

*J. Seaman Kelly*<sup>1</sup>

## Facsimile Documents: Feasibility for Comparison Purposes

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**ABSTRACT:** Transmission of documents via facsimile machines is becoming more common today. Can a document examiner use a facsimile copy of a handwritten document to perform an examination? This article examines facsimile copies of documents prepared with various writing instruments to determine how accurately they reflect the original. Facsimile copies of altered documents are also examined to determine if evidence of the alteration can be seen on the facsimile copy.

**KEYWORDS:** questioned documents, facsimile, comparison, error correction mode, stamp, thermal printing, laser printing, inkjet printing

Facsimile machines are commonplace in the everyday operations of the business community. They not only provide a means of communication between two parties, but also provide documentation of that communication. It is that documentation which presents a new challenge to the document examiner. Mr. Larry Nelson discussed a case of alteration using a fax copy in his paper, "Using Alias To Detect Alterations In Fax," [1] indicating that fax copies are being used as vehicles for deception in much the same way as photocopies are used. It is imperative the examiner know the limitations of fax copies to determine if it is possible to use a fax copy in an examination.

This paper examines various models of facsimile machines, operating in various modes, and reports the reliability with which these machines reproduce the elements studied by a document examiner attempting to determine authenticity and authorship of a document. It does not seek to function as a market survey or to offer an opinion as to which machine performs the best, but serves only to report the observations of this examiner concerning the effects of different printing processes on the faithful transmission of the original document.

All machines studied were Group 3 machines, and all did an excellent job of pictorially recreating the original document. But as examiners, we go beyond the pictorial and examine the minute internal characteristics of the writing. The individual characteristics of speed, line quality, pen pressure, pen lifts, letter formation, spacing, slant, size and height relationships contained in a writing are what the examiner uses in his comparison. Are these intricate features recreated in the fax copy?

The purpose of this article is to make the document examiner aware of the limitations of using a facsimile copy in an examination. Several states, including Oklahoma, have

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<sup>1</sup>Forensic Document Examiner, Oklahoma City, OK.

adopted statutes allowing a facsimile copy to be admitted into a court of law just as a photograph or a photocopy alleging the facsimile is an accurate reproduction of the original. The examiner must be aware of the limitations discussed in this paper enabling him to make a knowledgeable examination.

Some of the models used in this study had an error correction mode (ECM) feature. This feature enables the receiving machine to print a warning that an error was transmitted. If retransmission is unsuccessful or the errors too numerous, the transmission will be aborted. If there is crackling on the telephone line creating interference, a "7" may be received as a "1," thereby creating an undetected error. Both sending and transmitting machines must have error correction in order for this feature to be useful. Even so, the above error may not be detected and the receiving machine will not acknowledge the error. Even though there is line interference, a transmission may still be completed instead of aborted (Fig. 1).

Some models have a completion stamp feature. Sharp uses a small pink dot while Panasonic uses a dark blue stamp bearing an "x" inside a circle (Fig. 2). The completion stamp signifies a successful transmission.

The basic operation of the facsimile machine will not be discussed in this paper. For an in-depth understanding of the fax machine operation, please refer to Maureen Casey Owens paper, "A Look into Facsimile Transmission" [2].

## Method

In this paper, five printing processes of facsimile machines were used for comparison to the original documents. The printing processes are as follows:

1. Thermal printing by using specially treated paper that is heated by a heat-producing bar which scans the original.
2. Thermal-transfer ribbon melts the pigment from the ribbon and then depositing the pigment onto the plain paper which is on a roll sheet. The printed sheet is cut from the

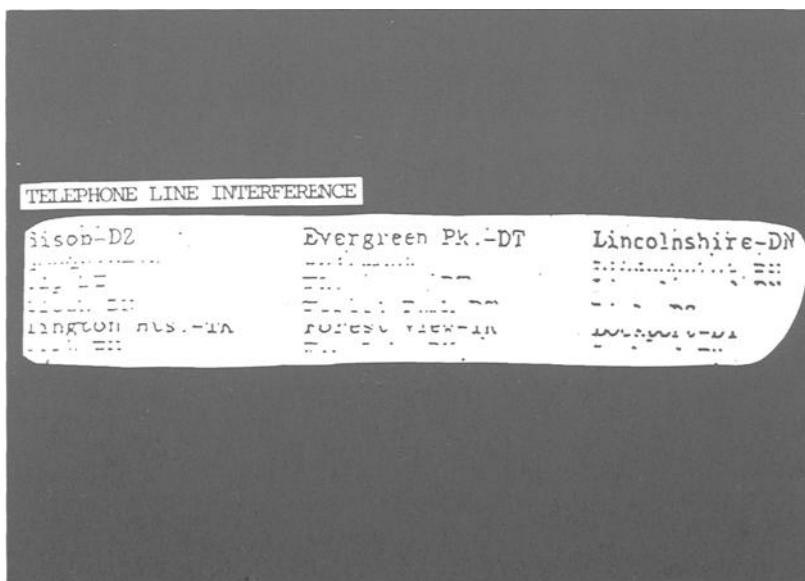


FIG. 1—Various examples of the appearance of telephone line interference.

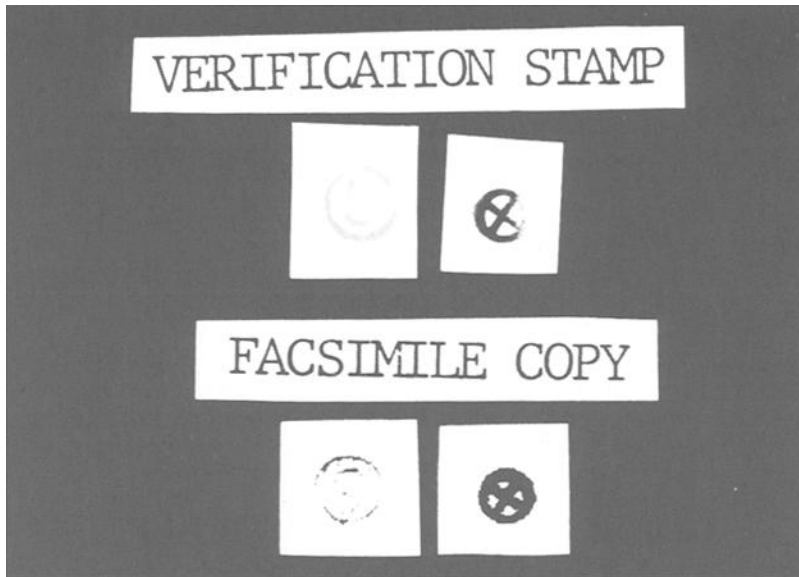


FIG. 2—The verification stamp on the right is a completion stamp from the Sharp laser fax and the stamp on the left is from the Panafax UF-300. The completion stamps were detected from a Canon L770 transmitting to a Hitachi HiFax 17 indicating the document had been faxed prior to this transmission.

roll by a blade. On the older machines, the printed image is left on the ribbon and can be read like the typewriter ribbon.

3. Laser printing which operates similarly to a photocopier by using a CCD scanner to copy the document and black toner to create a printed image. The Canon L770 uses a contact sensor instead of a CCD scanner.

4. Ink-jet printing which directs charged ink droplets in dot patterns to form the image. The dots are uniform in size and spacing.

5. Light Emitting Diode (LED): Unavailable for this paper.

Just as a writer cannot "write better than his best," so a facsimile transmission cannot be better than the abilities of the least capable machine involved in the transmission. For example, in order to enjoy the high resolution of the ultra-fine mode ( $400 \times 400$  lpi), the sending and receiving machine must have that ability. If one machine has the ultra-fine and the other machine has the fine mode, the copy will be in the fine mode ( $200 \times 200$  lpi).

For this research, I obtained sample signatures from 17 individuals. Some of the writers had a stylized signature which contained very fine and intricate movements, while others were less skilled and had less ornate signatures. Each of the writers used various writing instruments such as crayon, pencil, roller ball, fiber tip pen, ballpoint pen, and fountain pen. Various ink colors such as blue, black, red, and green were used. Traced signatures were also used in order to determine if the characteristics associated with tracings such as tremor and pen lifts could be detected from a fax copy. Alterations such as liquid paper and "cut and paste" of signatures were also tested.

The facsimile machines used were:

1. Xerox 7010: Thermal paper with standard and fine modes.
2. Hitachi Hi-Fax 17: Thermal paper with standard, fine, and superfine modes.

3. Canon 850: Thermal ribbon transfer with standard, fine, and superfine modes. Uses plain paper on a roll.

4. Canon L770: Laser printer using plain paper and has standard, fine, and superfine modes.

5. Canon L920: Laser printer using plain paper and has standard, fine, superfine, and ultra-fine modes.

6. Sharp 5000: Laser printer using plain paper and has standard, fine, superfine, and ultra-fine modes.

7. Sharp 6000: Laser printer using plain paper and has standard, fine, superfine, and ultra-fine modes.

8. Panafax UF-300: Panasonic fax using an inkjet printer and has standard, fine, and superfine modes. Uses plain paper (sheet).

The contrast was set on normal. Neither the halftone or contrast mode was used in this study. Please be aware that adjusting either one of these settings affects the quality of the image much like a photocopier being set on darker contrast.

### Observations

#### *Alterations*

*Liquid Paper*—Smooth application, even though grossly apparent on the original, is only detected and reproduced on the Panafax UF-300. The remaining printing processes did not reproduce the liquid paper.

Rough surface application, such as bumps, leaves irregular dots similar to “trash marks” in all the copy modes except the ultra-fine mode of the laser printers (Figs. 3 and 4). The laser printer cleans up the area and will not reproduce the alteration in the ultra-fine mode.

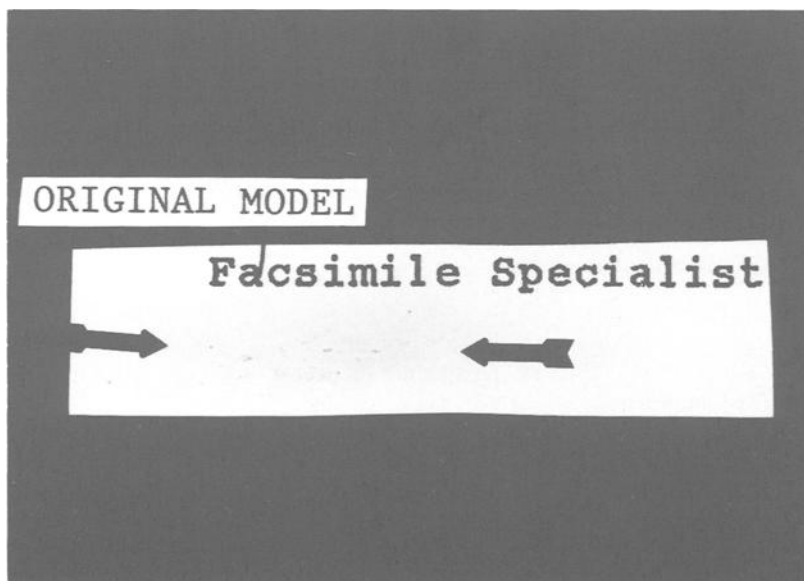


FIG. 3—This figure bears a heavy application of liquid paper between the two arrows. The application has a very rough texture, which is apparent to the eye as well as to the touch.

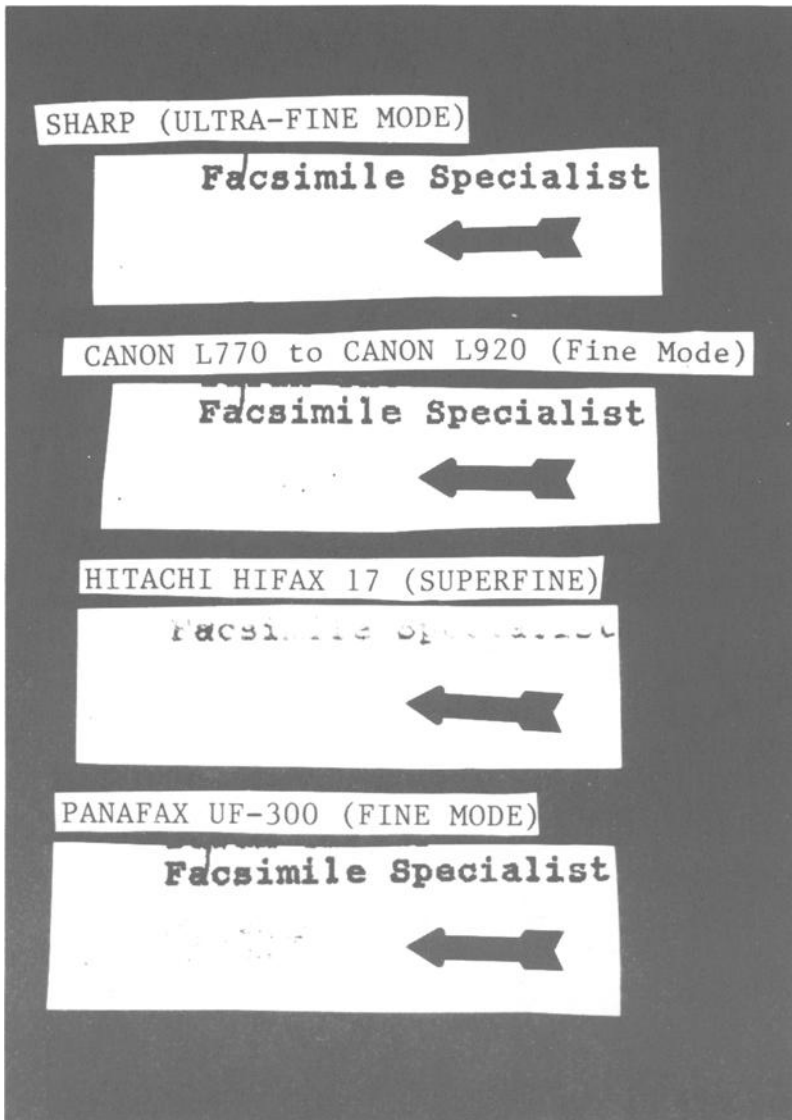


FIG. 4—Examples of the textured liquid paper reproduced by the four facsimile machines used in this study.

*Scotch Tape*—A signature was taped with one piece of scotch tape to the document. The tape outline was partially detected in the standard mode of the thermal paper fax.

A second signature was taped to a document with four layers of scotch tape. The results are as follows:

- Thermal paper: Small letters are obliterated with excess ink. “Trash marks” are more numerous with this printer.
- Thermal ribbon: In the standard mode, the outline of the tape is printed as a broken line. In the fine and superfine modes, the detection is printed with more line detail.

- Laser printer: “Trash marks” of sporadic dots are dispersed in between the letters of the signature on all printing modes (Figs. 5 and 6). The shape of the tape itself is not reproduced.

- Inkjet printer: Solid lines outlining the tape. Small letters are obliterated with excess ink. “Trash marks” are numerous with this printer.

*Cut and Paste*—Two documents overlay each other and are adhered to each other by glue. The results are:

- Thermal paper: Detects part of the shape of the second piece of paper and reproduces the outline with broken, stair-stepped lines in both modes.

- Thermal ribbon: In the standard mode, the shape of the second piece is reproduced with broken lines. In fine and superfine modes, some of the shape of the outline is reproduced with solid lines. The entire shape was not reproduced.

- Laser printer: The best result of reproducing the shape of the outline is in the standard mode. Less of the outline is reproduced in the fine mode, but is reflected by broken lines. In the superfine and ultra-fine modes, the outline is not reproduced, giving the appearance of one complete document.

- Inkjet printer: Produced majority of outline of the second piece of paper with a solid line. The top and bottom of the paper were outlined more than the sides.

### Erasures

*Thermal Paper*—“Trash mark” appearance in the area of the obliteration created by the erasure.

*Thermal Ribbon*—Fewer dots are present than on the thermal paper process. The dots or “trash marks” grew fainter as the resolution increased.

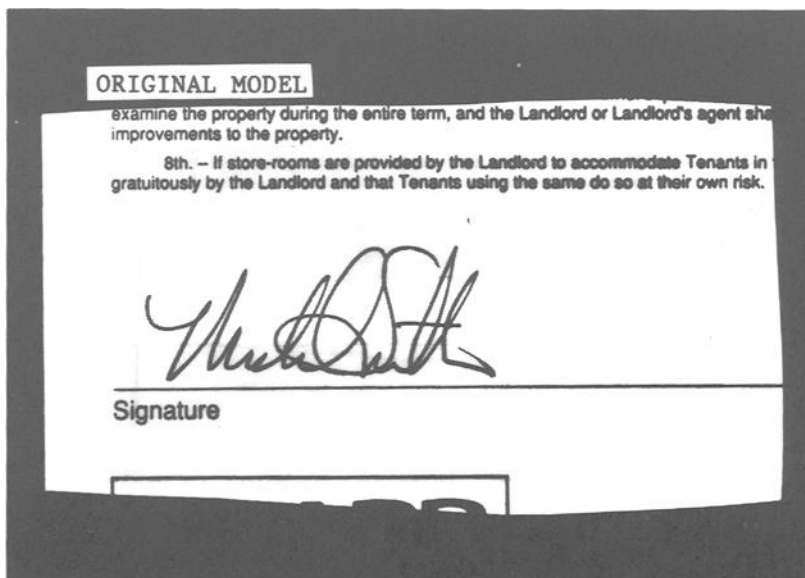


FIG. 5—Photocopy of genuine signature of “Michael Smith” taped with four layers of tape to a contract.

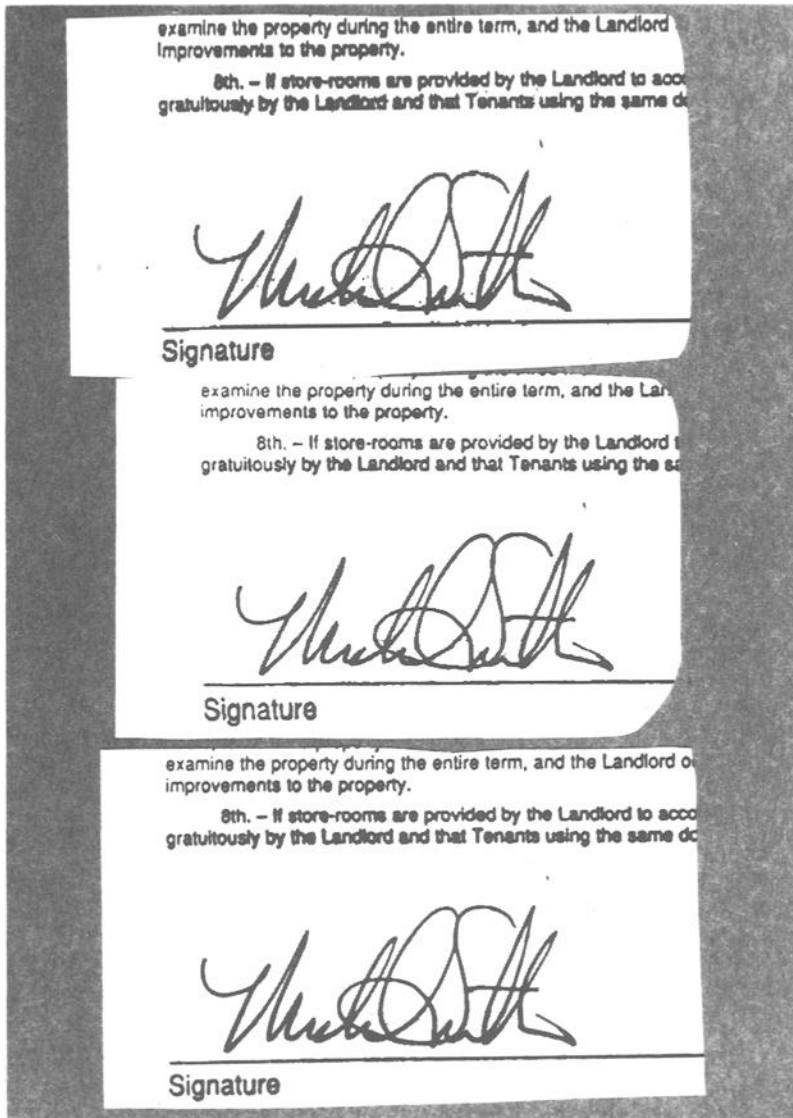


FIG. 6—Facsimile copy of the genuine “Michael Smith” signature from the Canon L770 in the standard (top), fine and superfine modes.

**Laser Printer**—The faint “trash marks” were present, but in the least amount compared to the reproduction of the other printing processes.

**Inkjet Printer**—“Trash marks” are present over the area of obliteration.

### Handwriting

#### Line Quality

- Thermal paper: Due to the notched effect, line quality is poor and very ragged. This will also affect determining the speed of the writing.

- Thermal ribbon: The notched effect can be observed with the naked eye, but is not as apparent as with the thermal paper. The higher the resolution, the better the line quality.
- Laser printer: Notched effect is apparent in the standard and fine modes. The notched appearance is slight in the ultra-fine mode, but can be detected microscopically.
- Inkjet printer: Notched effect is apparent microscopically. Ink particles and ink strands surround the individual letters. The inkjet fills line spaces and has a ragged and tight appearance.

The Canon L770 has a hypersmoothing feature. This is a digital image processing system that cleans up the incoming document to give an ultra-fine mode appearance. This feature enhances the line quality of the image by “filling in” areas in order to create more detail.

### *Tapering of Strokes*

- Thermal paper: Not detected in either mode as a result of the notched image.
- Thermal ribbon: Can be observed in all three modes. The best reproduction of the tapering occurs in the superfine mode.
- Laser printer: Partially reproduced. The finest strokes are not detected.
- Inkjet printer: Partially reproduced in all three modes.

### *Pen Pressure*

In order for an image to be reproduced by the fax machine, there has to be enough contrast between the paper or background and the writing instrument. If the pressure of the pen is light, adequate contrast may not be present and the image will contain sporadic dots or a dotted line instead of the complete letter form. The lack of contrast results in the majority of tapered strokes and lighter pen pressure not being reproduced. An examiner is not able to determine if the broken image lines are a result of light pen pressure or telephone line interference.

- Thermal paper: In some instances, will reflect lighter strokes with a dotted line in superfine mode.
- Thermal ribbon: On lighter pressure areas, the line is reproduced as a dotted line.
- Laser printer: Sporadic dots or complete blank spaces are present where the lighter pen pressure of a line is located on the original. In higher resolutions, the area is “cleaned up” and the sporadic dots are not present.
- Inkjet printer: Does not reflect varying pressure.

### **Traced Signatures**

*Thermal Paper*—Tremor and pen lifts associated with traced signatures are hidden due to the notched effect caused by digital-to-analog conversion.

*Thermal Ribbon*—Tremor is apparent in capital letters when reproduced in the fine and superfine modes. In the standard mode, the guide line is obscured and has the appearance of a shadow to the letters.

*Laser Printer*—Tremor is not as noticeable in the standard or fine modes. In the superfine and ultra-fine modes, tremor is evident in the capital letters. The guide line was reproduced to some degree in the fine and superfine modes, but not in the standard or ultra-fine modes.



*Inkjet printer:*—Tremor is hidden by the ragged appearance of the letters. The guideline is partially reproduced in all modes. The space between the guideline and the ink line was filled in and made the letter thicker.

It should be noted that telephone line interference can produce tremor in the fax copy that does not appear in the original.

### **Writing Instruments**

As a rule, the characteristics associated with the different kinds of writing instruments are not reproduced. In the standard mode, a pencil may show the thickness of a fiber tip. Striations associated with the ballpoint pen tend to be reproduced as blank spots in the image. The thermal ribbon detects the striations to a small degree, but the other fax printers do not. Fiber tip pens were reproduced with the best results by all the machines.

### **Summary**

Image quality is affected by the type of printing process of the fax machine, resolution setting, halftone and contrast setting, and the amount of telephone line interference during a fax transmission. Alterations, traced signatures, pen pressure, and type of writing instrument are difficult to detect. Tremor that is observed on the fax copy could be the result of being a traced forgery or it could be the result of telephone line interference.

Pictorially, all the fax machines capture an image from the original. What is lost are the subtle characteristics that are needed in order to conduct an examination. Good line quality that reflects speed, variation of pen pressure, pen lifts, and presence of tapered strokes are not always reproduced on the fax copy. The thermal ribbon will, to some degree, reproduce these characteristics, and thermal paper reproduces none of them. The laser printer reproduces a pictorially perfect document and actually "cleans up" distortions or extraneous marks. As a result, the examiner is not given the opportunity to examine the document with all of its imperfections and identifiable characteristics.

The technology of facsimile machines is moving forward. Group 4 machines are on the market and are able to produce higher quality copies. The facsimile machine is a mainstay in the business community and will soon be as much a part of the document examiner's repertoire as the photocopier.

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Address requests for reprints or additional information to  
Jan Seaman Kelly  
3701 Summerwind Ave.  
Oklahoma City, OK 73179