

# **Forensic Document Examination**

# FORENSIC DOCUMENT EXAMINATION

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*Principles and Practice*

*By*

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# *Dedication*

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*This book is dedicated to two outstanding teachers,  
Sr. Mary Frieda Chetelat and Dr. Clarence Terrill.*

# Foreword

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The field of forensic document examination is one of the oldest disciplines in forensic science. As reported by J. Newton Baker in his book, *The Law of Disputed and Forged Documents*, “forgery was practiced from the earliest times in every country where writing was the medium of communication” (1). Rules for identifying and comparing handwriting can be traced back to Roman law under the Code of Justinian in 539 AD. Thus, handwriting identification and forgery detection predates most of the other forms of forensic science by centuries.

The single leading court case that brought public and legal attention to the field of forensic document examination was perhaps the Lindbergh kidnapping trial in 1935. The testimony of the document examiner, Albert Osborn, demonstrated that Richard Hauptmann was the author of the ransom note. Osborn was the author of a leading treatise on document examination, *Questioned Documents*, published in 1929. The book is still considered to be the bible of document examination and set forth basic principles that document examiners continue to use to this day.

Although document examination has long been recognized as a forensic science discipline, the courts began to scrutinize the legitimacy of handwriting identification in the 1990s. In the 1995 case, *United States v. Starzeczyzel* (SSOF. Supp. 1027, SDNY 1995), the court heard testimony criticizing the reliability and scientific foundation of handwriting examinations. The court ruled that the testimony of the document examiner was technical in nature and not scientific. This case, coupled with the Daubert case (*Daubert v. Merrell Dow Pharmaceuticals*, 509 US 579, 1993) setting strict guidelines on the acceptance of scientific forensic evidence, revealed that forensic document examination was a discipline lacking empirical support as a science. The result was a flood of empirical studies in the late 1990s and into the early 21st century supporting the assumptions that document examiners had held for decades. In two studies by Kam et al., it was shown that document examiners were using scientific methods to render opinions that lay persons were unable to render (2,3). One of the more convincing studies supporting the scientific nature of forensic document examination is the work on handwriting identification at the State University of New York’s Center of Excellence for Document Analysis and Recognition (CEDAR). Funded by the National Institute of Justice, the CEDAR computer software program is able to recognize certain features of handwriting and provide possible matches from a handwriting database. Similar to the Automated Fingerprint Identification System for latent fingerprint identification, CEDAR assists document examiners but does not replace them. The CEDAR program proved that there were unique identifiable features to handwriting that can be objectively demonstrated. The result of these empirical studies was the general acceptance of forensic document examination as a scientific discipline in most courts. Daubert challenges still arise but they are rarely successful in omitting the testimony of forensic document examiners.

Currently, practitioners in the field of forensic document examination are striving to create standards and protocols for the examination of documents and the education and training of document examiners through the American Society for Testing and Materials. Further, although guidelines and protocols for examining documents are based on the general principles that nearly every document examiner practices, the standards for education and training of examiners have been met with some controversy and resistance.

Traditionally, document examiners have been trained through apprenticeship with a senior document examiner in a crime laboratory. There are few law enforcement training academies that train forensic document examiners, and the ones that do exist are only of a few days duration. Privately trained examiners face a greater problem. They do not have access to government crime laboratories to become trained like their publicly employed counterparts. Those individuals in the private sector must independently secure access to training and apprenticeship resources unless they are employed as a government examiner. However, because of recent court rulings, standardization and accreditation of certifying boards, there has been an increase in the number of colleges and universities offering coursework in forensic document examination. Although not designed to replace apprenticeship training, college coursework provides a much better educational foundation for those seeking knowledge or a career in document examination than do self-taught learning or brief training courses. Moreover, with the increasing numbers of accredited online college courses, apprenticeship learning can be accomplished as well.

Because of the increase in the number of colleges offering courses in document examination, there is a need for relevant instructional materials and resources. Many excellent textbooks in the field of forensic document examination are available; however, most of these textbooks are not classroom friendly. Published primarily for reference and self-learning, such texts are not necessarily designed for structured academic learning. Academic textbooks are designed to allow material to be learned in one semester, guided by an instructor. *Forensic Document Examination: Principles and Practice* is designed for that purpose.

This volume brings together the foundations of document examination laid down by the recognized treatises on the subject. *Forensic Document Examination: Principles and Practice*, designed as a textbook for an introductory course in forensic document examination, provides for effective structured learning. It embraces the student with an easy-to-read style with chapter questions and case studies. It is succinct and concise, yet comprehensive in scope for an introductory course. It will help fill the need for more instructional resources in the field of forensic document examination.

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## References

1. Baker JN. *Law of Disputed and Forged Documents*. The Mitchie Company, Charlottesville, VA.
2. Kam M, Fielding G, Conn R. Writer identification by professional document examiners. *J Forens Sci* 1997;42:778–785.
3. Kam M, Gummadidala K, Fielding G, Conn R. Signature authentication by forensic document examiners. *J Forens Sci* 2001;46:884–888.

# Preface

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The field of document examination does not have a standard training program or recommended course of study. No college degree in the field of forensic document examination is available and very few college courses are being offered in the field.

Agencies that house forensic laboratories have their own training programs based on the questioned document cases that come into their laboratories. Trainees read suitable books on the subject and learn from senior examiners.

A few colleges occasionally offer basic classes in the examination of questioned documents. However, until now, there has never been a textbook written specifically for a college course. This book has been written to meet the need for a textbook for students who wish to study questioned document examination.

The first step in learning any subject is the study of the principles of that field. *Forensic Document Examination: Principles and Practice* introduces students to the basic principles of handwriting and the factors that affect handwriting. Once the student has mastered the study of the development of handwriting, he or she is ready to pursue the study of the identification of handwriting.

Students who use this text will gain an understanding of the development of skill in handwriting analysis in document examination and a basic concept of the characteristics of handwriting that are compared when making an identification or elimination of a writer. Students will also learn to recognize the signs of forgery and disguise and how to distinguish between simulation and disguise.

Students need to know what types of documents are suitable for comparison purposes to identify or eliminate a writer. They will learn how to collect and safeguard documents and maintain an evidentiary chain of custody.

Students will learn about modern office equipment, paper, ink, and writing instruments. They will receive an introduction to the court system and the litigation process.

Much additional information is needed before one can become a forensic document examiner. Students need an opportunity to work on questioned document cases. They need to learn how to distinguish between genuine, disguised, and simulated writing. This process requires intensive training that is beyond the scope of this text.

*Forensic Document Examination: Principles and Practice* will also be helpful for professionals in related fields who interact with document examiners. It is useful for police officers, private investigators, and attorneys to have a basic understanding of the field of document examination and what is required for a document examiner to complete an assignment.

*Katherine Mainolfi Koppenhaver*

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# *Chapter 1*

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## *The Evolution of the Written Word*

### *THE HISTORY OF WRITING*

Writing consists of messages to convey ideas to others in a permanent or semipermanent mode. This includes pictures and drawings as well as penmanship systems. Many signs and symbols, such as the barber's pole and the three balls over pawnshops, grew out of early stages of the development of writing.

Writing evolved because humans had a desire to communicate their thoughts with others. Writing developed independently through different cultures and various epochs of history. All primitive people had an oral language and an early stage of writing, or something resembling writing. People devised a means of communicating through visible signs that could be understood by others. Records have been chiseled into stone, notched in sticks, carved in wood, knotted on ropes, pressed into clay tablets, and marked on animal skins.

Writing grew out of pictures; cave drawings being the first recorded record of humans. These paintings, called petroglyphs or petrograms, are believed to have developed between 20,000 and 10,000 BC (Fig. 1.1). Gradually, pictures came to represent words. Word pictures known as ideographs were used by Sumerians, Chinese, Aztecs, Mayas, and Egyptians. Most notable are the Egyptian word pictures, hieroglyphics.

Pictures were modified into symbols, symbols represented syllables, and a symbol used to represent a sound or a syllable is known as a phonograph. This developed into simplified phonetic symbols called the phonetic alphabet. The Sumerians assigned a symbol to each sound and are generally credited with the development of the first alphabet. The Phoenicians spread this alphabet throughout the known world between 1700 and 1500 BC. The

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Fig. 1.1. Petroglyphs are ancient writing carved into rocks at Three Rivers, NM.

Phoenician alphabet consisted of 22 letters. They separated words with periods and sentences with slash marks. Their writing went from right to left.

The word *alphabet* stems from the first two letters of the Greek alphabet, alpha and beta. The Greeks changed the writing direction from left to right. They also added vowels. Their alphabet consisted of 24 letters.

The Romans borrowed the alphabet from the Greeks and gave our letters their abecedarian names. For several centuries their writing consisted of disconnected capital letters. Roman scribes invented the lowercase letters that were patterned from the capital letters. These letters simplified the forms and made it easier to copy manuscripts. Writers added ascenders and descenders to the letter forms, which ascended above the ordinary height of a letter and descended below the baseline.

We owe much of our present cursive handwriting to Ludovico Arrighi, a scribe in the Vatican chancellery who popularized an italic style of handwriting in 1522. The word *italic* comes from Italy and is used because of the origin of italic script in that country. Today italic means script that slants to the right. Italic writing was a precursor to modern cursive writing. Gradu-

ally, connecting strokes, also known as ligatures, were added to connect the letters within words. Many styles were used over the centuries, but the most prevalent is the garland-connecting stroke.

Today the influence of the early alphabets is seen throughout Europe and the Americas. The European explorers brought the alphabet to the new world. North and South American systems are based on the Germanic system, which is derived from the Roman. They include English in the United States and Canada, Spanish in Central and South America, Portuguese in Brazil, and French in the province of Quebec in Canada.

The Greek alphabet is still used in Greece, Cyprus, and Crete. The Cyrillic alphabet derived from the Greek is used in Russia and Eastern European countries. This alphabet was introduced by Sts. Cyril and Methodis who proselytized the Slavic tribes of East Europe in the ninth century.

The countries of the Middle East use the Armenian alphabet and Hebrew text. Arabic is used in this part of the world as well as in Northern Africa. Our American alphabets are taught in many of the African countries. The Ethiopians have their own alphabet. The Hebrew and the Arabian characters are written from right to left.

India, Mongolia, Tibet, and other countries in Asia have their own writing systems. India has two main alphabets, Hindu and Urdu, with many dialects. The Burmese alphabet is a combination of Indian Sanskrit and Pali script of the Buddhist scriptures.

The major alphabets of the Far East are Korean, Chinese, and Japanese. The Korean alphabet was designed rather than evolving like other alphabet systems and is considered the only perfect alphabet. Chinese writing is the most complex although efforts have been made to simplify it. The Japanese writing was adapted and simplified from the Chinese. They use syllabaries called kana. The most popular are hiragana and katakana. Japanese is normally written in kanamajiri.

Some nationalities have independent alphabets. The Celtic alphabet of Ireland is one example. In 1823, Sequoyah invented an alphabet of 86 characters for the Cherokee Indian nation. The Hawaiian alphabet has only 12 letters: *a, e, h, i, k, l, m, n, o, p, u, and w.*

### *PENMANSHIP SYSTEMS*

Penmanship systems represent the class characteristics of handwriting. Knowledge of which penmanship system a writer was taught will assist you in distinguishing the class characteristics indicative of a penmanship system from the individual characteristics of a writer.

In 1507, Leonard Wagner began the first manuscript book containing 100 styles of handwriting. The first copybook was written by Sigismondo Fantis in Venice in 1514. It was titled *Theoretica et Practica*. Ludivico degli Arrighi published *La Operina* in 1522.

The first English copybook was published by John Debeau Chesne and John Baliden in 1570. This book contained samples of writing in every known alphabet of its day. It was titled *A Book of Divers Sorts of Hands*. In 1609, Daniel Crocker published a penmanship book in London.

Early American writing paralleled the English writing system because the earliest writing masters came from England. English Roundhand, which was based on the Italian hand, prevailed. In 1784, Benjamin Franklin and D. Hall published a compendium on various subjects including handwriting entitled *The American Instructor or Young Man's Best Companion*. The first true copybook published in the Americas was *The Writing Scholar's Assistant*. It was published in 1785 by Isaiah Thomas in Worcester, MA.

The first American-born author of a treatise on handwriting was John Jenkins. Published in 1791, it was called *The Art of Writing, Book I*. He was the first writing master to reduce writing to six principal strokes or lines. Instead of teaching whole letters, students learned the strokes of letters and combined them to form the letters. Henry Dean of Salem, MA, was the first American-born penman to publish a writing manual in 1804. In 1824, James Gordon Bennett founded the first commercial school in which penmanship played a major role. He later founded the *New York Herald*.

A modified Roundhand was the prevalent writing style between 1840 and 1865. This was subsequently influenced by Platt Roger Spencer, who created the Spencerian System in 1848. Spencer is known as the father of modern penmanship.

In 1851, J. W. Payson and Seldom Dunton produced the first modern system of teaching handwriting from "copy" books. Previous handwriting publications furnished handwriting plates in books that the students copied into their own separate copybooks. Spencer introduced his first copybook in 1851. The Spencerian System dominated from 1865 to 1890. Spencer simplified writing by omitting extra strokes and flourishes. His sons improved his writing style. The Vertical hand replaced the Spencerian and enjoyed brief popularity from 1900 to 1910.

The principal influence on 20th century scripts was the Spencerian System of Penmanship. Modern commercial hands were developed from the Spencerian near the turn of the century by several penmen, the most well known being the Palmer Method and the Zaner-Bloser System. This modification or adaptation of business writing developed in American commercial schools. All

American writing systems are based on this free arm movement, which falls under the general heading of American Business Systems. Since the early 1900s more than 62 different systems have been created.

Austin N. Palmer founded the muscular movement of penmanship, which he introduced through the publication of his *Palmer Guide to Muscular Movement Magazine* in 1888. Palmer began publishing a magazine on handwriting in 1884, which he called *The Western Penman*. This was renamed *The American Penman* in 1906. After the turn of the century, the Palmer Method of Muscular Movement was taught in every state and in Canada, replacing the Vertical Writing System.

Charles P. Zaner and Elmer W. Bloser introduced the running-hand style of business penmanship, which subsequently became the most popular penmanship system taught in modern times. The Zaner-Bloser System of Writing was first published in 1908 to meet the need for plain, legible writing in elementary schools. Many other systems were developed but most resembled the Palmer Method or the Zaner-Bloser Penmanship System.

Noble and Nobel introduced Better Handwriting for Everyone in 1928. Peterson Directed Handwriting has been taught in several school districts throughout the country. The D'Nealian System was developed in 1968 by Donald Thurber and has enjoyed wide popularity. It is popular because it is easily converted from manuscript to cursive. A list of 20th-century handwriting systems can be found in the appendix.

The advent of the typewriter in 1873 reduced the need for exquisite handwriting. Penmanship schools became extinct early in the 20th century as the typewriter replaced the penman in modern business offices. In the past 20 years, formal classes on penmanship have diminished. Children are encouraged to form their letters in a method that is comfortable for them as long as the letters are legible.

## *CASE STUDY: INSURANCE FRAUD*

### ***Background***

A life insurance agent was “selling” insurance policies to people without their knowledge and consent. The people were elderly immigrants from Eastern Europe. The agent falsified the medical information and changed the age of the insured. He was caught because the handwriting did not match the insured’s normal writing.

### ***Question***

What alphabet would immigrants of Eastern Europe use?

***Answer***

The Cyrillic alphabet.

***Outcome***

The document examiner determined that the handwriting of the immigrants was based on the Cyrillic alphabet, whereas the signatures in question were not. The insurance company sued the agent and recouped its losses.

***Questions***

1. What is the origin of the word “alphabet”?
2. What are ligatures?
3. What alphabet is used in Russia and Eastern European countries?
4. Name some alphabets that are written from right to left.
5. Name the major Far East alphabets.
6. Who published the first true copybook in America? When?
7. What writing style was prevalent in America between 1840 and 1865?
8. Who is known as the father of modern penmanship and why?
9. When was the Vertical hand used?
10. Name the leading alphabet systems of the 20th century.

## *Chapter 2*

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# *Principles of Handwriting*

### *BASIC PRINCIPLES OF HANDWRITING*

No two people write exactly alike. The principles of handwriting identification are based on basic scientific truths about handwriting. The first and foremost of these scientific truths is that no two people write exactly alike in an extended handwriting sample. The use of a signature in legal and financial transactions is possible because unique characteristics in an individual's handwriting distinguish it from every other handwriting. This principle enables document examiners to differentiate genuine and non-genuine writing and to identify the author of a sample of handwriting.

The second basic scientific truth about handwriting is all writing contains natural variation so that no two writing samples by the same writer will be exactly the same. There are slight deviations in all handwriting characteristics. The document examiner must learn to distinguish between natural variation and a different writer.

Writing is a complex act and a highly developed skill. Many influences affect the development of each person's writing ability, resulting in the unique style of each individual writer. These influences continue to occur throughout the life of the writer.

### *PHYSICAL FACTORS*

Physical factors, including hand-eye coordination, flexibility of wrist movement, and the grip of the writing instrument, play a part in the development of handwriting skills. Other factors include attitude and discipline. If handwriting is important to the writer, he or she will expend more effort in

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learning to write. Taking care to adhere more closely to the written model, the writer will continue practicing until reaching a skill level that is comfortable.

The process of learning to write begins in young children long before formal schooling. The first step involves the visual observation of one's surroundings. Children see many forms that they will eventually identify and duplicate. They develop a concept of what writing looks like. Gradually they learn to recognize the letters of the alphabet and numbers. Each person sees the shapes of letters a little differently. This is the beginning of the individuality that develops in everyone's handwriting.

Writing is affected by what we see and what we remember. We are surrounded by stimuli that influence our understanding of letters and words. Billboards, posters, magazines, and television all contribute to our learning the identity of letter forms.

At the same time children are learning to recognize letters, they begin to develop hand-eye coordination. Children's play is preparation for adult activities. They like to imitate their elders in their play. For example, children pretend to write by scribbling on any available surface from writing paper to walls. Young children actually begin learning to write when they start scribbling with a pencil or a crayon. Coloring is a precursor to writing and helps children develop coordination.

Writing begins formally when children are given paper and pencil and taught to create a form following a model. They trace the letter design with their pencil several times and then attempt to duplicate that letter design. They struggle to control their movements until they can copy a form.

At first the children are given large, fat pencils and are taught to form ball and stick letters. As their skills increase, they are taught to write smaller with finer writing instruments. Children learn handprinting in the primary grades. Cursive writing is generally introduced by the end of the second grade or the beginning of the third grade.

Students deviate from the standard penmanship forms from the time they begin to write. In fact, copybook style writing is so rare that anyone who writes perfect Palmer could easily be identified because the writing would be unique.

Several major factors control the success of mastering handwriting. The powers of observation and the ability to remember the forms observed are two principal considerations. Another major factor in the development of handwriting is the writer's attempt to reproduce the forms observed. Some children have more control over their muscles at an earlier age than others. Some are more patient and will spend more time developing their writing skill. Others will spend more time experimenting with different letter forms (Fig. 2.1).

The image shows the handwritten phrase "From Amanda" in a cursive script. The word "From" is written in a larger, more decorative font, while "Amanda" is written in a smaller, simpler cursive. The letters are connected, and there are some small dots or marks above the 'i' in "Amanda".

Fig. 2.1. The handwriting of a young child.

An important factor influencing the development of writing is the ability to overcome the mechanical and physical impediments to writing; that is, placing the paper at the proper angle, holding the paper in place with one hand to steady it while writing with the other, and learning to control the pen or pencil and direct the movements.

Each writer has innate powers of observation, capacity for graphic expression, and technical execution. It takes many years of practice to develop skill and proficiency at writing. Graphic maturity is reached when the motor skills of the writer are fully developed, and the writer no longer has to focus attention on the act of writing. At this point, the writer concentrates on content and lets his or her subconscious handle the execution of the writing act. The writing has become a habit. The method of construction of various letter combinations and words is set.

Some people never reach graphic maturity. Their writing remains at a low form level. The writer may not have mastered writing for many reasons. A person who does not find a need to write will not develop skill in writing. Lack of formal schooling also results in poorly developed handwriting.

Each person attains a level of skill that he or she finds acceptable. The more an individual practices writing, the better the skill, unless the writer has an impediment to learning. Before the advent of modern office equipment, penmanship practice continued into adulthood. Emphasis is no longer placed on handwriting skill. Even the methods of teaching handwriting are more relaxed in modern times. Children are not drilled in proper procedures for handwriting like our forefathers. Little attention is paid to posture, positioning of the paper, and the proper grip of the writing instrument.

### *PHYSIOLOGY OF WRITING*

Just how does the act of writing occur? Skilled writing uses arm, wrist, and finger movement. The arm moves across the paper as writing is produced so that the pen is presented at the proper location for writing. The arm may be in continual movement, or it may rest on the writing surface and move in segments as necessary.

The wrist is flexed to assist in the movement of the writing instrument. The wrist will bend to assist the writer in reaching the writing area. When the wrist can no longer reach, the arm slides forward toward the right margin to extend the writing line. The arm is pulled back to the left margin to start the next line of writing. The paper may be adjusted as well to assist the writer in reaching the available writing surface. The fingers work together to produce the forms of writing. When one finger pushes the writing instrument another offers resistance, which controls the motion. The contraction and release flow together to push the pen away and pull it back again. The strokes turning leftward and downward require contraction of the muscles, and the upward and rightward strokes involve the release of the muscles. Thus, downward writing is better controlled.

Right-handed writers use their thumb to exert pressure on the writing instrument to push it horizontally in a rightward and upward direction. The middle finger pushes the writing instrument leftward both diagonally and horizontally while the thumb and index finger pull the instrument down toward the baseline, which is the imaginary line to which the writing returns.

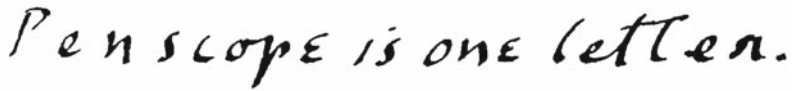
Because writer movement is from left to right, the right-handed writer has the advantage of being able to see the writing as it is being executed. The left-handed writer must adjust his or her hand to compensate for the fact that the hand is covering the line of writing as it is being executed. Many left-handed writers hook their hand over the writing so they can see what they are writing.

Skilled writers use a combination of finger, wrist, and arm movements to accomplish the act of writing. Poor writers use only their fingers and have to constantly lift and move their hand to reach across the page. Some writers use only arm movement, which is more difficult.

Writing becomes automatic to the point where the operation not only requires almost no conscious direction but is frequently beyond the control of the mind or the hand. This is evident when someone tries unsuccessfully to disguise his or her handwriting. The habits are so ingrained that the writer cannot eliminate all the characteristics comprising his or her writing style.

### *PEN SCOPE*

Pen scope is the distance the pen covers before the writer moves his or her hand to continue the writing act. It is possible to identify the pen scope by the breaks between letters, syllables, or words. This is one of the factors that can assist in the identification of a particular writer because pen scope is an individual characteristic.



*Pen scope is one letter.*

Fig. 2.2. Writing created using only finger movement, requiring the writer to adjust the writing instrument for each individual letter.



*Pen scope is one syllable.*

Fig. 2.3. Writing created using wrist movement, enabling the writer to complete one syllable before adjusting the writing instrument.



*Pen scope is one phrase.*

Fig. 2.4. Writing created using the whole arm, enabling the writer to write a complete sentence before readjusting the writing instrument.

How can one distinguish between finger movement and wrist movement? The writer using finger movement must constantly readjust his or her hand when writing across the page. This constant adjustment can be seen in abrupt turns and breaks in the letters. It is primarily used by unskilled writers and indicates unfamiliarity with the writing process. The writing will show frequent stops and pauses to relocate the pen because there is little lateral movement during the formation of letters using finger motion only (Fig. 2.2).

Wrist motion results in longer continuous motion before adjusting the pen position. Often, the baseline forms an arc in the writing because the hand swings from left to right. Phrases and words are completed in a single movement of the writing instrument (Fig. 2.3).

Modern writers have not been taught to use whole arm movement when writing. Although arm movement was used by the writing masters in the 19th century, in modern times this method is employed primarily on large writing surfaces such as blackboards. Writers using whole arm movement generally write larger. The movement can be extended across the page without having to readjust the pen position (Fig. 2.4).

### *FACTORS THAT INFLUENCE HANDWRITING*

An individual's handwriting changes over his or her lifetime. The most obvious change takes place from childhood through adolescence. Graphic maturity is generally reached toward the end of adolescence. Gradual changes will continue to occur. Many factors will affect the act of writing, although few factors will alter the handwriting so that it cannot be identified.

The penmanship system taught in schools influences handwriting. The primary systems currently being taught are Palmer, Zaner-Bloser, and D'Nealian. Although these systems are similar, some differences in letter forms and methods of construction exist. The characteristics learned from a penmanship system are called class characteristics because they are writing habits that are shared by many people.

Although students learn the same system of writing, each develops unique characteristics that distinguish his or her writing from all other writers. These are called individual characteristics, and they are either consciously created or subconsciously executed. A writer will copy an admired style or letter form. He or she will experiment with different designs to add unique and individual letter forms to his or her writing. More mature writers create more individual letter forms.

Some writing habits are so subtle that the writer is not aware of them. Like breathing, they occur without conscious effort. The writer does not plan them. Pressure patterns are examples of these subconscious habits. The writer is not aware of the variations of pressure when executing writing. Hooks and ticks are another example of writing habits that fit into this category. The writer is unaware of the slight flick of the wrist that creates these hooks. These characteristics are found at the beginning and ending of words. They may be found in any stand-alone letter form. Hooks or ticks may appear at the beginning of specific letter forms or may be found in all beginning or terminal strokes of words.

Some habits are developed by the writer when learning to write. These are consciously executed characteristics. Diacritics, or i-dots, may be consciously executed characteristics, particularly circle i-dots or the placement of i-dots or t-bars in a location that is pleasing to the writer. Some writers use printed capital letters in place of cursive or add a flourish to a letter or delete extra strokes. The writer chooses a particular letter form. These are consciously created handwriting characteristics.

Penmanship systems teach i-dots as static; that is, the writing instrument touches the paper and is immediately removed, leaving a dot on the page. Many writers execute the i-dot quickly, resulting in a dash instead of a dot. This dash may also have a specific direction. It can be horizontal, diagonal, or vertical. It may change direction, resembling a hook or a v-formation.



Fig. 2.5. The first signature is a genuine signature written by Carol L. Mainolfi. The second signature is her mother (this author) imitating her daughter’s signature.

**Table 2.1**  
**Principles That Assist in the Identification of Handwriting**

- 
- No two people write exactly alike.
  - Individual characteristics that are unique to a particular writer exist in every person’s handwriting, distinguishing it from every other handwriting.
  - The act of writing is a skill learned through repetition until it becomes a habit.
  - A person’s normal form of writing is based on mental images of learned letter designs.
  - People stylize their writing from the method they were taught.
  - People adopt writing styles by copying those they like.
  - Many writing habits are subconscious and therefore cannot be changed by the writer.
  - A person’s handwriting changes over the course of his or her lifetime.
- 

### *FAMILIAL CHARACTERISTICS*

Family members frequently share some handwriting characteristics. These are called familial characteristics. Children copy the writing style of their parents or siblings. They generally have plenty of opportunity to observe their parents’ handwriting. Many children practice their parents’ signatures until they become proficient at imitating them (Fig. 2.5).

Some groups of people who share a common bond develop handwriting characteristics that are unique to that group. Accountants, engineers, and draftsman fall into this category. People from foreign countries also share some common characteristics resulting from the system of writing they were taught. Unless the document examiner is aware of these influences, he or she could mistake national or group characteristics for individual characteristics of writing.

### *FEATURES OF HANDWRITING*

Handwriting features called characteristics are used to identify handwriting. Characteristics that are shared by many writers are called class characteristics. Individual characteristics are those that are unique to writer. It is a

combination of class and individual characteristics that are used to identify an individual's handwriting (*see* Table 2.1).

### *CHARACTERISTICS OF HANDWRITING*

The characteristics of writing that occur in handwriting include the appearance of the writing and the method of construction. They cover the range of writing of the writer. Class characteristics are those features shared by a large number of people. In handwriting, they are usually identified by the penmanship system a writer has learned. Although all writers deviate from the penmanship system they learned, many of the characteristics are retained. Class characteristics assist in identifying a writer but are not sufficient identifiers to limit the writing as belonging to one individual writer. Some deviations of penmanship standards are so common they fall into the category of class characteristics although they are not part of any penmanship system. An example would be the Greek letter, epsilon.

Individual characteristics are those deviations from the norm that writers make when they do not follow the rules of penmanship. Individual peculiarities creep into everyone's handwriting as they modify and stylize their writing. These modifications provide the strongest identification. No other writer duplicates exactly all the peculiarities that show up in a writer's handwriting. Although many writers may have similar individual characteristics in their writing, it is the unique combination of characteristics that identify a writer. No two writers share all the same characteristics. Each writer's characteristics are unique to that writer.

What are the characteristics or features that make up writing? The features of handwriting are classified for identification purposes. When the writer puts pen to paper, he or she uses movement, spatial relationships, and form.

### *MOVEMENT*

Movement includes direction, slant, rhythm, pressure patterns, line quality, and speed. The direction of writing is dictated by rules of penmanship, but not everyone adheres to the rules. It is necessary to know the normal progress of writing across the page to determine deviations from that norm. Slant is part of the direction of writing but is measured separately. Speed and rhythm are affected by the direction of writing. Pressure is also related to movement.

#### *Direction*

Rules of penmanship dictate that writing progresses from left to right on a horizontal plane. Each line is placed below the preceding one from the top

to the bottom of the page. Letters return to an imaginary baseline in a rhythmic motion. Most alphabets begin their letter formations at the baseline and move upward and to the right. Some letters begin in the mid-zone and move left, such as *a*, *c*, *d*, *g*, and *o*.

Writing requires a movement through space. Writers start at the imaginary baseline and move up or down to form their letters. They adhere to rules that govern the location of each letter, either above or below the baseline. They are taught to divide their writing into three zones: upper, middle, and lower. Writers are taught the proper proportions among the zones of writing. They learn the rules for size, slant, and spacing between letters and words of writing.

### ***Slant***

Slant refers to the direction in which the writing leans. It may lean to the right or the left, or it may be vertical. Slant may also be variable. Slant is sometimes called slope. When a writer tries to disguise his or her handwriting, that individual will usually change the slant because that will change the pictorial effect of the writing.

### ***Rhythm***

Rhythm refers to the writer's consistency of the slant combined with the even return to the baseline. Skilled writers produce more rhythmic writing than unskilled writers. Writing rhythm can have a consistent or variable slant and an even or erratic return to the baseline. It mostly falls somewhere in between. Rhythm is usually disrupted when a writer attempts to copy another's handwriting and may be one of the most significant factors in the identification of a forgery.

Rhythm is also an indicator of skill level. The writer who has a well-developed rhythm consistent with an even return to the baseline is a more highly skilled writer than one whose rhythm is poorly developed (Figs. 2.6 and 2.7).

### ***Pressure***

There are two types of pressure in handwriting: grip pressure, which refers to the hand's grasp on the writing instrument, and the amount of pressure used to push the pen across the paper. It varies for different writers from light to heavy. The writing instrument will not function properly if the pressure is too heavy or too light. Most writers apply lighter pressure on upstrokes when they are pushing the pen away and heavier pressure on downstrokes when they bring the pen toward them. These pressure patterns are individual-

Mary Helen Bean

Fig. 2.6. Good rhythm showing consistent slant, even spacing, and an even return to the baseline, revealing a highly skilled writer.

Ashley Brozyk

Fig. 2.7. Poor rhythm showing variable slant and a moderate skill level.

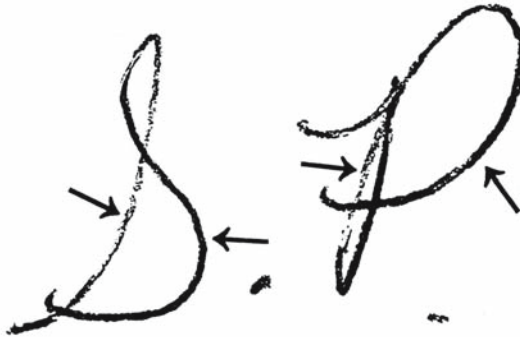


Fig. 2.8. Pressure patterns of a normal writer showing less pressure on the upstrokes and heavier pressure on the downstrokes.

ized and subconscious, therefore becoming strong identifying factors in handwriting (Figs. 2.8 and 2.9).

When the pen comes in contact with the paper, it indents the paper. The writing surface affects the depth of the indentations in a paper. A hard surface reduces the indentations, and a soft surface allows deeper embossing of the paper.

### ***Line Quality***

The smoothness of the line of writing represents the line quality or line value. The skill of the writer determines whether the line quality represents



Fig. 2.9. Writing lines showing even pressure that is a result of drawing a set of initials in an attempt to simulate another writer's habits.

high or low quality. Speed is generally the important determinant when measuring line quality. Slow writing is tremulous and lacks good line quality. Slow writing is the result of lack of skill or of copying another's style. It can be an important consideration in identification of a writer. Fast writing is smoother and more fluid. There are numerous indicators of speed in writing of which line quality is the principle one. The intricacies of the letter form as well as embellishments are part of line quality (Figs. 2.10 and 2.11).

### ***Speed***

Speed of writing differs for various reasons. Some writers think fast and try to write as fast as they think. Some are impatient and always in a hurry. Slow writers may be deliberate and meticulous or less familiar with the writing process. Writers trade speed for legibility. The faster the writing, the more difficult it is to read. Speed reduces legibility. Fast writers simplify the letter forms and slur the endings on words. Letters widen and height is shortened. I-dots seem to be jabbed and carelessly placed. T-bars are sweeping or tapered and may be joined to the following word. Connecting strokes widen. Word endings become blurred and decrease in size. Endings are abbreviated and impossible to read.

As the fast writers progress down the page, their left margins increase while right margins become uneven or diminished. Slant leans toward the right and strokes are steady and firm. Rhythm is smooth and natural with good line quality. Pressure patterns are usually obvious with strong downward strokes and lighter upward strokes.



Fig. 2.10. An illegible signature rapidly written, showing smooth lines that represent good line quality.



Fig. 2.11. Slow writing, resulting in tremor in the writing line as the result of illness.

The general pattern for slow writing is stiff and labored. Slow writers will make carefully executed letter forms that are generally consistent and exact. Many strokes of writing are retraced and cramped. T-bars are carefully placed and balanced, often with blunt endings. I-dots are more rounded and close to the stem. Beginning strokes and word endings are generally blunt to the point that bulbs may be observed without the aid of magnification.

Slow writers generally do not slant their writing as far right as the faster writers do. The margins are generally more even. Pressure is often monotonous. The writing may appear to be drawn instead of written. Poor line quality may result if the writer is not a proficient penman.

## *SPATIAL RELATIONSHIPS*

Spatial relationships include size; proportions; spacing between letters, words, and lines of writing; and utilization of space. Utilization of space includes arrangement and alignment of the writing. Arrangement is based on the space available, and alignment refers to the baseline, real or imaginary.

### *Size*

Penmanship systems dictate normal size of writing. Young children are taught to write using larger strokes with lower case letters 0.25-in. in height. By the time they master the basic letter forms, the students are expected to reduce the writing size to half the original size. Size of writing will vary under different circumstances.

### *Proportions*

Proportions usually are consistent in writing regardless of the size of the writing. When writers change the size of their writing, their letters remain proportional. Horizontal expansion also plays a part in establishing the identity of the writer and is considered part of spacing.

Penmanship systems dictate the proper proportions. Upper looped letters are twice as high as middle zone letters, and capitals can run as high as three times the middle zone letters.

Middle zone letters include *a, c, e, i, m, n, o, r, s, u, v, w,* and *x*. Letters with a middle zone area include *b, d, g, h, k, p, q, y,* and *z*. Upper and lower loop letters without a distinct middle zone area include *f, j, l,* and *t*.

The letter *f* is the only letter to fully extend into all three zones in cursive writing. Writers may vary the size of one of the zones in forming their letter *f*, just as they may emphasize a zone in other letter forms.

Most handwriting systems mandate the upper extenders of *d, p,* and *t* to be shorter than the other extended letters. The *d, p,* and *t* extenders are three-fourths the height of *b, f, h, k,* and *l*. The Palmer Method extends the *d* to the same height as the other letters. Palmer is the only system that puts a loop in the letter *d*.

### *Spacing*

Writers are taught to space their letters uniformly with connecting strokes that are the same size between each letter. Writers are taught to space their letters evenly on a horizontal plane. The rules of writing dictate two letter spaces between words. Sufficient space must be left between lines to prevent intermingling of upper and lower loops. Some writers crowd their writing with cramped letters, and others spread their writing across the page.