Determining the Sequence of Non-Intersecting Media on Documents: Ballpoint Pen Ink and Laser Toner Entries

Valery N. Aginsky

Forensic Ink Chemist and Document Dating Specialist, Riley, Welch & Associates Forensic Document Examinations, Inc., 920 Trowbridge Road, East Lansing, MI 48823

This paper describes a technique for establishing the sequence of ballpoint ink entries and laser-printed entries in instances when these entries do not intersect.

Introduction

Numerous techniques have been developed to determine which of two intersecting pieces of information on a document was added last. Poulin (1996) reported a comprehensive review of methods for establishing the sequence of strokes. Later, Planty (1997) reported a technique for determining the relative chronological sequence of intersecting ballpoint pen lines and laser printed marks on documents.

Until now, none of the published works known to this author reported the possibility of determining the sequence of *non-intersecting* ballpoint pen lines and laser printed marks. A necessity to determine the chronology of non-intersecting handwritten and machine printed entries has often been encountered in this author's casework. A typical question at issue was whether the document was signed after the text had been printed or whether the text was added to a blank sheet of paper that already contained a signature?

In a typical laser printing process, the laser transmits an image from a computer to the surface of an electrostatically charged cylinder (photosensitive drum) so as to destroy the charge in those areas where the document being printed will be "white." The negatively charged toner particles are then attracted to the residual positive charge of the drum bearing the image (text). The toner is subsequently transferred to the paper and fused to its surface through heat and/or pressure.

It is a well-established fact that while entries or images are being printed on paper, numerous toner particles, invisible to the naked eye, are transferred and fused to the "white" areas of the paper containing neither graphics nor the text. Usually, these toner particles ("blemish marks") are randomly distributed over the surface of the laser printed document. Under the microscope, they have a round, elliptic or irregular shape and a black sheen. Their size (a few micrometers in diameter) is significantly less than the width of a very thin handwritten ink line.

This study was undertaken to validate the hypothesis that, if a laser printed document bears ballpoint pen entries, the appearance of the fused toner particles will be clearly different depending on whether they are situated over or under the ink.

Methods and Materials

Specimens

Lines of 10 ballpoint inks of different formulas and colors (black, violet, blue, red and green) were placed on white and yellowish-gray sheets of paper. Then (in a few hours/days) several lines of printing were produced on each sheet of paper

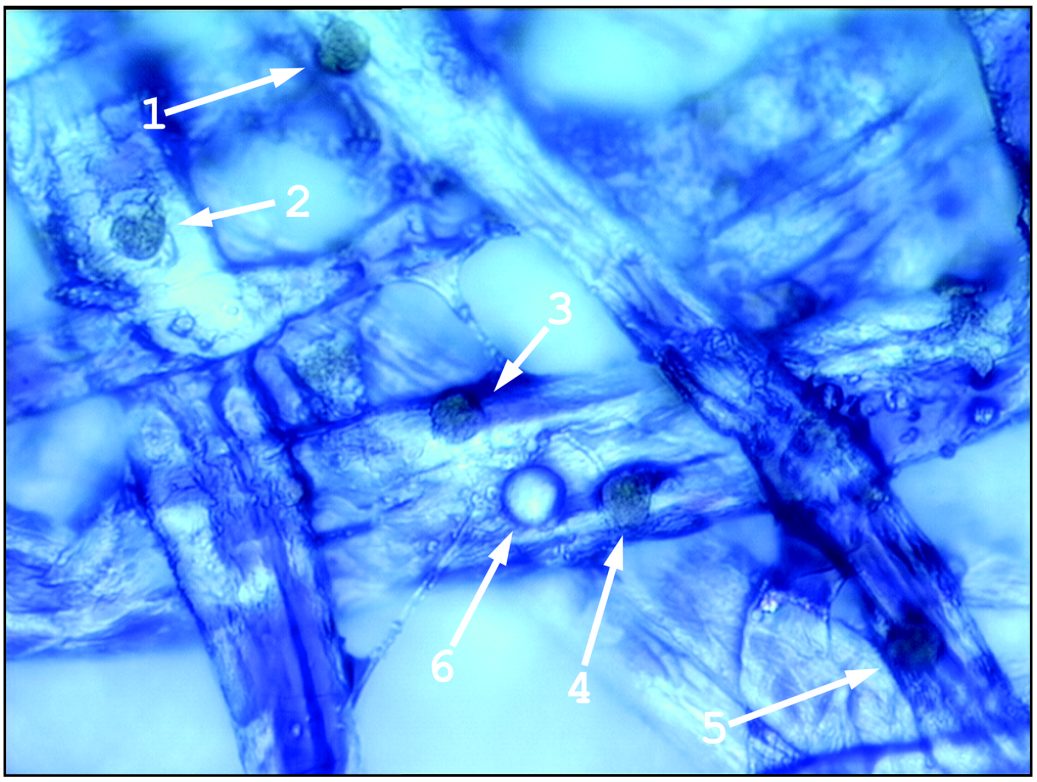

Figure 1. Toner under ink.

using a laser printer. Finally, lines of the same ballpoint inks were added to the sheets of paper.

Microscopy

The specimens were viewed with a Carl Zeiss Neophot-30 reflected light photomicroscope at magnifications between 125 to 500 times. Images of the specimens were captured using JVC video equipment and transferred to a personal computer to be processed with VideoTest-4.0 image analysis software.

Results

Fused toner particles under ballpoint ink

Figure 1 shows a typical bright field image (320x magnification) characterizing the appearance of fused toner particles under the ink. The toner particles look as if they are flat round buttons. The rim of the "button" is dark gray while its center either has the color of the ink (areas 1 through 5) or is practically colorless and glossy (area 6) due to the specular reflection of ink covering the toner.

Fused toner particles over ballpoint ink

Figure 2 shows a typical bright field image (320x magnification) characterizing the appearance of fused toner particles over the ink. The shape and color of the toner particles fused on the ink surface (areas 1 and 2) are similar to the shape and color of toner particles fused on blank areas of the paper (area 3).

If, during the laser printing process, a toner particle is deposited on a thick layer of ink, the particle sinks into the ink forming a "crater." The toner particle appears to lie on the bottom of the "crater" (area 4).

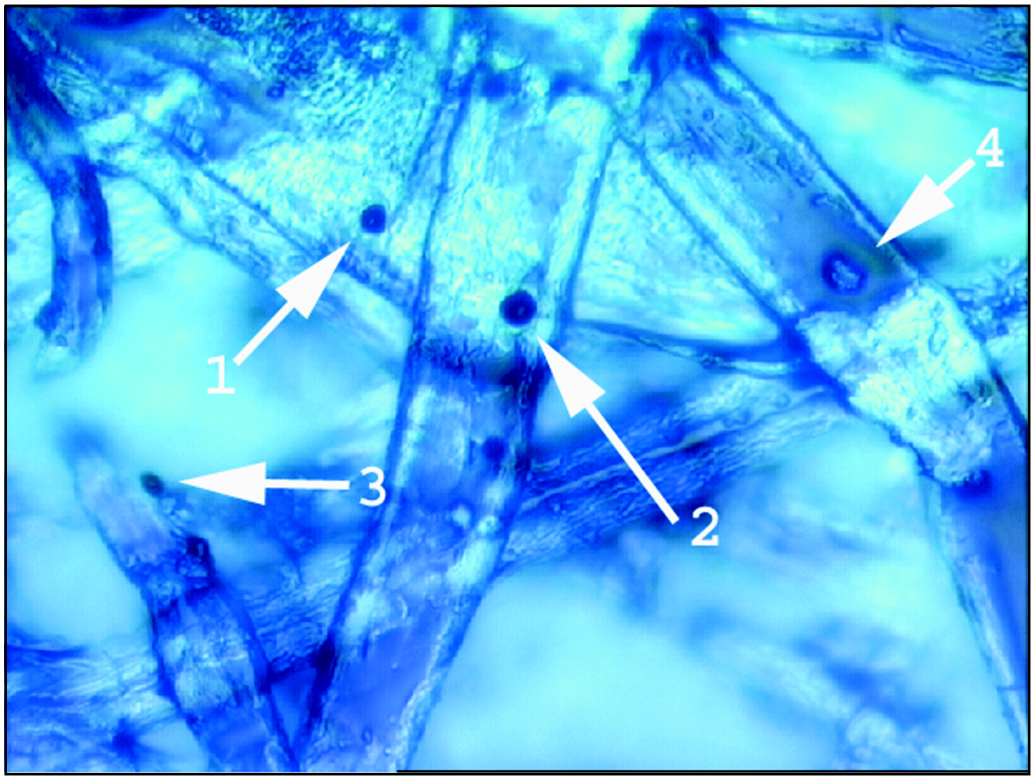

Figure 2. Toner over ink.

Discussion

Case Example

This technique was used in a criminal case where the deputy director of a trade firm was suspected of creating a counterfeit cession treaty. The text of the treaty was made with a laser printer. Both a director and the deputy director of the firm signed the document with ballpoint inks. The director claimed that he had not signed the treaty. He recalled signing a few clean sheets of paper as he was leaving his office for a business trip and giving them to the deputy director to prepare some urgent documents during his absence.

Neither of the two signatures intersected the laser printed text on the questioned document. The microscopic examination (using the above described equipment) revealed that the fused toner particles were *under* the ink strokes of the deputy director's signature and *over* the ink strokes of the director's signature. Thus, the results of the examination established the order of the three non-intersecting pieces of information placed on the questioned document: first, the director's signature, secondly the printed text, and finally the deputy director's signature.

Faced with these findings, the deputy director of the trade firm admitted he had made a counterfeit cession treaty using one of the blank sheets of paper signed by the director.

Conclusion

This paper shows a useful method for determining the chronology of non-intersecting handwritten and machine printed entries - specifically those produced by ballpoint pens and laser printing.

Acknowledgements

The author thanks Ilya Afanas'ev and Nicky Sokolov, Forensic Science Center of Russia's Ministry of the Interior, for access to the microscope used in this work. Special thanks go to Thomas P. Riley for his useful and constructive comments in the preparation of this paper.

References

Planty, M.G. (1997). Determining the Relative Chronology of Intersecting Ball-Point Pen Lines and Laser Printed Document Marks – Linton Godown Revisited, *International Journal of Forensic Document Examiner*s, Vol. 3, No. 1, pp. 31-34.

Poulin, G. (1996). Establishing the Sequence of Strokes: The State of the Art, *International Journal of Forensic Document Examiner*s, Vol. 2, No. 1, pp. 16-32.