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Determination of Sequence of Strokes: Under Various Light Sources and Conditions

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ABSTRACT

"Document: Anything written on any surface using any material"

Analysis of sequence of movement of ink in strokes is easily analyzed by examining physical features of fiber of writing surface, for instance, writing surface, such as, normal paper made from lignin rag, printing paper made from chemically treated wood-pulp & wrapping paper from jute, hemp & old rope, bears characteristic feature because of presence of individual characteristic feature of each component of writing surface. These features plays vital role in absorption or adsorption, as the case may be, of ink on the writing surface. An examiner may easily determine Sequence of execution of Strokes by examining characteristic features of writing instrument and surface at the intersection of strokes. In this paper author have examined various types of intersections i.e. Different inks on different surface under various and necessary equipment's, author have also examined printing ink, carbon ink and others for concluding specific features, to be consider by an examiner for the determination of Sequence of Strokes.

KEYWORDS: *Stroke, Fiber, Lignin, Intersection, Guidelines, Tagging, Topography, Point-of-Sale, Illumination*

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A

B

Figure 1 : a & b ---- Texture of Writing Surface

Microscopic Analysis of Inter-sections of strokes, their characteristics, qualities, and differences with respect to interaction with the writing surface is utilized for conclusive opinion. Paper's, thickness, finish or surface, wove or laid style, cutting, ruling, padded or loose woven pattern, wire marks effects movement of writing instrument and formation of writing path.

Significance of Tagging Material in Analysis of Sequence of Strokes

Dating of ink is identified by analyzing its tagging material, in 1975, ATF initiated national ink tagging program which plays significant role for dating of ball point ink. These materials mainly use to identify manufacturer of particular ink, while in identification of these materials help to specify presence or absence of certain ink on writing surface[1]. Under high & proper magnification, an examiner may easily observe illumination of tagging material as they illuminate whenever an intense/spot light incidence over them.

Figure 2 Fluorescence of Tagging material

Intersection of Glycol based Ink, Letterpress & Lead Pencil

In case of Lead pencil deposition of Graphite during execution forms a parallel path with scratches and continuous strokes, under high magnification these particles are visible with characteristic illumination and subsequently marks their presence over ink. In the above image scratches are prominent under oblique & transverse light on the sample. These scratches will not appear, if, Lead pencil is executed before other writing instrument[1].

Figure 3 : Scratches from Lead Pencil on Glycol based Ink

Significance of Oblique Light for Observation

As per literature a standard degree for observation of strokes under oblique light is 45° [2]. Edges of any traced path by a writing instrument is observed by utilizing characteristic feature of properties of light i.e. reflection or Technology), Galgotias University refraction as the case may be. IF blots are present, under Oblique and Spot light this blot will appear as a false protrution, insite of thick deposition on writing surface whch forms a good observation for the presence of Glycol based ink on writing surface.

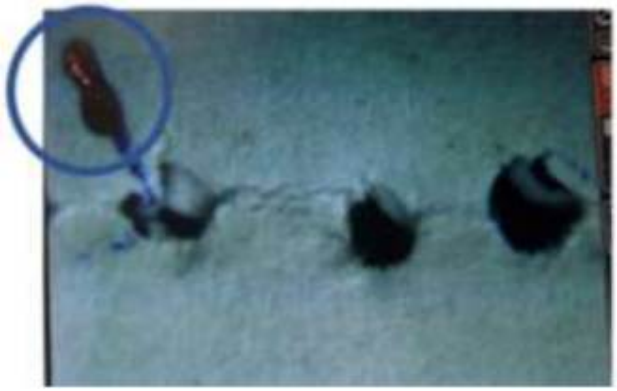


Figure 4 : Prominent feature of Writing surface under Oblique along with Spot light

While examining an horizontal surface and observing an edge of path at various angles, one may trace a continuous track of an writing instrument. Further, Sequence of strokes is important for the analysis or establishment of genuinity of any disputed document. There are no automatic or standard operating procedures to follow to conclude sequence of strokes. It solely depends on observer observation of characteristic feature of writing instrument and surface at intersection of strokes[3]. Fibers of writing surface are disturbed and form a visible track of subsequently executed stroke.

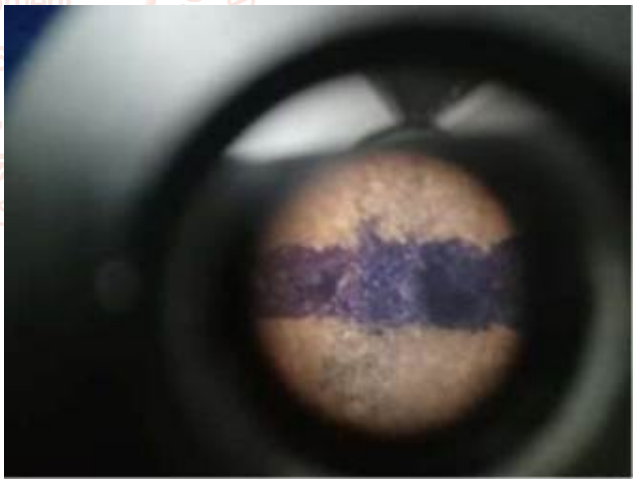


Figure 5 Prominent vertical inkless stroke is observed above Blue horizontal stroke

Printing ink (Intaglio/Letterpress) – Various types of printing processes having characteristic features plays a vital role in formation of definite or conclusive opinion by examiner, features such as, raised feature of Intaglio printing forms a 3D image of intersecting stroke by the formation of groove over the printed matter leads appearance of “feathering of ink”. This feathering is observed within the cracks of raised printing. Seepage of ink leads to formation of shaded area at the edges of Intaglio printing it also forms a

dimensional image with respect to movement of paper fiber along the movement of writing instrument..

Postage stamp is significant in estimating date of undated document, theses postage stamps have a definite date value. Below image shows signature of authorized person after adhering a postage stamp which signifies sequence of occurrence of strokes, i.e. proper preparation of any postal envelop or letter for communication[4]. Execution of signature should be after preparation of any document as perpetrators do fraudulent incidence by preparation of Built-up document.

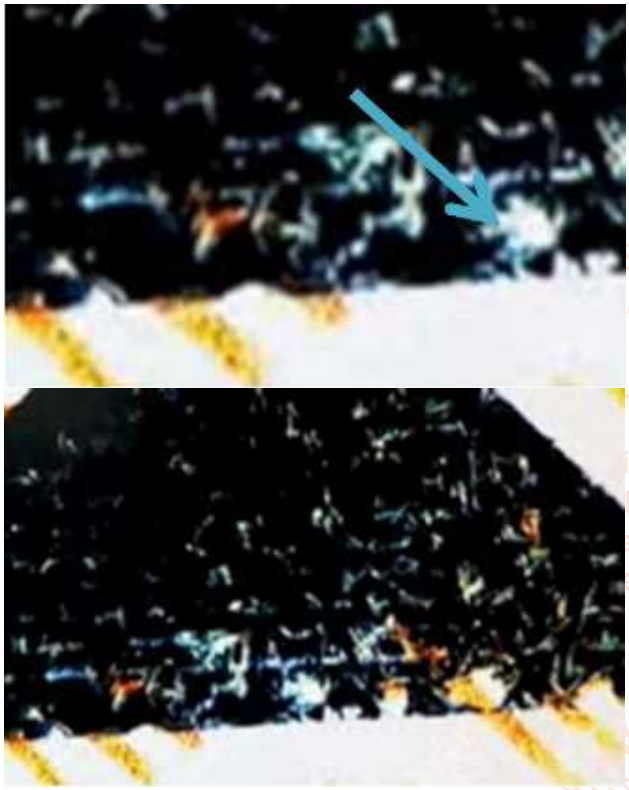


Figure 6 Seepage in Intaglio Printing

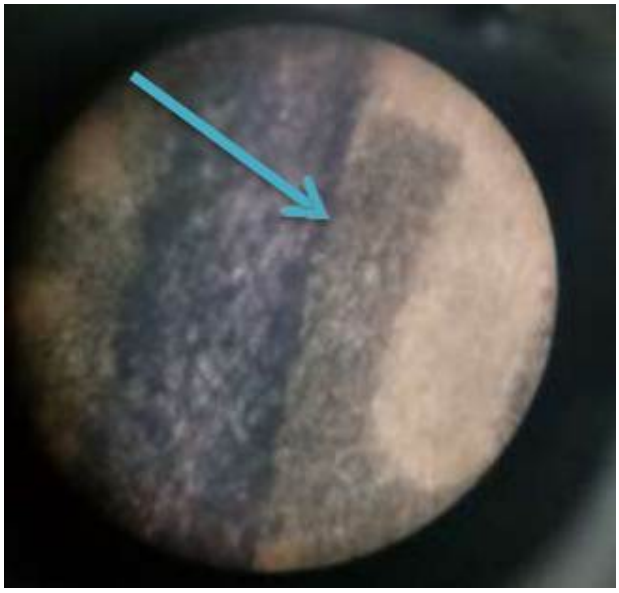


Figure 6 A Built up Document : Signature execution above Postage Stamp

For Instance, Water repellent property of postage stamp shows significant features for concluding sequence of strokes. Folds, embossing, binding marks, and postmark impressions appearing in the document can have dating value.[4]

Certain features, which forms because of combination of physical feature of Writing surface and chemical features of ink may be observed in 2D and 3D, further with respect to Hydrophobic and hydrophilic nature of ink, a deposition of ink without mixing is observed.

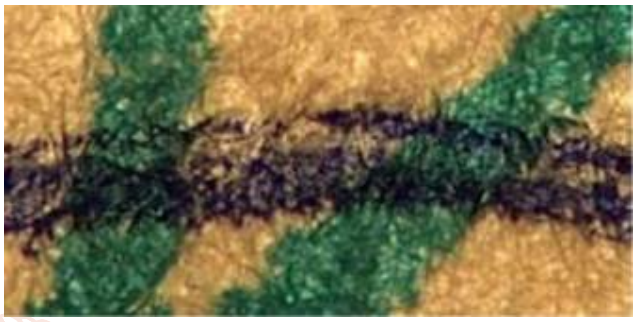


Figure 7 : Deposition of Hydrophilic and Hydrophobic ink on Writing Surface

Why Tagging material shows Fluorescence?

Whenever EMW interacts with a matter it causes a characteristic feature which is visible for an observer to arrive at a definite or conclusion opinion, such as, in case of Radio frequency Nuclear Magnetic Resonance or Electron Spin Resonance may be observe, in case of micro wave region observer will observe rotational spectroscopy of a molecule, in case of IR region observer will observe vibrational spectroscopy and in case of visible & UV region characteristics electronic transition facilitates observer to form an opinion with respect to test sample.

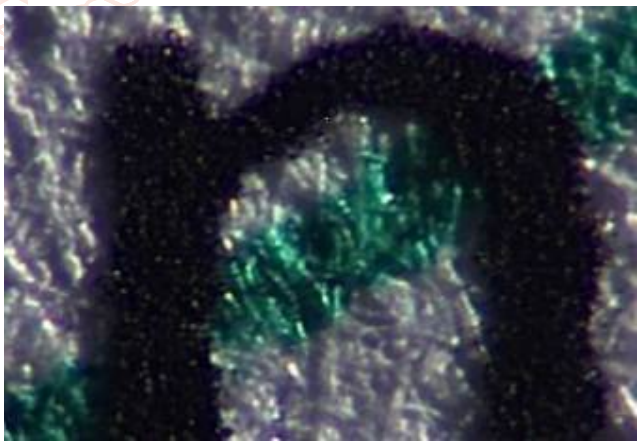


Figure 8 : Execution of Water based ink on Toner

In Laser printer, printing is done by electrostatic deposition of toner on charged surface of paper where toner is negatively charged and paper surface is positively charged, this deposition forms a second layer on paper sheet with a subsequent addition of strokes over the printed matter dragging and

adsorption/absorption is observed. In the above image printed text 'in' through laser printer with a subsequent addition of stroke of green ink pen shows a prominence of dragging and absorption of tint of ink in printer toner. A raised appearance is observed of the printed matter along with a pressed appearance of ink stroke above the printed matter, this shows a dimensional image of intersections.

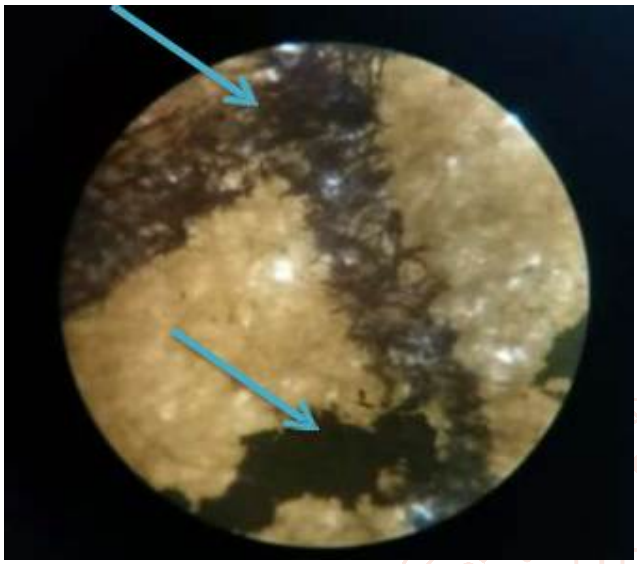


Figure 9 : Intersection of Carbon, Glycol based Ink and Printing Ink

Deposition of carbon over a printing matter results a characteristic fluorescence as the sequence of deposition makes the specific area to show fluorescence within a specific range. As carbon is opaque to Infra-Red radiation, this blocks a wide range which minimizes observer range of observance, for conclusion. Intersection of Printing ink, Carbon ink and Ball point pen ink

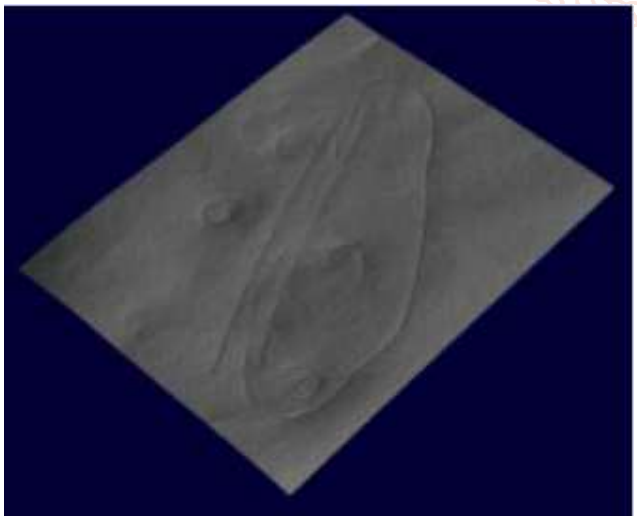


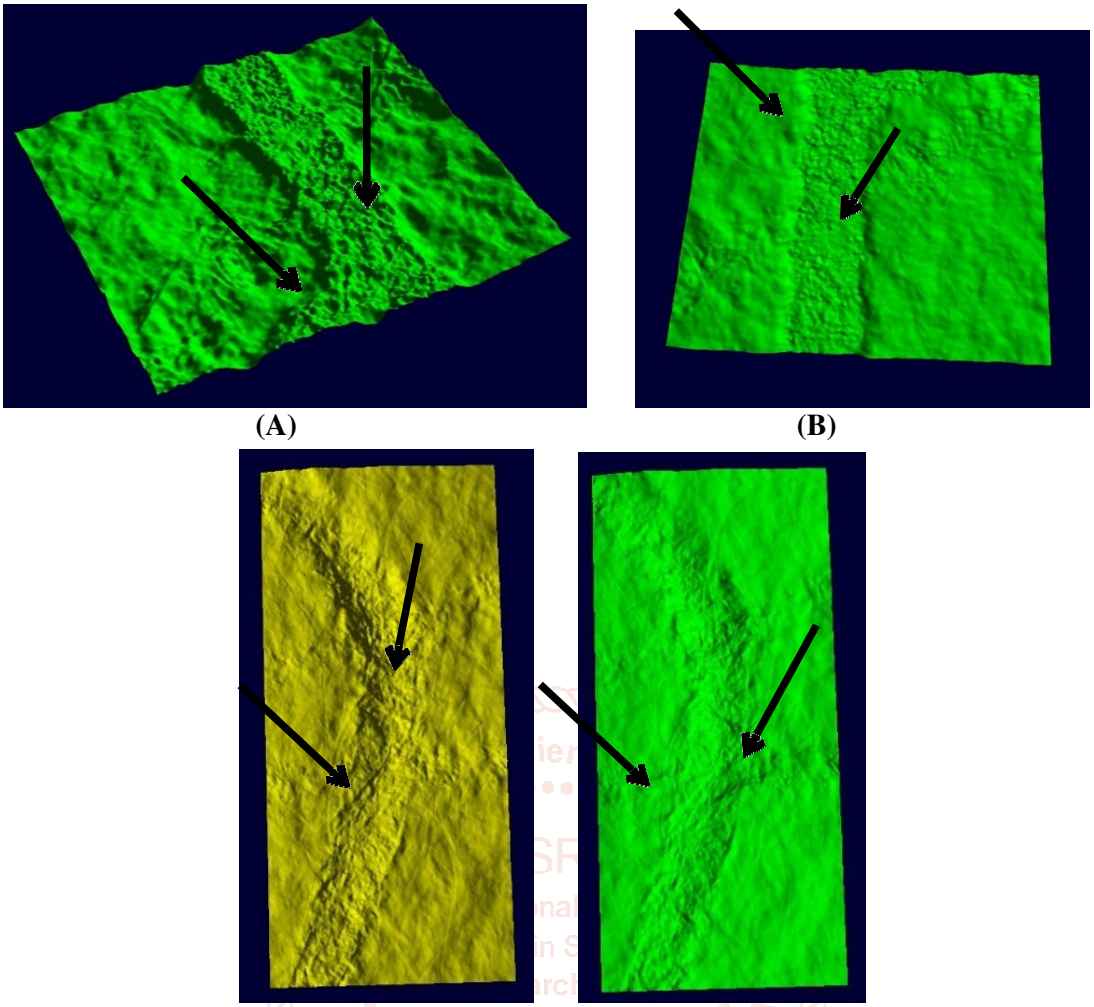
Figure 10 Prominent Indentations of Strokes

Continuity of stroke is also established by examining indentation, above image shows a prominent indented writing surface under various inclination angles. Sequence of execution of strokes preliminary may also examined by an examiner with this method as subsequent addition of strokes will intersect an earlier drawn stroke on writing surface.

Figure 11 Undulation of Writing surface

Depths of Stroke (crust & troughs) forms a depression for other track as these features may be observed in various light sources and magnification, In the above image, subsequent stroke form a continuous track with a defined depression of track. Under oblique light shadow of boundary of strokes is observed, which forms a confirmed observation of presence of pressed stroke on writing surface and undulated the surface. Inkless strokes must not be confused with impressed writing or hidden strokes, as during execution on slack of papers certain strokes form depression on subsequent pages which may forms a doubt with the continuous strokes, clarity of theses hidden strokes depends on pressure, number of sheets, nature of backing below one paper, thickness or kind of paper, and sharpness & firmness of instrument.[4]

Figure 12 Inkless Starting , Gooping in Glycol based Ink



3D Imaging Technique: (a & b Horizontal stroke; c & d Curved stroke)

Examination of writing surface under high waveband reveals physical features of writing surface. In the above image depressions made by strokes are prominent with raised & grooved surface, subsequent addition of strokes on surface forms a surface for the inclination of light at various angles which results in formation three dimensional images of particular area of writing surface.3D topography supports examiner in examination and analysis of sequence of execution of strokes.

Significant capturing of writing surface at various angles forms a well-defined track. As this is a non- destructive and non-contact technique physical features of writing surface remains, as it is, as prior to the examination of writing surface.

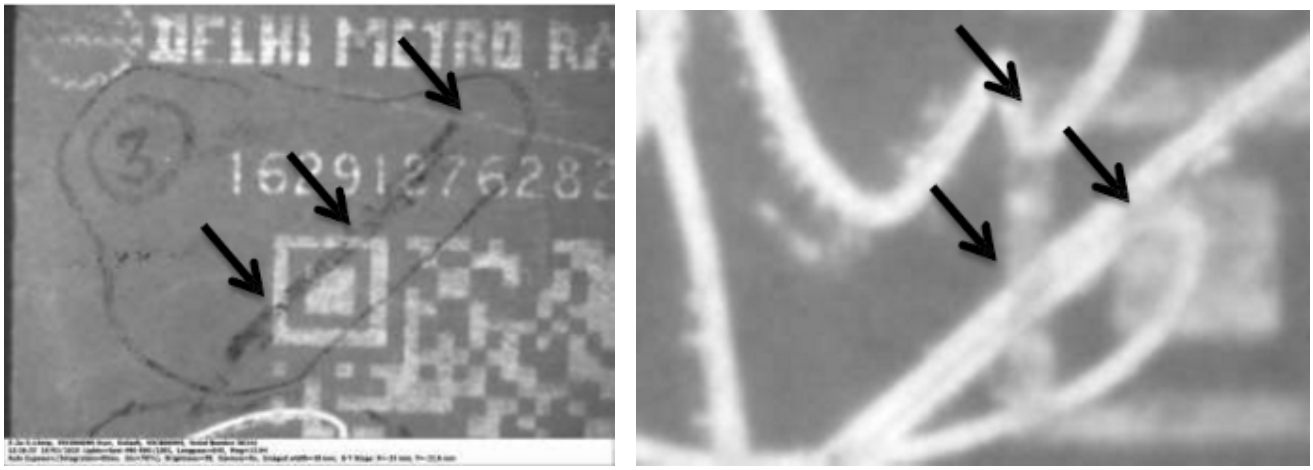


Figure 13 a & b : Dragging of Thermal printing

As payments are collected at physical location through Point of Sale machine with generation of payment receipt these receipts are used as a proof of payment with authorized signatory signature, as the case may be. Deposition of ink is observed in thermal printing, this deposition is when examined microscopically is dragged towards the direction of movement of subsequently added stroke. Above image shows dragging of ink powder along with the movement of signature under high magnification.

Discussion & Conclusion

Preliminary (Physical appearance (Hand lens/Simple Microscope) – Certain features of paper are visible under day /normal light such as water mark, Inset letter, paper finish, glare, brightness, thickness, porosity, opacity and others.[5]

Significance of loading material in analysis of sequence of strokes – Different manufacturers uses different loading material in formation of ink which forms base for identification of ink, while observing intersections under various magnification, dragging of ink results in mixing or spreading of loading material across the intersecting region, characteristic fluorescence may be observed for the presence or absence of certain ink at intersection.

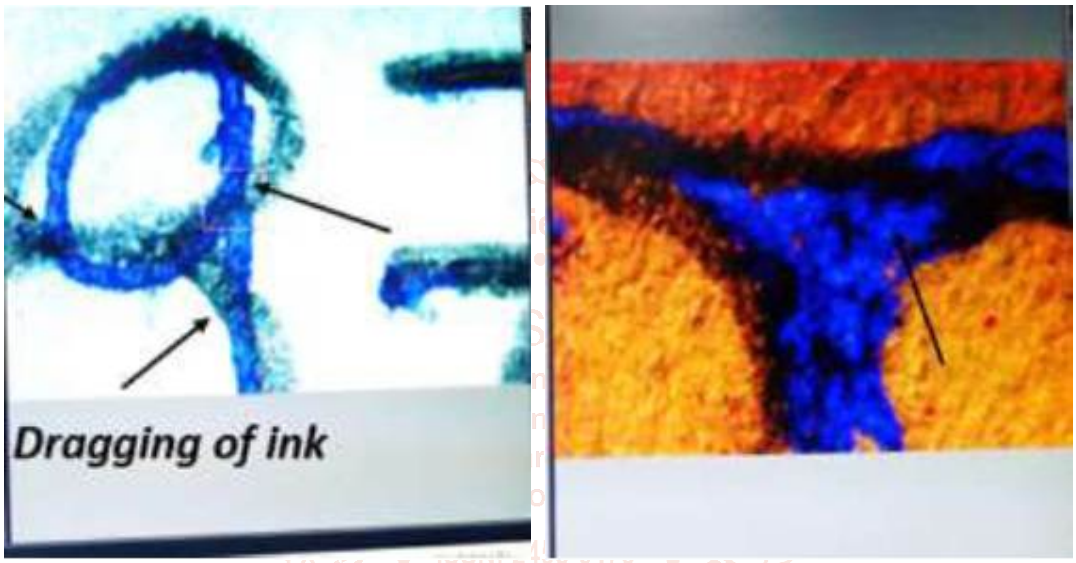


Figure 14 a & b Movement of Strokes under High Magnification

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[5] **Osborn, Albert Sherman.** *Questioned Documents: Complete and Unabridged.* California: Boyd Printing Co., 1929.