

Ordway Hilton,<sup>1</sup> M.A.

## Effects of Writing Instruments on Handwriting Details

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**REFERENCE:** Hilton, O., "Effects of Writing Instruments on Handwriting Details," *Journal of Forensic Sciences*, JFSCA, Vol. 29, No. 1, Jan. 1984, pp. 80-86.

**ABSTRACT:** A study was made of handwriting specimens prepared with different classes of common, modern day writing instruments. It was found that the basic characteristics of some types of pens can suppress certain writing details. It is not true of every class of writing instrument, however, since some different classes of pens produce comparable writing strokes. These latter specimens can be easily compared but in the former case the examiner must recognize the kind of variables that can be introduced by the pen in order to avert erroneous opinions.

**KEYWORDS:** forensic science, handwriting, pens, pencils

In A. S. Osborn's *Questioned Documents* [1,2] there is an important discussion of the differences between writing with a pencil and the flexible steel nib pen. With the very significant changes in writing instruments since Osborn's studies no one has attempted a comprehensive update of his work. Some papers have appeared pointing out writing characteristics of new types of pens, but with the possible exception of Mathyer's 1968 study [3], no comparative investigation of the work of modern pens has been undertaken [4-6]. A need exists for such a project.

The steel nib pen, Osborn's principal ink writing utensil, has become an historic writing instrument that is seldom encountered today. In its place are the less flexible nib fountain pen, whose popularity has waned; the ball point pen, which for a time was almost the exclusive ink writing instrument; the porous point pen with either felt or fiber tip; more recently the porous plastic tip pen; and finally the roller pen, a ball pen capable of using fluid inks. Throughout all these changes the pencil maintained its place as an important instrument for working drafts and informal writings. Ball point pen writing and that of other contemporary pens can display significant differences in some writing details, and this is also true with pencil writing and that of modern pens.

### Pencils and Ball Point Pens

Comparison of pencil and ball pen writing tends to reveal comparable writing details. It is certainly true of work of a mechanical pencil or a stick pencil with a moderately sharp point. As a rule soft broad point pencils produce rather smudgy strokes that obscure finer details, producing writing that does not compare well with either the average pencil writing or that of a ball pen. Except for the broad point pencil, emphasis and its release is similarly reproduced

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<sup>1</sup>Examiner of questioned documents, Landrum, SC.

in the writing of pencils and ball pens. With a soft flexible backing, on a tablet pad for example, heavy pressure produces similar grooved impressions. The type of turns, angular, sharp, or rounded, are not greatly modified by interchanging these instruments. Narrow loops, stops and hesitations, and breaks in strokes where the instrument is returned to the end of the former stroke leave comparable evidence. The discussion presumes that the examiner thoroughly understands and recognizes typical ball pen defects of skipping, gooping, and striations common to many of its writing strokes [7]. In other words, except for the occasional writer who finds one or the other instrument easier to use, these writings can be compared without undue concern.

### Porous Point Pens

The most commonly used pens today capable of writing with an aqueous ink are those with porous points. There are two differently constructed writing tips. One is a pen with a stiff perforated plastic point and the other with a fiber or felt tip. Writing prepared with either type of point is sufficiently similar so that it is difficult to distinguish between them. Both subclasses are available in several width points. The plastic tips are used in most of the pens that have a fine point and in some pens that write a moderately broad stroke (the "standard" or common width). Often standard width pens, however, have the fiber point, and apparently all that write a very broad, heavy stroke have fiber tips if the ink is water based (Fig. 1).<sup>2</sup> Manufacturers who market more than one width point normally mark the pen itself for the fine tips

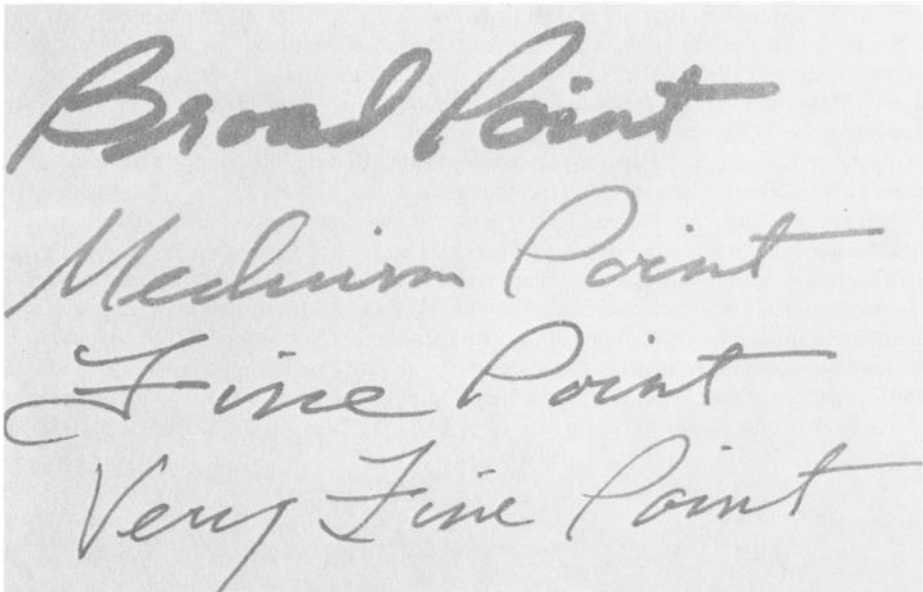


FIG. 1—Four varying width points on porous tip pens. Manufacturers label their fine line pens differently and some appear to write a slightly finer stroke than others. No attempt was made to determine whether the fine and very fine line specimens shown above actually had tips of slightly different diameters, or whether the difference was a function of use or ink flow. Differences between the medium and broad tip pens are significant, and the effect on the writing can be seen easily.

<sup>2</sup>Makers of felt tip pens also produce broad tip instruments but these pens write with a nonaqueous ink. The pens are seldom used in signing documents, but they produce writing that is comparable to the broad fiber tip pens.

and very broad tips while the standard or regular tips carry only the brand name. If only one width point is marketed the medium or standard width tip can be expected.

The fluid ink of these pens is specially compounded so that it dries or is absorbed quickly once it contacts the paper. There is some capillary flow of the ink on and into the paper, and consequently, this action can close up narrow loops or spaces between strokes more readily than in writing with a ball pen or pencil. Unlike the ball pen or pencil, when a porous tip pen stops in contact with the paper the ink continues to run out forming a small accumulation at the stopping point. Capillary action can also be seen under the microscope along the jagged edges of the pen strokes where the ink runs out slightly along the paper fibers and on unsized, porous paper where it both spreads and bleeds through to the back even with writing of a fine point pen that delivers less ink. In contrast, on the same paper ball pen ink does not react in this way but leaves cleaner strokes, little different than on the better grades of writing papers. This action of fluid ink can create some apparent differences between a person's writing produced by a porous tip pen and by a ball point pen.

With fine pointed plastic or fiber tip pens a relatively small amount of ink is deposited and except as noted above the writing produced is not significantly different from writing with a properly operating ball pen or a reasonably sharp pencil. Writing details may be affected by the slight capillary flow encountered with these fine tip pens but not to the extent that should confuse an alert examiner. Differences in an individual's writing utilizing a pencil, a ball pen, or a fine tip porous pen should not be significantly greater than writings with several instruments of the same class (Fig. 2). It presumes, however, that writing in all cases are on a good quality writing paper. This statement further presumes that small differences introduced by typical characteristics of each class are understood and considered by the examiner.

With the standard width fiber tip pen the action of the fluid ink on the paper must be considered. The strokes may not be as sharply defined as those of either ball pens or pencils. Also they are wider than those of ball or roller pens. The former condition is due to the capillary action of the liquid ink that occurs despite the relatively short drying time. Spreading from the damp line occurs, actually to only a slight extent, whereas it does not occur with the heavier, slow flowing ball pen ink. Experiments have indicated that the flow into the damp ink of a downstroke, for example, by the pen recrossing the stroke to close a loop of a lower letter projection does not appear to be significantly greater than on clear paper, but in both instances there is some minor widening of the stroke as well as penetration of the ink into the paper. This action results in slightly narrower gaps between strokes of sharp turns or actual closing of the narrow openings in letters. Shading caused by release of pressure and rapid pen movement is less apparent with this class of fiber tip pens. Free tapering endings can be found but may not be recorded as often in a person's writing as with a pencil or ball point pen. Square and wedge shape initial strokes are common (Fig. 3). When the pen is virtually stopped in

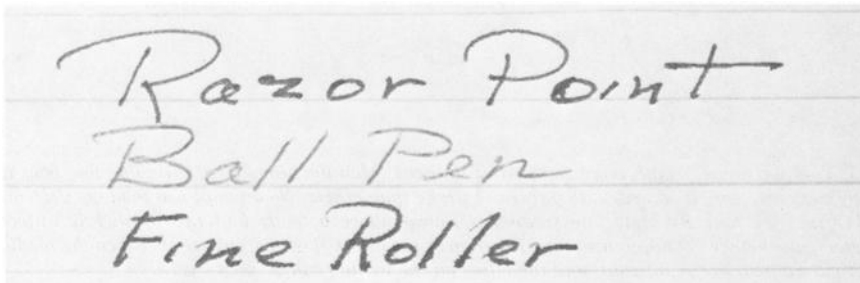


FIG. 2—Three writing instruments of different construction produce comparable width strokes. Close examination of the roller pen specimen (lowest) reveals short horizontal ink flow along paper fibers caused by the aqueous ink.

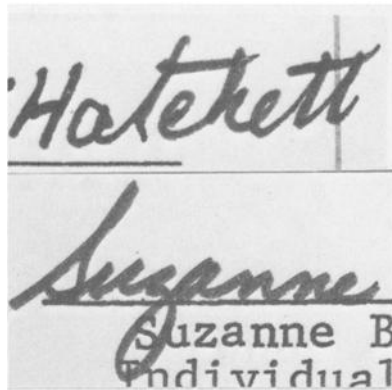


FIG. 3—Two examples of writing with standard width porous pens. Suzanne shows square starting and ending strokes and only slight evidence in the lower z-loop of variation in pen pressure between the down and upstrokes. In contrast, Mrs. Hatchett produces very fine upstrokes in the double-t combination and a fine tapering terminal stroke. The porous tip pen can produce different stroke appearances in the hands of different writers.

contact with the paper at a word ending there may be a small accumulation of ink caused by the continual ink feeding. Except for the plastic point pen this condition is not encountered in other writings. The wider strokes of this class of pens are a result of the writing tips that are broader than the ball of ball point and roller pens and deposit ink across the entire width of the tip.

With the broad point fiber tip pens, which were the first to be introduced, the pen stroke fails to reproduce many of the finer movements. Some such details may be lost as well with the standard width point, but the broader strokes of these pens create more obvious modifications in a number of aspects of a person's writings. The broad rough textured point develops significant friction as it moves across the paper. Thus, a person unfamiliar with this pen is apt to find his writing speed slightly slowed with the resulting writing containing suggestions of such execution. Still, experienced users who employ the pen regularly for signing documents develop a stylized signature with limited details and indistinct letter design suggesting a hurried attempt to complete the writing (Fig. 4). Disputed writing of this nature requires some known specimens written with comparable writing instruments, and if these are not available, extreme care must be exercised in evaluating apparent differences between the writing in question and known specimens. Limited shading, closed loops, and blunt starts or endings are common when a writer uses this pen despite the fact that these writing characteristics are not a part of his typical writing with other instruments.

Medium width plastic tip pens produce strokes comparable to the medium width fiber tip pens. The basic difference between these pens is the ability of the plastic tip to create carbon copies. Thus when papers rest on a flexible surface a slight groove may be created, but otherwise this pen writes in a very similar manner to a fiber tip pen. Writing of both instruments can be easily compared, but neither one necessarily produces the best writing for comparison with fine tip pens, ball pens, or pencils.

### Roller Pens

The roller pen, the ball point pen modified to write with fluid ink, produces a typical fluid ink stroke. Two different size balls are available, the standard and a smaller ball of fine line pens. In the hands of some writers there is very little difference in the width of the strokes produced, but possibly with release of writing pressure the fine point version produces a slightly



FIG. 4—Two writings of the name. Heinz, by the same writer. The upper with a ball point pen and the lower with a broad tip porous pen. Note the closing of the narrow enclosures because of pen width and the obscuring of finer details in this specimen. The variations are typical of the two writing instruments.

greater variation in line width. While the standard ball can produce strokes very comparable to the fiber tip pen, it preserves the fine tapering endings more readily. In this respect the roller pen is like the ball point pen but differs in producing a broader stroke. The capillary action is present in writing with these pens as with fiber and plastic tip pens. On a soft background the roller pen makes a characteristic writing groove that is found with ball pen writing under similar support conditions. In comparing writing of a roller pen with other pens discussed, one must be aware of its possible writing characteristics. Since the pen is capable of recording changes in writing pressure more readily than porous tip pens this factor must be considered when comparing writings of the two classes. Furthermore, the typical action of fluid ink on paper is present and must be compensated for when comparing any of its writing with that of pencils and ball point pens.

### Fountain Pens

One remaining class of pen, the fountain pen, should be considered. One might be tempted to treat it as an old, discarded writing instrument, but fountain pens are available in stationary stores today. There are a limited number of writers who use a fountain pen, some only occasionally, others almost exclusively. Thus it is possible to encounter writing from it in contemporary problems. It has characteristics that are unlike any other writing instrument discussed [2,7].

The split nib writing point is capable of producing lines of varying width, but this quality depends to some extent on the flexibility of the point. Most modern pens have a relatively stiff

point that restricts shading, producing a fluid ink line more comparable to the uniform strokes of the porous tip pens. However, especially with broader points, there is a significant difference in the written strokes when the nibs are at right angles to the direction of the stroke than when they are parallel to it. Besides, the upstroke of a fountain pen tends to be narrower than downstrokes because the nibs deliver ink more readily with downward movement.

The modern fountain pen tends to reflect more information concerning the writer's habits of holding it than most other writing instruments, but not nearly as much as the pens that were being used when Osborn discussed writing instruments [1,2].<sup>3</sup> Some recording of emphasis, direction of pen movement, and the angle of the nibs to the paper can be reflected in the writing which is not true of porous pens. Still the action of the fluid ink on the paper is comparable to other modern fluid ink pens. If the characteristics of other writing instruments are kept in mind and the realization that the fountain pen may be slightly more sensitive to writing speed, emphasis, and how the instrument is held, writing produced by it can be compared with that of other instruments. Again the greatest difficulties are encountered with direct comparison between fountain pen writing and broad point fiber tip pens because of the uniformity of strokes of the latter and its tendency to obscure evidence of small writing movements.

### Conclusions

The principal factors at work in this study relate to the width of the marking point and ink composition that influences its action when applied to the paper. Fine pointed writing instruments are capable of reproducing the finer details of a person's writing. Broader points normally obscure these details with the result that certain significant aspects of fine line writing are lost in the broader, less distinct writing strokes.

At the same time the reaction between inks and papers can influence the appearance of the writing. The high viscosity ball pen ink is rolled onto the paper with little or no spreading beyond the edges of the stroke. Fluid inks of porous tip and roller pens, and even fountain pens, not only penetrate the paper fibers but may spread out slightly from the line deposited by the writing instrument itself. This spreading is slight but tends to widen the stroke and to close narrow openings between the strokes of sharp turns and small enclosures.

It is the combination of the two factors that create significant apparent differences between fine line writing of pencils or ball point pens and the broader strokes of the wider tipped porous pens. The careless or uninitiated examiner can fall into serious error in comparing writings of these two classes. Even the well-qualified, careful worker can encounter significant difficulties when comparing writing of pens with greatly different writing characteristics. In some instances he may even be forced to qualify his opinion with the problem at hand whereas with comparably written standards he could have expressed a definite opinion.

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<sup>3</sup>Many fountain pens in this earlier period had flexible points that could duplicate the shading of steel pens.

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Address requests for reprints or additional information to  
Ordway Hilton  
P.O. Box 592  
Landrum, SC 29356