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## Illusions of Tracing

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**REFERENCE:** Vastrick, T. W., "Illusions of Tracing," *Journal of Forensic Sciences*, JFSCA, Vol. 27, No. 1, Jan. 1982, pp. 186-191.

**ABSTRACT:** Numerous explainable phenomena occur in handwriting that give the product the illusion of being a tracing. This paper exposes various illusions of tracing by describing specific case studies that include diffusion of ink components viewed under infrared luminescence, "sister" lines, rough writing surfaces, writing machines, and plastic lamination. Also discussed is a common principle that exposes illusions.

**KEYWORDS:** questioned documents, tracings, forgery, infrared luminescence, writing machines, guidelines, sister lines, indentations

Numerous questioned signatures have been examined by this author that have contained typical characteristics of a tracing. These signatures, however, were subsequently found to be either genuine signatures, simulated forgeries, or simple forgeries containing certain characteristics promoting an illusion of tracing. These characteristics included apparent guidelines, apparent differences in infrared luminescent properties, and embossed dots located along the entire writing line. A few of these illusions have been discussed previously, in the literature [1] and in less formal presentations. This paper gives consolidated exposure to various illusions of tracing using specific case studies and discusses a common principle that exposes illusions.

### The Illusions

The illusions of tracing noted by this author encompassed a variety of formats. Predominant among these formats were "sister" lines (defined below). These lines were found on various types of paper for a number of reasons. Other formats included diffusion of ink components as viewed under infrared luminescence, the use of a rough writing surface, writing machines, and documents encased in plastic lamination.

### Sister Lines

A sister line is a line or indentation that is separate but geometrically equidistant from the primary line. These lines are caused by pressure resulting from contact between the ball housing of a ball-point pen (that part of a ball-point pen that holds the rotating ball in place) when held at an acute angle and the document during the writing process. Sister lines caused by this independent pressure are directly attributable to either the type of paper used or inherent problems in ball-point pens. These lines have been noted in zinc-oxide-coated paper,

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no-carbon-required (NCR) paper, business forms utilizing two-sided carbon paper, and commercial grade papers, such as bond, notebook, and safety. Created by the same writing act, sister lines contain the exact same movements and characteristics. By mapping corresponding characteristics between the primary line and the sister line, a determination can be made as to the pen position while writing. This determination can substantially indicate which hand the writer used in preparing the document. For example, movements in the sister line of a right-handed writer will often be located below and to the right of the corresponding movement on the primary line.

Zinc-oxide-coated paper is commonly used in many photocopiers. Its metallic surface is actually harder than the metal used to coat the ball housing of many ball-point pens. As a result, when a ball housing is rubbed along the surface of zinc oxide during the writing process, some of the coating of the ball housing may be scraped from the writing instrument and deposited on the surface of the paper in the form of a sister line. This sister line bears a striking resemblance to a pencil line. This phenomenon will gradually disappear as the coating of the ball housing is rubbed away. In a previous paper written about sister lines on zinc-oxide-coated paper [1], it was stated that the sister lines completely disappeared after only a few letters. This writer has not found it uncommon for sister lines to be present throughout the entire signature. Original experimentation revealed that both pressure and pen position are among the variables affecting the continuity of sister lines on zinc-oxide-coated paper.

Since its inception in 1954, NCR paper has become increasingly common throughout the business world. It is a carbonless, business form paper [2] that provides simultaneous multiple copies of the original without the use of carbon paper. This is achieved through a chemical transfer system that uses colorless dyes and a clay-like coating. Pressure from handwriting, typewriting, or printing ruptures the microscopic capsules containing the colorless dye on the reverse side of the original directly under the writing line. The dye obtains its color through a chemical reaction with a clay-like coating on the surface of the copy. Sister lines are created when a ball-point pen (or similarly designed writing instrument such as a "rolling writer") is held at an acute angle so that pressure from the ball housing independently ruptures the microscopic capsules. These sister lines, of course, would not appear on the original form; however, corresponding indentations may be present.

Credit card sales receipts frequently incorporate the use of two-sided carbon paper between the copies. One side of the carbon insert is for copying information written on the top sheet to the copies below. The other side is used for copying information from the charge card to the copies above. A unique characteristic of this type of business form is that any information written on the front side of the top sheet will not only be copied on the front side of the second sheet but also on the back side of the top sheet. Sister lines on the back side of the front sheet, as seen in Fig. 1, are created when a ball-point pen is held in such a way that pressure from the ball housing creates an independent carbon transfer. This sister line is quite visible through the very thin paper.

Commercial grade papers, such as stationary, bond paper, and notebook paper, are not immune from the formation of sister lines. The cause of these sister lines is, again, pressure on the paper by the ball housing of a ball-point pen held at an acute angle. However, sister lines on commercial grade paper can be found in the form of indentations. Figure 2 depicts an actual case that contained this phenomenon. Adding to the difficulty of the examination in this case was the slowly written writing line.

In addition to sister lines conditional on the type of paper used, these lines can also result from inherent problems in ball-point pens. Ink can collect and dry on the edge of the ball housing. When the pen is held at an acute angle so that the coagulated ink comes in contact with the document during the writing process, some of the ink can be transferred to the document in the form of a sister line. These lines contain features consistent with deposited coagulated ink ("gooping") and should be readily identifiable as such. In addition, this phenomenon should be isolated within a small portion of the questioned signature. Certain

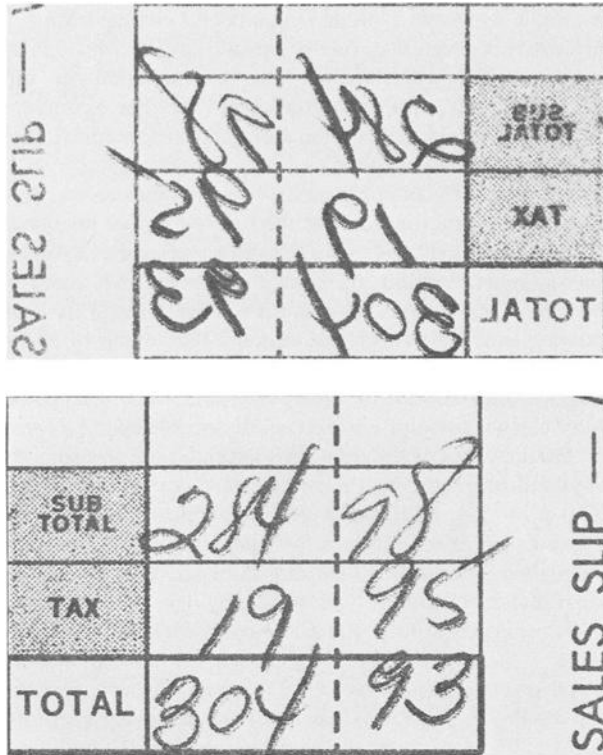


FIG. 1—Photographs of the two sides of the top sheet of a credit card receipt form from an actual case; (top) back side: the two-sided carbon paper adjacent to this side of the document left these impressions of the original writing from the front side and the sister line formed by pressure from the ball housing during the writing process; (bottom) front side: shown is the original handwritten amounts and the sister line on the back side of the receipt showing through the thin paper.

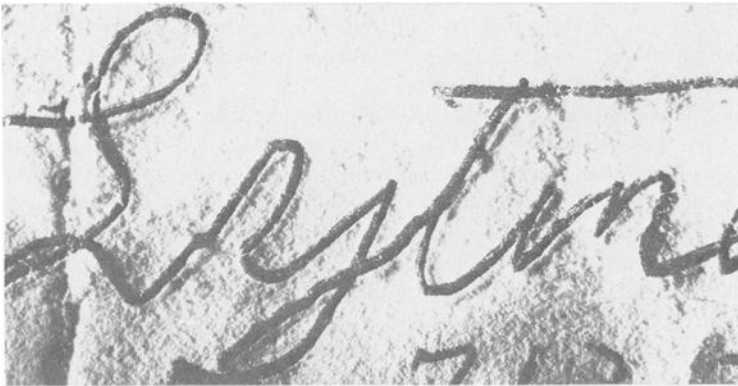


FIG. 2—Sister lines in the form of indentations consistent, in location, with a right-handed writer. Note the poor line quality as an additive feature to the illusion of tracing.

unusual burr striation formations on cases examined by this author gave an initial illusion of being two separate lines. This feature is, of course, isolated to particular pen movements and directions, depending on the characteristics of the particular pen. As such, examination beyond a mere glance should reveal the true nature of the writing.

### *Infrared Luminescence*

One form of nondestructive ink differentiation available to the document examiner is through the use of infrared luminescence. During this procedure, a primary energy source in the blue-green wavelengths of the electromagnetic spectrum is exposed to the questioned writing. Some ink components will absorb these wavelengths without any secondary heat emission characterized by a black appearance through an infrared viewer or on special film. Some ink components will absorb these wavelengths and, as a result, emit secondary heat characterized by a glowing white appearance through an infrared viewer or on special film. It is not uncommon for an ink to have certain components that emit secondary heat and other components that do not. This can result in the masking of the heat-emitting components to various degrees by the other components.

The signature in Fig. 3 appears to consist of two different writing lines as would be found in a guideline tracing. However, what cannot be ignored in this examination is that the two writing lines contain the exact same movements and characteristics. The signature, therefore, must be the product of a single writing act due to the axiom of handwriting comparison that states that separate writing acts, including tracings, cannot be exactly alike. The illustrated phenomenon resulted from the diffusion of certain components within the ink that will emit secondary heat during infrared luminescence examination from other components within the ink that normally mask the emission.

### *Rough Writing Surface*

There are times when factors other than the writer, writing instrument, or the specific document can have a substantial impact on the written product. Writing onto a document that is on a rough surface is one example of this outside influence. Figure 4 depicts handwriting from a case examined by this author containing apparent tremor and abrupt directional changes in the writing line. In addition, examination of the writing by side lighting disclosed a series of dots deeply impressed into the paper surface along the entire writing line, as if the signature were a connect-the-dots tracing. The unique aspect of these suspi-

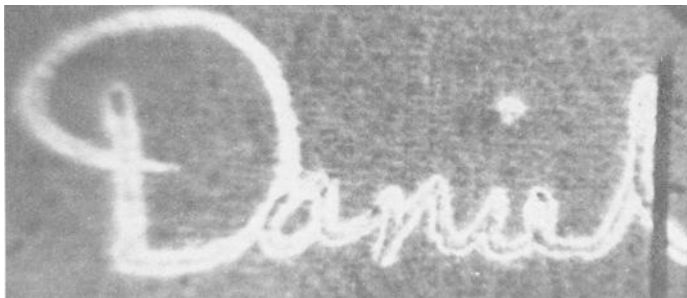


FIG. 3—*Infrared luminescent photograph of a questioned signature. Normally, the secondary heat emission is masked by the ink components appearing dark in this photograph. However, in this case, heat-emitting components have diffused into the surrounding paper fibers.*

cious writings depicted in Fig. 4 is that they were part of the known request specimens obtained in the presence of an investigator!

Although these characteristics commonly associated with tracings were present, other features were present that contradicted the tracing theory. The signature, although containing apparent tremor, displayed various characteristics consistent with speed of execution, such as tapered initial and terminal strokes and pen pressure variation. The "tremor" in the writing also showed a uniformity inconsistent with slowly drawn handwriting. In addition, the dots appeared much too numerous, equally spaced, and too pronounced for tracing purposes. Finally, it was noted that the writing line always crossed directly over the dots. This shows a lack of variation inconsistent with two separate writing acts. It would be expected, and rightfully so, that the pen line would not cross over the center of each and every dot. Writing onto a document that is on a rough surface will recreate these seemingly contradictory set of features. The rough surface will guide the pen slightly in one direction or the other, creating the characteristic "tremor." In addition, the writing instrument, while moving over the paper surface, will act as a localized embosser, impressing and embossing the depth variations of the writing surface onto the document and creating the characteristic dots.

#### *Laminated Documents*

Many of today's important documents are being protected against wear, water, and even tampering by plastic lamination. However, in an interesting case examined by this author it was the lamination that gave a questioned signature the illusion of tracing. The signature was written in blue ink, but within portions of the blue writing were thin black lines. Examination revealed that the black lines were located at specific points within the blue writing line where the plastic lamination was not in direct contact with the document. It appeared that contact was not made because of the depth of the furrow created by pressure from the writing instrument. The possibility that this phenomenon was the result of a chemical reaction was eliminated when the lamination was removed and the thin black lines disappeared. It appears that these disappearing lines were the result of light refraction differences (the bending of light rays). This hypothesis would account for the black color, which is characteristic of refractions of this kind, and for its disappearance when the lamination was removed.

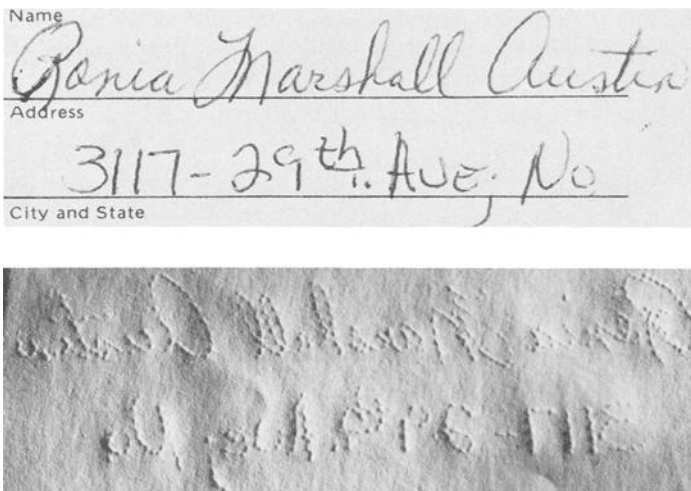


FIG. 4—The questioned writing (top) and its reversed image of the backside (bottom) disclosing the "tremor" and dots.

### *Writing Machines*

Since before the turn of the century, people have patented devices engineered to repeatedly "sign" a name. Although not a relatively common part of the business community today, there are numerous, diverse writing machines available on the market. Consideration of these writing machines with regard to tracings results in a dilemma. Thought must be given to the suggestion that the products of various writing machines are actually a form of tracing or even of genuineness. One thing is certain—the appearance of numerous signatures bearing a high degree of similarity should warrant serious examination into the possibility of tracing. Because of the diversity of writing machines and their class characteristics, no simple key to differentiation can be made. Some of the common features to observe and analyze include the lack or presence of tremor, pen pressure, and apparent speed of execution. Numerous articles have been written on the subject of writing machines [3,4] and will not be elaborated on herein. It is suggested that reference be made to one of these papers should the need arise.

### **Summary**

A number of examples have been demonstrated, all of which contain illusions of tracing. As can be clearly seen, the circumstances surrounding the creation of these illusions are both diverse and unpredictable. However, a common principle applied to their examination will assist in exposing any illusion. An illusion of tracing will contain at least one contradiction of handwriting identification axioms, whereas a true tracing will not. For example, many of the illustrations set forth previously contained an apparent guideline. Some of these illustrations also contained textbook tracing characteristics, such as a slow, drawn-like line quality, pen stops, and blunt initial and terminal strokes. However, it was also noted that these apparent guidelines and their primary lines contained the exact same movements and characteristics. To an extent, this sameness is a characteristic of tracing. But even tracings will show a degree of difference consistent with separate writing acts.

The examples depicted in this paper have graphically demonstrated the need for comprehensive and thorough examinations of apparent tracings, even when seemingly overwhelming evidence of such is present. It is hoped that readers will realize and reinforce in their minds the need for thoroughness and reasoning in every examination.

### **References**

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