The Unabomber

In 1978, a parcel addressed to a Northwestern University professor exploded as it was being opened by a campus security officer. This was the start of a series of bomb-containing packages that typically were sent to universities and airlines. Considering the intended victims, the perpetrator was dubbed UN (university) A (airlines) BOM; hence, the Unabomber.

The explosives were usually housed in a pipe within a wooden box. The explosive ingredients generally were black powder, smokeless powder, or an ammonium nitrate mix. The box was filled with metal objects to create a shrapnel effect on explosion. The device typically had the initials “FC” punched into it.

The first Unabomber fatality came in 1985, when a computer store owner was killed after picking up a package left outside his business. The Unabomber emerged again in 1993 after a six-year hiatus by mailing bombs to two university professors. Their injuries were not fatal, but his next two attacks did result in fatalities.

In 1995, the case took an unexpected turn when the Unabomber promised to end his mad spree if his 35,000-word typewritten “Manifesto,” sent to the New York Times and the Washington Post were published. The manifesto proved to be a long, rambling rant against technology, but it offered valuable clues that broke the case. David Kaczynski realized that the manifesto’s writing style and the philosophy it espoused closely resembled that of his brother, Ted. His suspicions were confirmed by linguistics experts, who carefully pored over the manifesto’s content. Ted Kaczynski was arrested in Montana in 1996. Inside his ramshackle cabin were writings similar to the manifesto, three manual typewriters, and bomb-making materials. Forensic document examiners were able to match the typewritten manifesto to one of the typewriters recovered from the cabin.
Document Examination

Key Terms
charred document
erasure
exemplar
Indented writings
infrared luminescence
natural variations
obliteration
questioned document
Learning Objectives
After studying this chapter you should be able to:

- Define questioned document
- Know what common individual characteristics are associated with handwriting
- List some important guidelines for collecting known writings for comparison to a questioned document
- Recognize some of the class and individual characteristics of printers and photocopiers
- List some of the techniques document examiners use to uncover alterations, erasures, obliterations, and variations in pen inks

The Document Examiner
Ordinarily, the work of the document examiner involves examining handwriting and typescript to ascertain the source or authenticity of a questioned document. However, document examination is not restricted to a mere visual comparison of words and letters. The document examiner must know how to use microscopy, photography, and even such analytical methods as chromatography to uncover all efforts, both brazen and subtle, to change the content or meaning of a document.

Alterations of documents through overwriting, erasures, or the more obvious crossing out of words must be recognized and characterized as efforts to alter or obscure the original meaning of a document. The document examiner identifies such efforts and recovers the original contents of the writing. An examiner may even reconstruct writing on charred or burned papers, or uncover the meaning of indented writings found on a paper pad after the top sheet has been removed.

Any object that contains handwritten or typewritten markings whose source or authenticity is in doubt may be referred to as a questioned document. Such a broad definition covers all of the written and printed materials we normally encounter in our daily activities. Letters, checks, driver’s licenses, contracts, wills, voter registrations, passports, petitions, and even lottery tickets are commonly examined in crime laboratories. However, we need not restrict our examples to paper documents. Questioned documents may include writings or other markings found on walls, windows, doors, or any other objects.

Document examiners possess no mystical powers or scientific formulas for identifying the authors of writings. They apply knowledge gathered through years of training and experience to recognize and compare the individual characteristics of questioned and known authentic writings. For this purpose, gathering documents of known authorship or origin is critical to the outcome of the examination. Collecting known writings may entail considerable time and effort and may be further hampered by uncooperative or missing witnesses. However, the uniqueness of handwriting makes this type of physical evidence, like fingerprints, one of few definitive individual characteristics available to the investigator, a fact that certainly justifies an extensive investigative effort.
Handwriting Comparisons

Document experts continually testify that no two individuals write exactly alike. This is not to say that there cannot be marked resemblances between two individuals’ handwritings, because many factors make up the total character of a person’s writing.

General Style

Perhaps the most obvious feature of handwriting to the layperson is its general style. As children we all learn to write by attempting to copy letters that match a standard form or style shown to us by our teachers. The style of writing acquired by the learner is that which is fashionable for the particular time and locale. In the United States, for example, the two most widely used systems are the Palmer method, first introduced in 1880, and the Zaner-Bloser method, introduced in about 1895 (see Figure 16–1). To some extent, both of these systems are taught in nearly all fifty states.

The early stages of learning and practicing handwriting are characterized by a conscious effort by the student to copy standard letter forms. Many pupils in a handwriting class tend at first to have writing styles that are similar to one another, with minor differences attributable to skill in copying. However, as initial writing skills improve, a child normally reaches the stage at which the nerve and motor responses associated with the act of writing become subconscious. The individual’s writing now begins to take on innumerable habitual shapes and patterns that distinguish it from all others. The document examiner looks for these unique writing traits.

Variations in Handwriting

The unconscious handwriting of two different individuals can never be identical. Individual variations associated with mechanical, physical, and mental functions make it extremely unlikely that all of these factors can be exactly reproduced by any two people. Thus, variations are expected in angularity, slope, speed, pressure, letter and word spacings, relative dimensions of letters, connections, pen movement, writing skill, and finger dexterity.

Furthermore, many other factors besides pure handwriting characteristics should be considered. The arrangement of the writing on the paper may be as distinctive as the writing itself. Margins, spacings, crowding, insertions, and alignment are all results of personal habits. Spelling, punctuation, phraseology, and grammar can be personal and, if so, combine to individualize the writer.

In a problem involving the authorship of handwriting, all characteristics of both the known and questioned documents must be considered and compared. Dissimilarities between the two writings strongly indicate two writers, unless these differences can logically be accounted for by the facts surrounding the preparation of the documents. Because any single characteristic, even the most distinctive one, may be found in the handwriting of other individuals, no single handwriting characteristic can by itself be taken as the basis for a positive comparison. The final conclusion must be based on a sufficient number of common characteristics between the known and questioned writings to effectively preclude their having originated from two different sources.

What constitutes a sufficient number of personal characteristics? Here again, there are no hard-and-fast rules for making such a determination.
The expert examiner can make this judgment only in the context of each particular case.

**Challenges to Handwriting Comparison**

When the examiner receives a reasonable amount of known handwriting for comparison, sufficient evidence to determine the source of a questioned document is usually easy to find. Frequently, however, circumstances
prevent a positive conclusion or permit only the expression of a qualified opinion. Such situations usually develop when an insufficient number of known writings are available for comparison. Although nothing may be found that definitely points to the questioned and known handwriting being of different origin, not enough personal characteristics may be present in the known writings that are consistent with the questioned materials.

Difficulties may also arise when the examiner receives questioned writings containing only a few words, all deliberately written in a crude, unnatural form or all very carefully written and thought out so as to disguise the writer’s natural style—a situation usually encountered with threatening or obscene letters. It is extremely difficult to compare handwriting that has been very carefully prepared to a document written with such little thought for structural details that it contains only the subconscious writing habits of the writer. However, although one’s writing habits may be relatively easy to change for a few words or sentences, maintaining such an effort grows more difficult with each additional word.

When an adequate amount of writing is available, the attempt at total disguise may fail. This was illustrated by Clifford Irving’s attempt to forge letters in the name of the late industrialist Howard Hughes in order to obtain lucrative publishing contracts for Hughes’s life story. Figure 16–2 shows forged signatures of Howard Hughes along with Clifford Irving’s known writings. By comparing these signatures, document examiner R. A. Cabbane of the U.S. Postal Inspection Service detected many examples of Irving’s personal characteristics in the forged signatures.

For example, note the formation of the letter r in the word Howard on lines 1 and 3, as compared with the composite on line 6. Observe the

![Figure 16–2 Forged signatures of Howard Hughes and examples of Clifford Irving’s writing. Reprinted by permission of the American Society for Testing and Materials from the Journal of Forensic Sciences, copyright 1975](image)
manner in which the terminal stroke of the letter r tends to terminate with a little curve at the baseline of Irving’s writing and the forgery. Notice the way the bridge of the w drops in line 1 and also in line 6. Also, observe the similarity in the formation of the letter g as it appears on line 1 as compared with the second signature on line 5.

The document examiner must also be aware that writing habits may be altered beyond recognition by the influence of drugs or alcohol. Under these circumstances, it may be impossible to obtain known writings of a suspect written under conditions comparable to those at the time the questioned document was prepared.

**Collection of Handwriting Exemplars**

Collection of an adequate number of known writings (exemplars) is critical for determining the outcome of a comparison. Generally, known writings of the suspect furnished to the examiner should be as similar as possible to the questioned document. This is especially true with respect to the writing implement and paper. Styles and habits may be somewhat altered if a person switches from a pencil to a ballpoint pen or to a fountain pen. The way the paper is ruled, or the fact that it is unruled, may also affect the handwriting of a person who has become particularly accustomed

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**Forensics at Work**

**Hitler’s Diaries**

In 1981 a spectacular manuscript attributed to Adolf Hitler was disclosed by the brother of an East German general. These documents included Hitler’s twenty-seven-volume diary and an unknown third volume of his autobiography, *Mein Kampf*. The existence of these works was both culturally and politically significant to the millions who were affected by World War II.

Authentication of the diaries was undertaken by two world-renowned experts, one Swiss and one American. Both declared that the handwritten manuscripts were identical to the known samples of Adolf Hitler’s handwriting that they were given. Bidding wars began for publishing rights, and a major national newspaper in the United States won with a price near $4 million.

The publishing company that originally released the documents to the world market undertook its own investigation, which ultimately revealed a clever but devious plot. The paper on which the diaries were written contained a whitener that didn’t exist until 1954, long after Hitler committed suicide. The manuscript binding threads contained viscose and polyester, neither of which was available until after World War II. Further, the inks used in the manuscript were all inconsistent with those in use during the year these pages were allegedly written.

Moreover, the exemplars sent to the Swiss and American experts as purportedly known examples of Hitler’s handwriting were actually from the same source as the diaries. Thus, the experts were justified in proclaiming the documents were authentic because they were written by the same hand—it just wasn’t Hitler’s. Chemical analysis of the inks later determined that the “Hitler diaries” were in fact less than one year old—spectacular, but fake!
to one type or the other. Known writings should also contain some of the words and combinations of letters present in the questioned document.

The known writings must be adequate in number to show the examiner the range of natural variations in a suspect’s writing characteristics. No two specimens of writing prepared by one person are ever identical in every detail. Variation is an inherent part of natural writing. In fact, a signature forged by tracing an authentic signature can often be detected even if the original and tracing coincide exactly, because no one ever signs two signatures exactly alike (see Figure 16–3).

Many sources are available to the investigator for establishing the authenticity of the writings of a suspect. An important consideration in selecting sample writings is the age of the genuine document relative to the questioned one. It is important to try to find standards that date closely in time to the questioned document. For most typical adults, basic writing changes are comparatively slow. Therefore, material written within two or

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<tr>
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</tr>
<tr>
<td>8/7/96</td>
<td>Patrick Williams</td>
</tr>
</tbody>
</table>

**FIGURE 16–3** Examples of handwriting from the same individual over an extended period of time. Courtesy Robert J. Phillips, Document Examiner, Audubon, New Jersey

**natural variations**

Normal deviations found between repeated specimens of an individual’s handwriting.
three years of the disputed writing is usually satisfactory for comparison; as the age difference between the genuine and unknown specimens becomes greater, the standard tends to become less representative.

Despite the many potential sources of handwriting exemplars, obtaining an adequate set of collected standards may be difficult or impossible. In these situations, handwriting may have to be obtained voluntarily or under court order from the suspect. Ample case law supports the constitutionality of taking handwriting specimens. In *Gilbert v. California*, the Supreme Court upheld the taking of handwriting exemplars before the appointment of counsel. The Court also reasoned that handwriting samples are identifying physical characteristics that lie outside the protection privileges of the Fifth Amendment. Furthermore, in *United States v. Mara*, the Supreme Court ruled that taking a handwriting sample did not constitute an unreasonable search and seizure of a person and hence did not violate Fourth Amendment rights.

As opposed to nonrequested specimens (written without the thought that they may someday be used in a police investigation), requested writing samples may be consciously altered by the writer. However, the investigator can take certain steps to minimize attempts at deception. The requirement of several pages of writing normally provides enough material that is free of nervousness or attempts at deliberate disguise for a valid comparison. In addition, the writing of dictation yields exemplars that best represent the suspect’s subconscious style and characteristics.

Other steps that can be taken to minimize a conscious writing effort, as well as to ensure conditions approximating those of the questioned writing, can be summarized as follows:

1. The writer should be allowed to write sitting comfortably at a desk or table and without distraction.
2. The suspect should not under any conditions be shown the questioned document or be told how to spell certain words or what punctuation to use.
3. The suspect should be furnished a pen and paper similar to those used in the questioned document.
4. The dictated text should be the same as the contents of the questioned document, or at least should contain many of the same words, phrases, and letter combinations found in the document. In handwriting cases, the suspect must not be told whether to use uppercase (capital) or lowercase (small) lettering. If, after writing several pages, the writer fails to use the desired type of lettering, he or she can then be instructed to include it. Altogether, the text must be no shorter than a page.
5. Dictation of the text should take place at least three times. If the writer is trying to disguise the writing, noticeable variations should appear among the three repetitions. Discovering this, the investigator must insist on continued repetitive dictation of the text.
6. Signature exemplars can best be obtained when the suspect is required to combine other writings with a signature. For example, instead of compiling a set of signatures alone, the writer might be asked to fill out completely twenty to thirty separate checks or receipts, each of which includes a signature.
7. Before requested exemplars are taken from the suspect, a document examiner should be consulted and shown the questioned specimens.
Key Points

- Any object with handwriting or print whose source or authenticity is in doubt may be referred to as a questioned document.
- Document examiners gather documents of known authorship or origin and compare them to the individual characteristics of questioned writings.
- Collecting an adequate number of known writings is critical for determining the outcome of a handwriting comparison. Known writing should contain some of the words and combinations of letters in the questioned document.
- The unconscious handwriting of two different individuals can never be identical. However, the writing style of an individual may be altered beyond recognition by the influence of drugs or alcohol.

Typescript Comparisons

The document examiner analyzes not only handwritten documents, but machine-created ones as well. This includes a wide variety of devices including computer printers, photocopiers, fax machines, and typewriters.

Photocopier, Printer, and Fax Examination

With the emergence of digital technology, document examiners are confronted with a new array of machines capable of creating documents subject to alteration or fraudulent use. Personal computers use daisy wheel, dot-matrix, ink-jet, and laser printers. More and more, the document examiner encounters problems involving these machines, which often produce typed copies that have only inconspicuous defects.

In the cases of photocopiers, fax machines, and computer printers, an examiner may need to identify the make and model of a machine that may have been used in printing a document. Alternatively, the examiner may need to compare a questioned document with test samples printed from a suspect machine. Typically, the examiner generates approximately ten samples through each machine to obtain a sufficient representation of a machine’s characteristics. A side-by-side comparison is then made between the questioned document and the printed exemplars to compare markings produced by the machine.

Photocopiers Transitory defect marks originating from random debris on the glass platen, inner cover, or mechanical portions of a copier produce images. These images are often irregularly shaped and sometimes form distinctive patterns. Thus, they become points of comparison as the document examiner attempts to link the document to suspect copiers. The gradual change, shift, or duplication of these marks may help the examiner date the document.

Fax Machines Fax machines print a header known as the transmitting terminal identifier (TTI) at the top of each fax page. For the document examiner, the TTI is a very important point of comparison (see Figure 16–4). The header and the document’s text should have different type styles.
TTIs can be fraudulently prepared and placed in the appropriate position on a fax copy. However, a microscopic examination of the TTI’s print quickly reveals significant characteristics that distinguish it from a genuine TTI.

In determining the fax machine’s model type, the examiner usually begins by analyzing the TTI type style. The fonts of that line are determined by the sending machine. The number of characters, their style, and their position in the header are best evaluated through a collection of TTI fonts organized into a useful database. One such database is maintained by the American Society of Questioned Document Examiners.

**Computer Printers**  Computer printer model determination requires extensive analysis of the specific printer technology and type of ink used. Visual and microscopic techniques help determine the technology and toner used. Generally printers are categorized as *impact* and *nonimpact* printers by the mechanism of their toner application. Nonimpact printers, such as ink-jet and laser printers, and impact printers, such as thermal and dot-matrix printers, all have characteristic ways of printing documents. Character shapes, toner differentiation, and toner application methods are easily determined with a low-power microscope and help the examiner narrow the possibilities of model type.

In analyzing computer printouts and faxes, examiners use the same approach for comparing the markings on a questioned document to exemplar documents generated by a suspect machine. These markings include all possible transitory patterns arising from debris and other extraneous materials. When the suspect machine is not available, the examiner may need to analyze the document’s class characteristics to identify the make and model of the machine. It is important to identify the printing technology, the type of paper, the type of toner or ink used, the chemical composition of the toner, and the type of toner-to-paper fusing method used in producing the document.
Examination of the toner usually involves microscopic analysis to characterize its surface morphology, followed by identification of the inorganic and organic components of the toner. These results separate model types into categories based on their mechanical and printing characteristics. Typically, document examiners access databases to help identify the model type of machine used to prepare a questioned document. The resulting list of possibilities produced by the database hopefully reduces the number of potential machines to a manageable number. Obviously, once a suspect machine is identified, the examiner must perform a side-by-side comparison of questioned and exemplar printouts as described previously.

**Typewriters** Although typewriters are not used as widely as they were at one time, document examiners still analyze typescripts. Examiners are most often asked the following two questions about typewriters: (1) Can the make and model of the typewriter used to type the questioned document be identified? (2) Can a particular suspect typewriter be identified as having prepared the questioned document?

To answer the first question, the examiner must have access to a complete reference collection of past and present typefaces used by typewriter manufacturers. The two most popular typeface sizes are pica (ten letters to the inch) and elite (twelve letters to the inch). Although a dozen manufacturers may use a pica or an elite typeface, many of these are distinguishable when the individual type character’s style, shape, and size are compared.

As is true for any mechanical device, use of a typewriter will result in wear and damage to the machine’s moving parts. These changes occur both randomly and irregularly, thereby imparting individual characteristics to the typewriter. Variations in vertical and horizontal alignment (characters are too high or low or too far left or right of their correct position) and perpendicular misalignment of characters (characters leaning to the left or to the right), as well as defects in each typeface, are valuable for proving the identity of a typewriter (see Figure 16–5).

Associating a particular typewriter with a typewritten document requires comparing questioned document to exemplars prepared from the suspect typewriter. As with handwriting, collection of proper standards is the foundation of such comparisons. In this respect, it is best if the document examiner has the questioned typewriter, allowing the examiner to prepare an adequate number of exemplars and examine the machine’s

![Figure 16–5](https://example.com/image.png) **Figure 16–5** A portion of a typewriting comparison points to the conclusion that the same machine typed both specimens. Besides the similarity in the design and size of type, note the light impression consistently made by the letter M. Also, the letter E slants to the right, almost touching D in the word USED in both specimens. Courtesy New Jersey State Police
CHAPTER 16

Typefaces. If the investigator must prepare standards from the questioned machine, a minimum of one copy in full word-for-word order of the questioned typewriting must be obtained.

Another area of investigation relates to the ribbon. An examination of the type impressions left on a ribbon may reveal the portion of the ribbon on which a particular text was typed.

When the suspect typewriter is not available for examination, the investigator must gather known writings that have been typed on the suspect machine. Ideally, material should be selected that contains many of the same combinations of letters and words found on the questioned document. The individual defects that characterize a typewriter develop and change as the machine is used; some may have changed between the preparation of the questioned and standard material. Hence, if many specimens are available, those prepared near the time of the disputed document should be collected.

Key Points

- The examiner compares the individual type character’s style, shape, and size to a complete reference collection of past and present typefaces.

- Use of a printing device results in wear and damage to the machine’s moving parts in a way that is both random and irregular, thereby imparting individual characteristics to it.

- Transitory defect marks originating from random debris on the glass platen, inner cover, or mechanical portions of a copier produce irregularly shaped images that may serve as points of comparison.

- A TTI, or transmitting terminal identifier, is a header at the top of each page of a fax document. It is useful in document comparison because it serves as a way to distinguish between a real and a fraudulently prepared fax document.

- Variations in vertical and horizontal alignment and perpendicular misalignment of characters, as well as defects in each typeface, are valuable for proving the identity of a typewriter.

Alterations, Erasures, and Obliterations

Documents are often altered or changed after preparation, to hide their original intent or to perpetrate a forgery. Documents can be changed in several ways, and for each way, the application of a special discovery technique is necessary.

One of the most common ways to alter a document is to try to erase parts of it, using an India rubber eraser, sandpaper, a razor blade, or a knife to remove writing or type by abrading or scratching the paper’s surface. All such attempts at erasure disturb the upper fibers of the paper. These changes are apparent when the suspect area is examined under a microscope using direct light or by allowing the light to strike the paper obliquely from one side (side lighting). Although microscopy may reveal
whether an erasure has been made, it does not necessarily indicate the original letters or words present. Sometimes so much of the paper has been removed that identifying the original contents is impossible.

In addition to abrading the paper, the perpetrator may also obliterate words with chemicals. In this case, strong oxidizing agents are placed over the ink, producing a colorless reaction product. Although such an attempt may not be noticeable to the naked eye, examination under the microscope reveals discoloration on the treated area of the paper. Sometimes examination of the document under ultraviolet or infrared lighting reveals the chemically treated portion of the paper. Interestingly, examination of documents under ultraviolet light may also reveal fluorescent ink markings that go unnoticed in room light, as seen in Figure 16–6.

Some inks, when exposed to blue-green light, absorb the radiation and reradiate infrared light. This phenomenon is known as infrared luminescence. Thus, alteration of a document with ink differing from the original can sometimes be detected by illuminating the document with blue-green light and using infrared-sensitive film to record the light emanating from the document’s surface. In this fashion, any differences in the luminescent properties of the inks are observed (see Figure 16–7). Infrared

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obliteration
Blotting out or smearing over writing or printing to make the original unreadable.

 luminescence has also revealed writing that has been erased. Such writings may be recorded by invisible residues of the original ink that remain embedded in the paper even after an erasure.

Another important application of infrared photography arises from the observation that inks differ in their ability to absorb infrared light. Thus, illuminating a document with infrared light and recording the light reflected off the document’s surface with infrared-sensitive film enables the examiner to differentiate inks of a dissimilar chemical composition (see Figure 16–8).

Intentional obliteration of writing by overwriting or crossing out is seldom used for fraudulent purposes because of its obviousness. Nevertheless, such cases may be encountered in all types of documents. Success at permanently hiding the original writing depends on the material used to cover the writing. If it is done with the same ink as was used to write the original material, recovery will be difficult if not impossible. However, if the two inks are of a different chemical composition, photography with infrared-sensitive film may reveal the original writing. Infrared radiation may pass through the upper layer of writing while being absorbed by the underlying area (see Figure 16–9).

Close examination of a questioned document sometimes reveals crossing strokes or strokes across folds of perforations in the paper that are not
Any document that has become darkened and brittle through exposure to fire or excessive heat.

Infrared photography sometimes reveals the contents of a document that has been accidentally or purposely charred in a fire. Another way to decipher charred documents involves reflecting light off the paper’s surface at different angles in order to contrast the writing against the charred background (see Figure 16–10).

Digital image processing is the method by which the visual quality of digital pictures is improved or enhanced. Digitizing is the process by which the image is stored in memory. This is commonly done by scanning an image with a flatbed scanner or a digital camera and converting the image by computer into an array of digital intensity values called pixels, or picture elements (see p. 499). Once the image has been digitized, an image-editing program such as Adobe Photoshop is used to adjust the image. An image may be enhanced through lightening, darkening, and color and contrast controls. An example of how the technology is applied to forensic document examination is shown in Figures 16–11 and 16–12.

Other Document Problems
Document examiners encounter other challenges when analyzing questioned documents, including visualizing writing pressed or indented into a surface and analyzing the inks and paper used in suspect documents.

Indented Writings
Indented writings are the partially visible depressions on a sheet of paper underneath the one on which the visible writing was done. Such depressions are due to the application of pressure on the writing instrument and would be in a sequence that is consistent with the natural preparation of the document. Again, these differences can be shown by microscopic or photographic scrutiny.

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appear as a carbon copy of a sheet if carbon paper had been inserted between the pages.

Indented writings have proved to be valuable evidence. For example, the top sheet of a bookmaker’s records may have been removed and destroyed, but it still may be possible to determine the writing by the impressions left on the pad. These impressions may contain incriminating evidence supporting the charge of illegal gambling activities. When paper
is studied under oblique or side lighting, its indented impressions are often readable (see Figure 16–13).

An innovative approach to visualizing indented writings has been developed at the London College of Printing in close consultation with the Metropolitan Police Forensic Science Laboratory. The method involves applying an electrostatic charge to the surface of a polymer film that has been placed in contact with a questioned document, as shown in Figure 16–14. Indented impressions on the document are revealed by applying a toner powder to the charged film. For many documents examined by this process, clearly readable images have been produced from impressions that could not be seen or were barely visible under
FIGURE 16–11 This composite demonstrates the various changes that can be applied to a digitized image in order to reveal information that has been obscured. Using a photo editor (Adobe Photoshop), the original was duplicated and pasted as a second layer. Colors were changed in selected areas of the image using the “screen” and “exclusion” options. “Replace color” allows the user to choose a specific color or range of colors and lighten, darken, or change the hue of the colors selected. “Level” and “curves” tools can adjust the lightest and darkest color ranges and optimize contrast, highlights, and shadow detail of the image for additional clarity. Courtesy Lt. Robert J. Garrett, Middlesex County Prosecutor’s Office, N.J.

normal illumination. An instrument that develops indented writings by electrostatic detection is commercially available and is routinely used by document examiners.

Ink and Paper Comparisons
A study of the chemical composition of writing ink present on documents may verify whether known and questioned documents were prepared by the same pen. A nondestructive approach to comparing ink lines is accomplished
FIGURE 16–12  (a) Receipts have been used in investigations to establish a victim’s whereabouts, provide suspects with alibis, and substantiate a host of personal conduct. Unfortunately, due to wear, age, or poor printing at the register, the receipt is often unreadable. This can be corrected using photo-editing software. In this example, the original toll receipt was scanned at the highest color resolution, which allows more than 16 million colors to be reproduced. The image was then manipulated, revealing the printed details, by adjusting the lightest and darkest levels and the color content of the image. (b) Invoices may contain details about a transaction that are important to an investigation. The copy that ships with the merchandise may have that information blocked out. This information may be recovered using digital imaging. The left figure shows the original shipping ticket. The right figure shows the information revealed after replacing the color of the blocking pattern. Courtesy Lt. Robert J. Garrett, Middlesex County Prosecutor’s Office, N.J.
FIGURE 16–13 A suspected forger was arrested. In his car, police found written lists of the victims he intended to defraud. Some of these writings are shown in (a). A writing pad found in his house had indentations on the top page of the pad shown in (b). These indentations corresponded to the writings found in the car, further linking the suspect to the writings. Courtesy Centre of Forensic Sciences, Toronto, Canada

FIGURE 16–14 An electrostatic detection apparatus (ESDA) works by applying an electrostatic charge to a document suspected of containing indented writings. The indentations are then visualized by the application of charge-sensitive toner. Courtesy Foster & Freeman Limited, Worcestershire, U.K., www.fosterfreeman.co.uk
with a visible microspectrophotometer (see pp. 248–251). A case example illustrating the application of this approach to ink analysis appears in Figure 7–11, on p. 250. Thin-layer chromatography is also suitable for ink comparisons. Most commercial inks, especially ballpoint inks, are actually mixtures of several organic dyes. These dyes can be separated on a properly developed thin-layer chromatographic plate. The separation pattern of the component dyes is distinctly different for inks with different dye compositions and thus provides many points of comparison between a known and a questioned ink.

Ink can be removed from paper with a hypodermic needle with a blunted point to punch out a small sample from a written line. About ten plugs or microdots of ink are sufficient for chromatographic analysis. The United States Secret Service and the Internal Revenue Service jointly maintain the United States International Ink Library. This collection includes more than 8,500 inks, which date back to the 1920s. Each year new pen and ink formulations are added to the reference collection. These inks have been systematically cataloged according to dye patterns developed by thin-layer chromatography (TLC; see Figure 16–15). On several occasions, this approach has been used to prove that a document has been fraudulently backdated. For example, in one instance, it was possible to establish that a document dated 1958 was backdated because a dye identified in the questioned ink had not been synthesized until 1959.

To further aid forensic chemists in ink-dating matters, several ink manufacturers, at the request of the U.S. Treasury Department, voluntarily tag their inks during the manufacturing process. The tagging program allows inks to be dated to the exact year of manufacture by changing the tags annually.

Another area of inquiry for the document examiner is the paper on which a document is written or printed. Paper is often made from cellulose fibers found in wood and fibers recovered from recycled paper products. The most common features associated with a paper examination are general appearance, color, weight, and watermarks. Other areas of examination include fiber identification and the characterization of additives, fillers, and pigments present in the paper product.

**Key Points**

- Document examiners deal with evidence that has been changed in several ways, such as through alterations, erasures, and obliterations.
- Infrared luminescence can be used to detect alterations to a document made with ink differing from the original. Infrared luminescence can also reveal writing that has been erased.
- A digitized image can be lightened, darkened, and color and contrast adjusted with appropriate software.
- It may be possible to read indented writing—the impressions left on a paper pad—by applying an electrostatic charge to the surface of a polymer film that has been placed in contact with a questioned document.
- Studying the chemical composition of writing ink present on documents may verify whether known and questioned documents were prepared by the same pen.
FIGURE 16-15  Chart demonstrating different TLC patterns of blue ballpoint inks. Courtesy Alcohol, Tobacco, Firearms and Explosives Laboratory, U.S. Department of Justice, Washington, D.C.
Chapter Summary

Any object with handwriting or print whose source or authenticity is in doubt may be referred to as a questioned document. Document examiners apply knowledge gathered through years of training and experience to recognize and compare the individual characteristics of questioned and known authentic writings. For this purpose, gathering documents of known authorship or origin is critical to the outcome of the examination.

Many factors compose the total character of a person’s writing. The unconscious handwriting of two different individuals can never be identical. Furthermore, the writing style of one individual may be altered beyond recognition by the influence of drugs or alcohol. Collecting an adequate number of known writings is critical for determining the outcome of a handwriting comparison. Known writing should contain some of the words and combinations of letters present in the questioned document.

The two requests most often made of the examiner in connection with the examination of typewriters and printing devices are to identify the make and model of the typewriter and printing devices used to prepare the questioned document and to determine whether a particular suspect typewriter or printing device prepared the questioned document. The individual type character’s style, shape, and size are compared to a complete reference collection of past and present typefaces. As is true for any mechanical device, use of a printing device results in wear and damage to the machine’s moving parts. These changes occur both randomly and irregularly, thereby imparting individual characteristics to the printing device. The document examiner deals with problems involving business and personal computers, which often produce printed copies that have only subtle defects.

Document examiners deal with evidence that has been changed in several ways, such as through alterations, erasures, and obliterations. Indented writings have proved to be valuable evidence. It may be possible to determine what was written by the impressions left on a paper pad. Applying an electrostatic charge to the surface of a polymer film that has been placed in contact with a questioned document visualizes indented writings. A study of the chemical composition of writing ink on documents may verify whether known and questioned documents were prepared by the same pen.

Review Questions

Facts and Concepts

1. What is a questioned document?

2. Name at least five characteristics of handwriting in which one might expect to encounter variations between individuals.

3. Name at least five factors besides handwriting characteristics that can impart individual variations to writing.

4. Describe two situations in which a document examiner may be prevented from coming to a positive conclusion about a questioned document.
5. What are exemplars? Why are they important for document examination?

6. What are natural variations? How can they be useful for detecting forgeries?

7. When comparing sample writing to a suspect document, the age difference between the documents should be no more than
   a. six to twelve months.
   b. twelve to eighteen months.
   c. two to three years.
   d. five to seven years.

8. What constitutional principle did the Supreme Court address in *Gilbert v. California*, and how did the court rule?

9. What constitutional principle did the Supreme Court address in the case of *United States v. Mara*, and how did the court rule?

10. What distinguishing marks serve as points of comparison on documents produced by a photocopier?

11. What is a TTI? Name two ways in which it is useful in document comparison.

12. Name the two general categories of printers and list two examples of each type.

13. Name five important characteristics of a printer, photocopier, or fax machine that a document examiner must identify when analyzing a document in a situation where the suspect machine is not available.

14. What two processes typically are involved in examination of toner?

15. What two questions are document examiners most often asked about typewriters?

16. What individual characteristics of a typewriter are valuable for proving its identity?

17. Name two ways in which infrared luminescence is useful in examining documents.

18. Describe two methods for visualizing indented writing.

19. Name two analytical techniques used to analyze writing inks.

20. List the most common features associated with a paper examination.

**Application and Critical Thinking**

1. Criminalist Julie Sandel is investigating a series of threatening notes written in pencil and sent to a local politician. A suspect is arrested and Julie directs the suspect to prepare writing samples to compare to the writing on the notes. She has the suspect sit at a desk in an empty office and gives him a pen and a piece of paper. She begins to read one of the notes and asks the suspect to write the words she dictates. After reading about half a page, she stops, then dictates the same part of the note a second time for the suspect. At one point, the suspect indicates that he does not know how to spell one of the words, so Julie spells it for him. After completing the task, Julie takes the original notes and the dictated writing from the suspect to a document examiner. What mistakes, if any, did Julie make?
2. In each of the following situations, indicate how you would go about recovering original writing that is not visible to the naked eye.

a. The original words have been obliterated with a different ink than was used to compose the original.
b. The original words have been obliterated by chemical erasure.
c. The original writing was made with fluorescent ink.
d. The original documents have been charred or burned.

3. You have been asked to determine whether a handwritten will, supposedly prepared thirty years ago, is authentic or a modern forgery. What aspects of the document would you examine to make this determination? Explain how you would use thin-layer chromatography to help you come to your conclusion.

Web Resources

Emily J. DeWill, Certified Document Examiner (Page with articles on history, theory, and applications of document examination)
www.qdewill.com

Forgery Finder (Site that discusses handwriting identification and offers examples of altered documents, obliterations, ink identification, graffiti, and anonymous letters)
www.forgeryfinder.com

Guidelines for Forensic Document Examination (Article that discusses procedures for collecting, handling, and examining questioned documents)
www.fbi.gov/hq/lab/fsc/backissu/april2000/swgdoc1.htm

Handwriting, Typewriting, Shoeprints, and Tire Treads: FBI Laboratory’s Questioned Documents Unit (Article that includes sections on analysis of questioned handwriting and typewriting samples)
www.fbi.gov/hq/lab/fsc/backissu/april2001/held.htm

Obtaining Handwriting Specimens (Article on sources of and methods for obtaining and submitting handwriting samples)
www.fdeservices.com/Exemplars.htm

Questioned Document Examination (Discusses the history, techniques, and court use of document examination; includes a brief list of links to document examination sites)
www.faculty.ncwc.edu/toconnor/425/425lect05.htm

Endnotes