Criminalistics

An Introduction to Forensic Science

ELEVENTH EDITION

Richard Saferstein

ALWAYS LEARNING

PEARSON

edition 11

Criminalistics

An Introduction to Forensic Science

Global Edition

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33. ___________ vapors chemically combine with fatty oils or residual water to visualize a fingerprint.

34. The chemical ___________ visualizes fingerprints by its reaction with amino acids.

35. Chemical treatment with ___________ visualizes fingerprints on porous articles that may have been wet at one time.

36. True or False: A latent fingerprint is first treated with Physical Developer followed by ninhydrin. ___________

37. A chemical technique known as ___________ is used to develop latent prints on nonporous surfaces such as metal and plastic.

38. ___________ occurs when a substance absorbs light and reemits the light in wavelengths longer than the illuminating source.

39. High-intensity light sources known as ___________ are effective in developing latent fingerprints.

40. Once a fingerprint has been visualized, it must be preserved by ___________.

41. The image produced from a digital file is composed of numerous square electronic dots called ___________.

42. A (high-pass filter, frequency Fourier transform analysis) is used to identify repetitive patterns such as lines or dots that interfere with the interpretation of a digitized fingerprint image.

application and critical thinking

1. Classify each of the prints shown in the figure as loop, whorl, or arch.

(1). ___________

(2). ___________

(3). ___________

(4). ___________

(5). ___________

(6). ___________

2. A description of the types of prints from the fingers of a criminal suspect appears below. Using the FBI system, determine the primary classification of this individual.

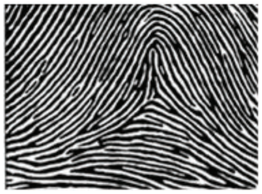
Finger	Right Hand	Left Hand
Thumb	Whorl	Whorl
Index	Loop	Whorl
Middle	Whorl	Arch
Ring	Whorl	Whorl
Little	Arch	Whorl

3. While searching a murder scene, you find the following items that you believe may contain latent fingerprints. Indicate whether prints on each item should be developed using fingerprint powder or chemicals.
   a. A leather sofa
   b. A mirror
   c. A painted wooden knife handle
   d. Blood-soaked newspapers
   e. A revolver

4. Criminalist Frank Mortimer is using digital imaging to enhance latent fingerprints. Indicate which features of digital imaging he would most likely use for each of the following tasks:
   a. Isolating part of a print and enlarging it for closer examination
   b. Increasing the contrast between a print and the background surface on which it is located
   c. Examining two prints that overlap one another

5. The following are fingerprint patterns of three men and a woman with criminal records for robbery. Identify the following fingerprints according to the three groups and the subgroups of fingerprints.


KJ


Inan


Lisa

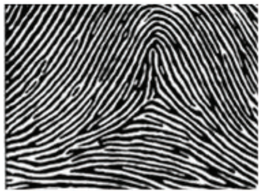

Charlie

6. Count the number of bifurcations in the following prints. Choose between 9, 11, and 13 as the number of bifurcations:

7. At the Museum of Culture Studies, a diary that belonged to Martin Luther King, Jr., has been stolen and replaced by a fake. The only evidence is a fingerprint impression left by the thief on the fake diary. The police suspects four individuals who have had previous criminal records for similar crimes. Their fingerprints already exist in the police database. KJ, Ivan, Lisa, and Charlie are the four suspects. Carefully examine the criminal's fingerprint impression and identify the suspect fingerprint that matches with it.


Crime Scene Fingerprint


KJ


Ivan


Lisa


Charlie

further references

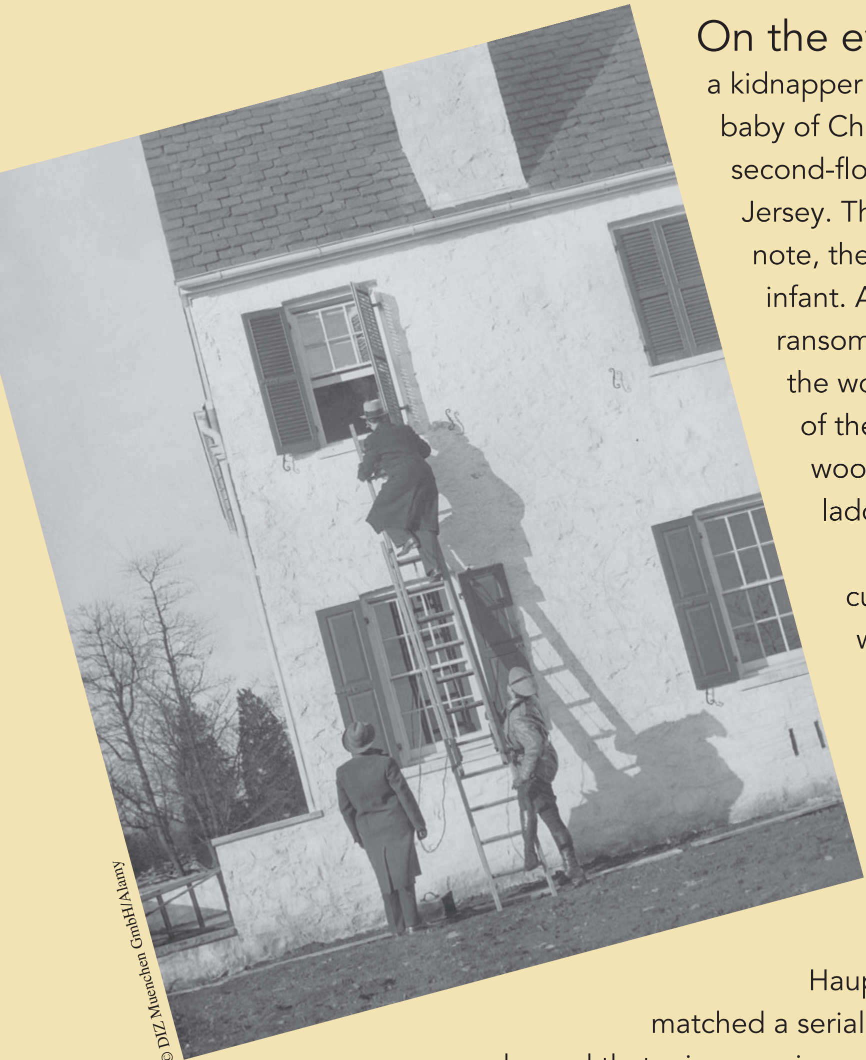
Komarinski, Peter, *Automated Fingerprint Identification Systems (AFIS)*. Burlington, Mass.: Elsevier Academic Press, 2004.

Ramotowski, R., ed., *Lee and Gaensleen's Advances in Fingerprint Technology*, 3rd ed. Boca Raton, Fla.: CRC Press, 2012.

U.S. Department of Justice, *The Fingerprint Sourcebook*, http://www.OJP.usdoj.gov/nij/pubs-sum/225320.htm.

headline news

The Lindbergh Baby Case



On the evening of March 1, 1932, a kidnapper crept up his homemade ladder and stole the baby of Charles and Anne Lindbergh directly from the second-floor nursery of their house in Hopewell, New Jersey. The only evidence of his coming was a ransom note, the ladder, a chisel, and the tragic absence of the infant. A couple of months later, though the $50,000 ransom had been paid, the baby turned up dead in the woods a mile away. There was no additional sign of the killer. Fortunately, when finally studied by wood technologist Arthur Koehler, the abandoned ladder yielded some important investigative clues.

By studying the types of wood used and the cutter marks on the wood, Koehler ascertained where the materials might have come from and what specific equipment was used to create them. Koehler traced the wood from a South Carolina mill to a lumberyard in the Bronx, New York. Unfortunately the trail went cold, as the lumberyard did not keep sales records of purchases. The break in the case came in 1934, when Bruno Richard Hauptmann paid for gasoline with a bill that matched a serial number on the ransom money. Koehler showed that microscopic markings on the wood were made by a tool in Hauptmann's possession. Ultimately, handwriting analysis of the ransom note clearly showed it to be written by Hauptmann.

chapter 7

the microscope and its forensic applications

KEY TERMS

binocular
condenser
depth of focus
eyepiece lens
field of view
microspectrophotometer
monocular
objective lens
parfocal
plane-polarized light
polarizer
real image
transmitted illumination
vertical or reflected illumination
virtual image

Learning Objectives

After studying this chapter you should be able to:

- List and understand the parts of the compound microscope
- Define magnification, field of view, working distance, and depth of focus
- Contrast the comparison and compound microscopes
- Understand the theory and utility of the stereoscopic microscope
- Appreciate how a polarizing microscope is designed to characterize polarized light
- Appreciate how a microspectrophotometer can be used to examine trace physical evidence
- Compare and contrast the image formation mechanism of a light microscope to that of a scanning electron microscope
- Outline some forensic applications of the scanning electron microscope

Basics of the Microscope

A microscope is an optical instrument that uses a lens or a combination of lenses to magnify and resolve the fine details of an object. The earliest methods for examining physical evidence in crime laboratories relied almost solely on the microscope to study the structure and composition of matter. Even the advent of modern analytical instrumentation and techniques has done little to diminish the usefulness of the microscope for forensic analysis. If anything, the development of the powerful scanning electron microscope promises to add a new dimension to forensic science heretofore unattainable within the limits of the ordinary light microscope.

The earliest and simplest microscope was the single lens commonly referred to as a *magnifying glass*. The handheld magnifying glass makes things appear larger than they are because of the way light rays are refracted, or bent, in passing from the air into the glass and back into the air. The magnified image is observed by looking through the lens, as shown in Figure 7–1. Such an image is known as a **virtual image**; it can be seen only by looking through a lens and cannot be viewed directly. This is distinguished from a **real image**, which can be seen directly, like the image that is projected onto a motion picture screen.

virtual image
An image that cannot be seen directly. It can be seen only by a viewer looking through a lens.

real image
An image formed by the actual convergence of light rays on a screen.

objective lens
The lower lens of a microscope, which is positioned directly over the specimen.

eyepiece lens
The lens of a microscope into which the viewer looks; same as the ocular lens.

The ordinary magnifying glass can achieve a magnification of about 5 to 10 times. Higher magnifying power is obtainable only with a *compound microscope*, constructed of two lenses mounted at each end of a hollow tube. The object to be magnified is placed under the lower lens, called the **objective lens**, and the magnified image is viewed through the upper lens, known as the **eyepiece lens**. As shown in Figure 7–2, the objective lens forms a real, inverted, magnified image of the object. The eyepiece, acting just like a simple magnifying glass, further magnifies this image into a virtual image, which is what is seen by the eye. The combined magnifying power of both lenses can produce an image magnified up to 1,500 times.

The optical principles of the compound microscope are incorporated into the basic design of different types of light microscopes. The microscopes most applicable for examining forensic specimens are as follows:

1. The compound microscope
2. The comparison microscope
3. The stereoscopic microscope
4. The polarizing microscope
5. The microspectrophotometer

After describing these five microscopes, we will talk about a completely different approach to microscopy, the scanning electron microscope (SEM). This instrument focuses a beam of electrons, instead of visible light, onto the specimen to produce a magnified image. The principle and design of this microscope permit magnifying powers as high as 100,000 times.

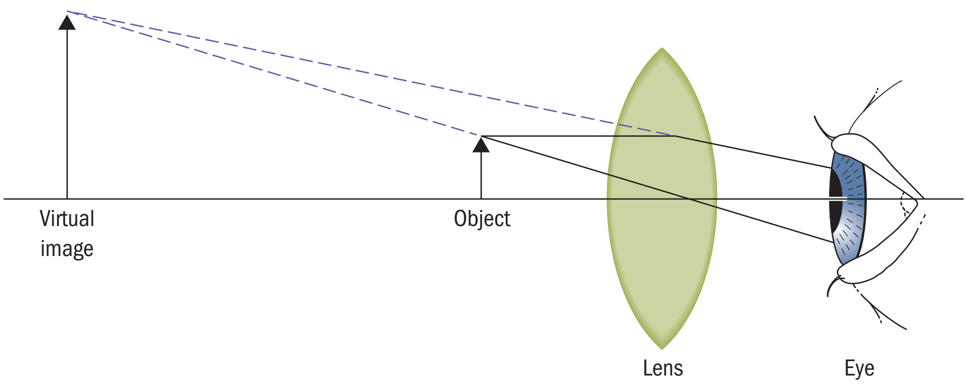


FIGURE 7–1
The passage of light through a lens, showing how magnification is obtained.

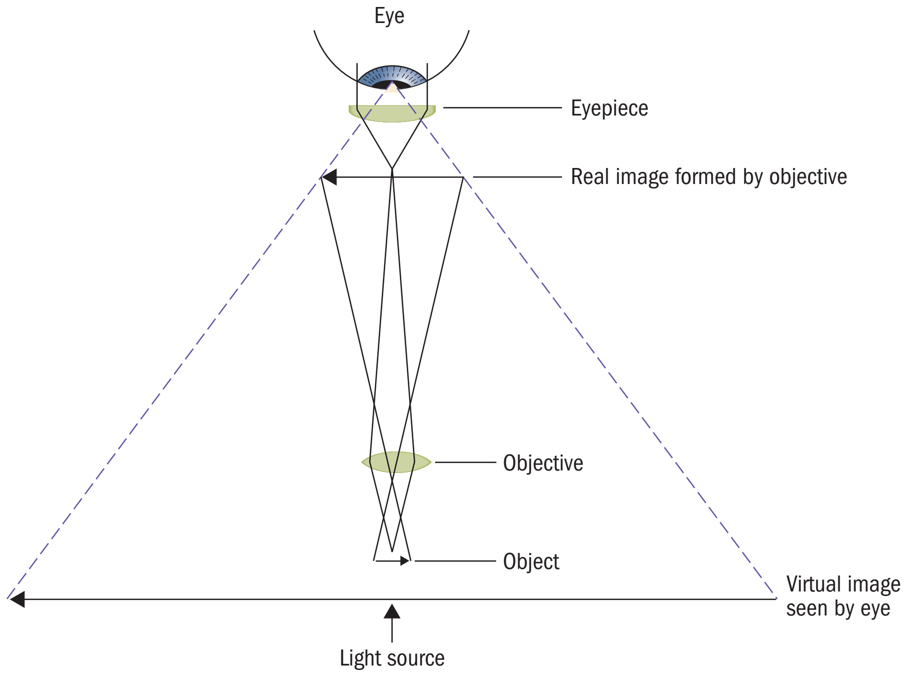


FIGURE 7–2
The principle of the compound microscope. The passage of light through two lenses forms the virtual image of the object seen by the eye.

The Compound Microscope

The parts of the compound microscope are illustrated in Figure 7–3. Basically, this microscope consists of a mechanical system, which supports the microscope, and an optical system. The optical system illuminates the object under investigation and passes the light through a series of lenses to form an image of the specimen on the retina of the eye. The optical path of light through a compound microscope is shown in Figure 7–4.

Parts of the Compound Microscope

The mechanical system of the compound microscope is composed of six parts:

Base (1). The support on which the instrument rests.
Arm (2). A C-shaped upright structure, hinged to the base, that supports the microscope and acts as a handle for carrying.
Stage (3). The horizontal plate on which the specimens are placed for study. The specimens are normally mounted on glass slides that are held firmly in place on the stage by spring clips.
Body tube (4). A cylindrical hollow tube on which the objective and eyepiece lenses are mounted at opposite ends. This tube merely serves as a corridor through which light passes from one lens to another.
Coarse adjustment (5). This knob focuses the microscope lenses on the specimen by raising and lowering the body tube.
Fine adjustment (6). The movements effected by this knob are similar to those of the coarse adjustment but are of a much smaller magnitude.

The optical system is made up of four parts:

Illuminator (7). Most modern microscopes use artificial light supplied by a lightbulb to illuminate the specimen being examined. If the specimen is transparent, the light is directed up toward and through the specimen stage from an illuminator built into the base of the microscope. This is known as **transmitted illumination**. When the object is opaque—that is, not transparent—the light source must be placed above the specimen so that it can reflect off the specimen's surface and into the lens system of the microscope. This type of illumination is known as **vertical** or **reflected illumination**.

transmitted illumination
Light that passes up from the condenser and through the specimen.

vertical or reflected illumination
Illumination of a specimen from above; in microscopy it is used to examine opaque specimens.