of these samples developed nonvisible writing on the top protective sheet and 5 of these 14 samples also developed nonvisible writing on the corresponding undersheet.

With the blue fluid ink samples, 11 of the 25 samples developed nonvisible writing on

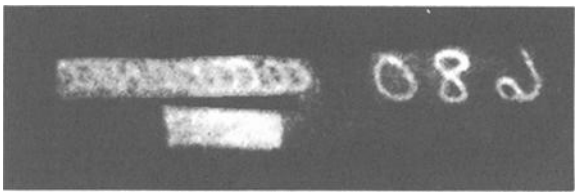

FIG. 3—*Ultraviolet fluorescence of absorption on a top sheet.*

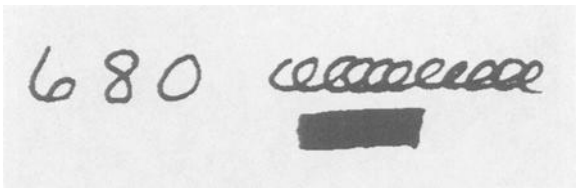

FIG. 4—*Sample writing on an original sheet.*

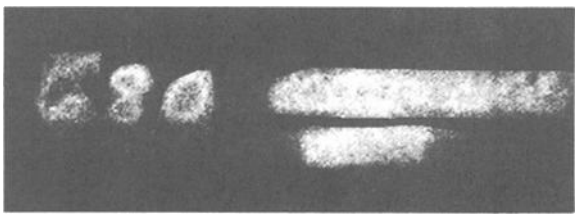

FIG. 5—*Ultraviolet fluorescence of absorption on a corresponding undersheet.*

the top protective sheet and 8 of these 11 samples also developed nonvisible writing on the corresponding undersheet.

The black fluid ink samples developed nonvisible writing on the top protective sheet of 8 samples, as well as on 6 of the corresponding undersheets of the same 8 samples.

The phenomenon of nonvisible writing resulting from the absorption of noncolor ink components may also occur when a "carbonless copy paper" is used as a cover document [*1*].

> The reverse side of the top sheet has a coating of microcapsules which contain a solution of a so-called color former. This is a chromogenic compound in its colorless form.

The top sheet of a "carbonless copy paper" set was placed over a piece of filter paper and writing was applied to the top sheet. Nonvisible writing was detected on the undersheet when examined for infrared luminescence (Figs. 6 and 7).

Variables affecting the absorption of noncolor ink components include the components of the ink, the physical properties of the paper, the time period of contact, and the storage conditions of the documents. Also "disappearing" inks, "invisible" inks, and some eradicated inks may exhibit similar fluorescence or luminescence.

The following authors have reported on the optical examination of inks related to forensic document problems: Cantu and Prough [*2*], Ellen and Creer [*3*], Mathyer, Veillon, and Rothenbuehler [*4*], and Von Bremen [*5*].

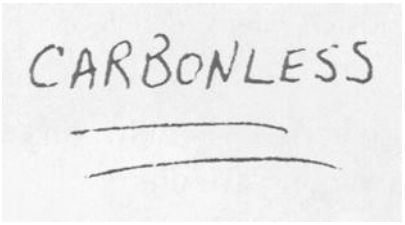

FIG. 6—*Writing on a top sheet of "carbonless copy paper."*

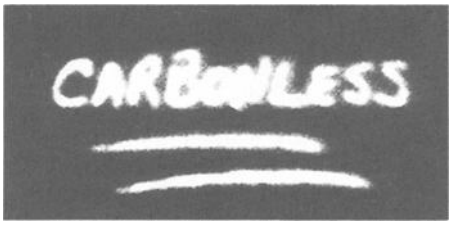

FIG. 7—*Infrared luminescence of nonvisible writing on an undersheet.*

Conclusion

Nonvisible writing on questioned documents, which may or may not be accompanied by detectable indented impressions, can sometimes be detected by infrared luminescence and ultraviolet fluorescence. This evidence may prove to be helpful in linking a questioned document with an individual or source, or in showing a relationship between two or more documents.

References

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Address requests for reprints or additional information to
William M. Riordan
Internal Revenue Service
National Forensic Laboratory
29 North Wacker Drive, 3rd Floor
Chicago, IL 60606