

Forensic Instrumentation

PART ONE Microscopes



Microscopes

A microscope is an optical instrument that uses a lense or 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.

Virtual vs Real Images

- Virtual image: refers to an image that is only observable through a lense or series of lenses.
- Real image: refers to an image that is not observed through a lense.

The magnifying glass

A single lense generally held in the hand that can magnify an image about five to ten times.



Types of Microscopes

The optical principles of the compound microscope are incorporated into the basic design of different types of light microscopes.

1. The compound microscope
2. The comparison microscope
3. The stereoscopic microscope
4. The polarizing microscope
5. The microspectrophotometer
6. The scanning electron microscope (SEM) is a different and final approach to microscopy that will be considered.

1. The Compound Microscope

A compound microscope is a type of microscope which uses visible light and a system of lenses to magnify images of small samples

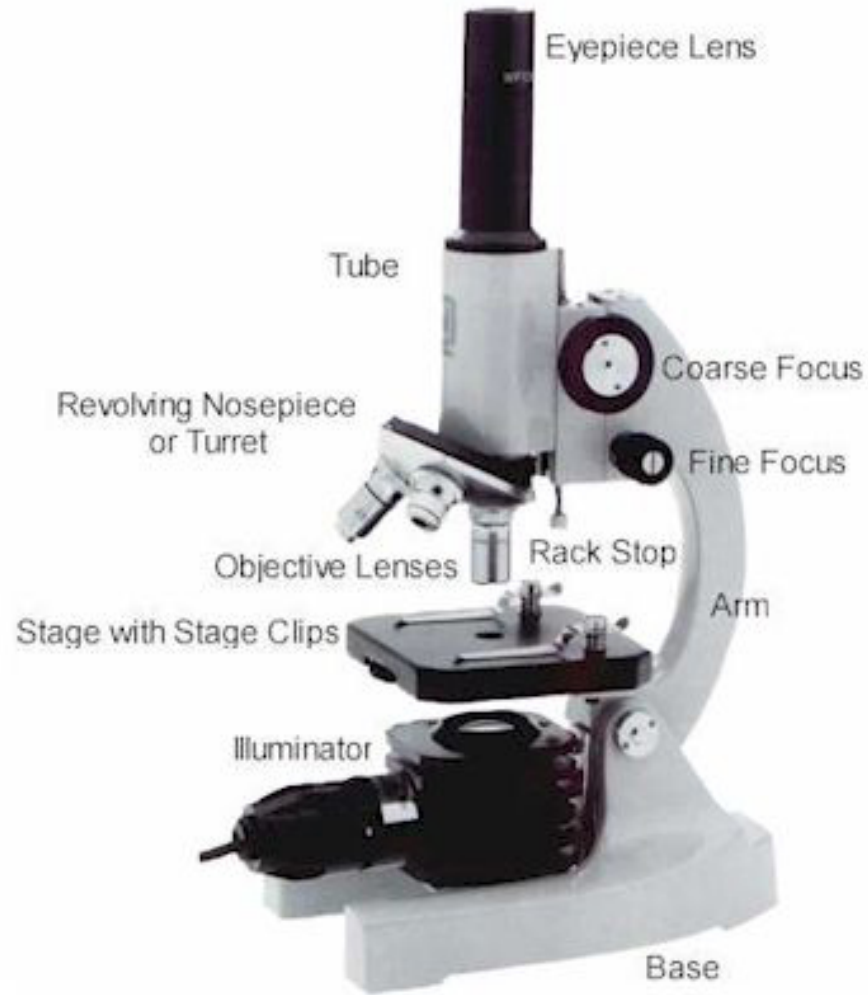


Objective Lenses

- Usually you will find 3 or 4 objective lenses on a microscope.
- **Our microscopes consist of 4x, 10x, 40x powers.**
- When coupled with a **10x** (most common) **OCULAR -eyepiece lens**, total magnification is
 - $40x = (4x \text{ times } 10x)$
 - $100x = (10x \text{ times } 10x)$
 - $400x = (40x \text{ times } 10x)$

Compound Microscope

cost \$100-500+



The mechanical system is composed of six parts:

- **Base**- the support upon which the instrument rests.
- **Arm**- a C-shaped upright structure, hinged to the base, that supports the microscope.
- **Stage**- The horizontal plate upon which the specimen rests
- **Body Tube**- which houses the objective and focus lenses
- **Course and Fine adjustments**- to bring the lenses into alignment.

The optical system is made up of four parts:

- **Illuminator**, artificial light source used to illuminate the specimen being examined.
- **Condenser**, collects light rays from the illuminator and concentrates them on the specimen.
- **Objective lense**, is the lense positioned closest to the specimen.
- Eyepiece, **Ocular lense**, is the lense closest to the eye.

2. Comparison Microscope

- Modern firearms (BALLISTICS) examination began with the introduction of the comparison microscope, with its ability to give the firearms examiner a side-by-side magnified view of bullets
- Essential to the use and application of the comparison microscope is the closely matched nature of the objective lenses with minimal but identical lens distortions

Comparison Microscope cost is \$1500-3000+



3. Stereoscopic Microscope: The Dissecting Microscope

- The stereoscopic microscope has proven most useful for the examination of details that characterize many types of physical evidence, not requiring high magnification.
- The stereoscopic microscope provides magnifying powers that range from 10x to 125x
- The stereoscopic microscope has the distinct advantage of offering a three-dimensional image of an object. It also provides a right-side-up image.
- The stereoscopic microscope has a wide field of view and offers great depth of focus, making it an ideal instrument for locating trace evidence that may be associated with debris, garments, weapons, or tools.

Stereoscope Microscope

cost \$500-1000+



4. The Polarizing Microscope

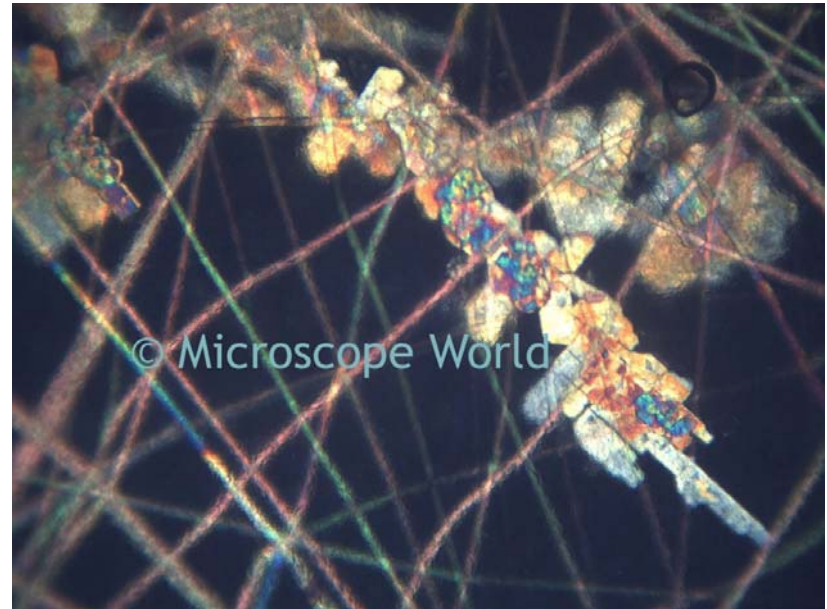
- A *compound or stereoscopic* microscope can be modified to be outfitted with a polarizer and analyzer so as to be capable of allowing the viewer to detect polarized light.
- The effect of introducing a specimen that polarizes light will be to orient the polarized light, allowing it to pass through the analyzer. *The result produces vivid colors and intensity contrast* that make the specimen readily distinguishable.
- Usually used in the field of geology.

Polarizing Microscope cost can be more than \$1000

JSP-20 Series



Polarization Microscope

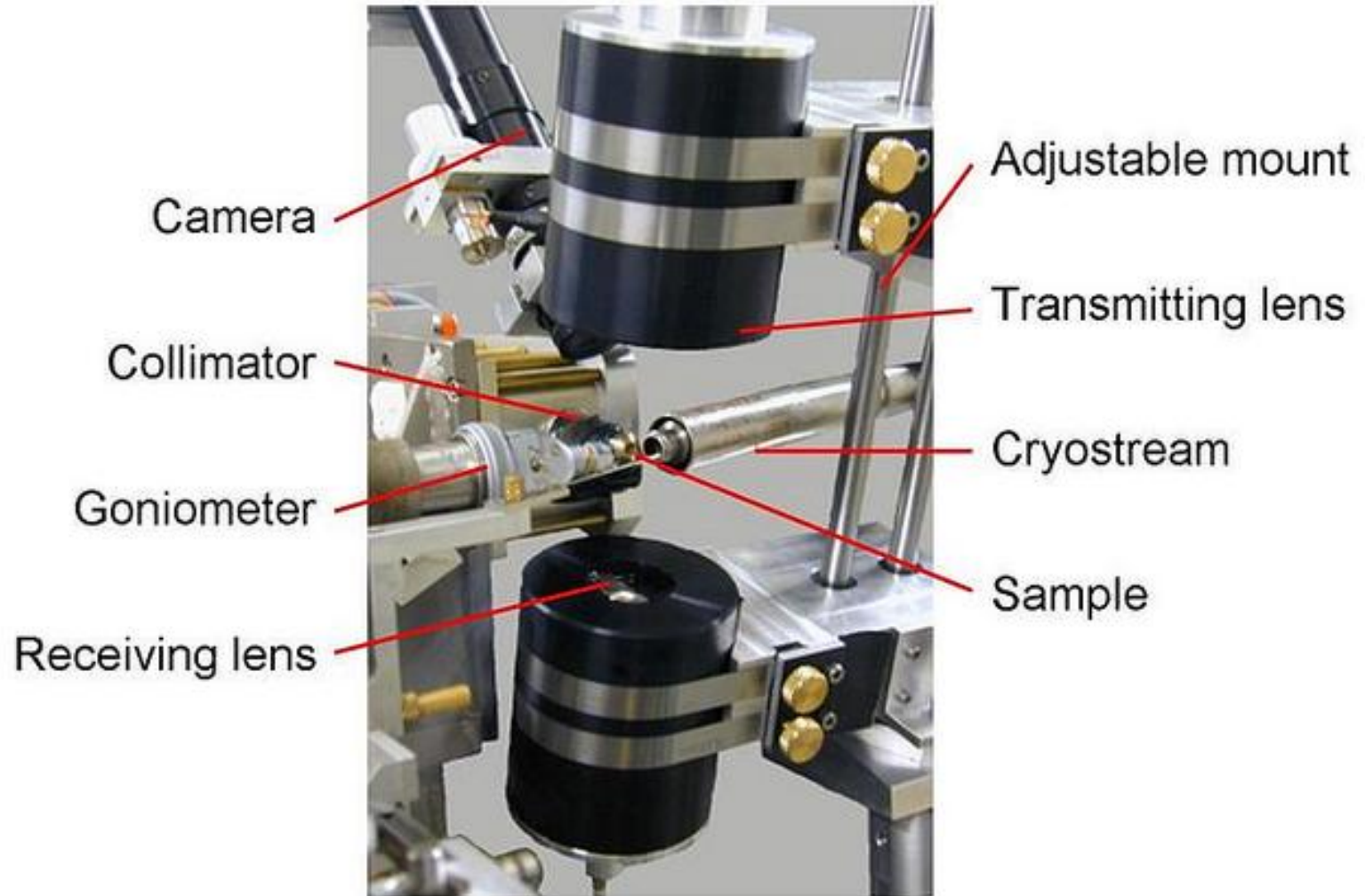


5. The Microspectrophotometer

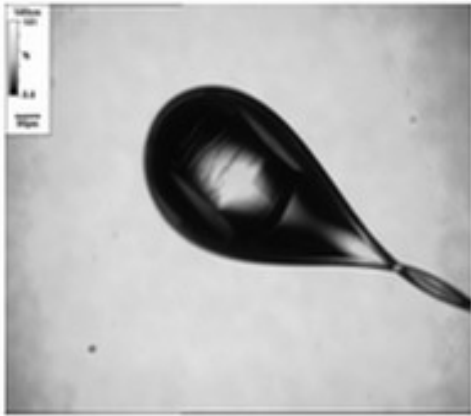
- By linking a microscope to a computerized spectrophotometer, a new dimension has been added to the capability of the microscope, giving rise to the microspectrophotometer.
- Using the microspectrophotometer, a forensic analyst can now view a particle under a microscope while, at the same time, a beam of light is directed at the particle in order to obtain its absorption spectrum.
- Designed to measure **UV-Visible-NIR** spectra of microscopic samples or microscopic areas of larger objects. **(Note: NIR= near infrared)**

Microspectrophotometer

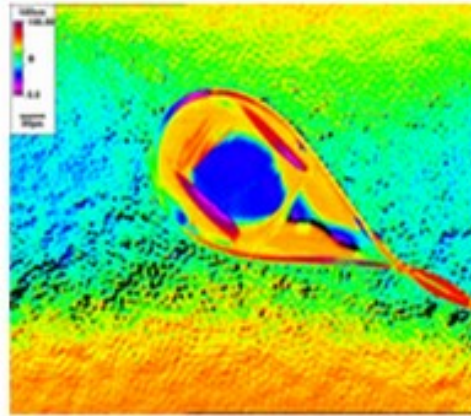
Cost \$6,500-20,000



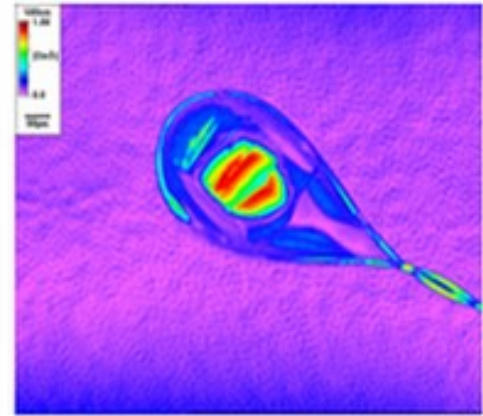
Comparison of different microscopic sperm cells:



Compound



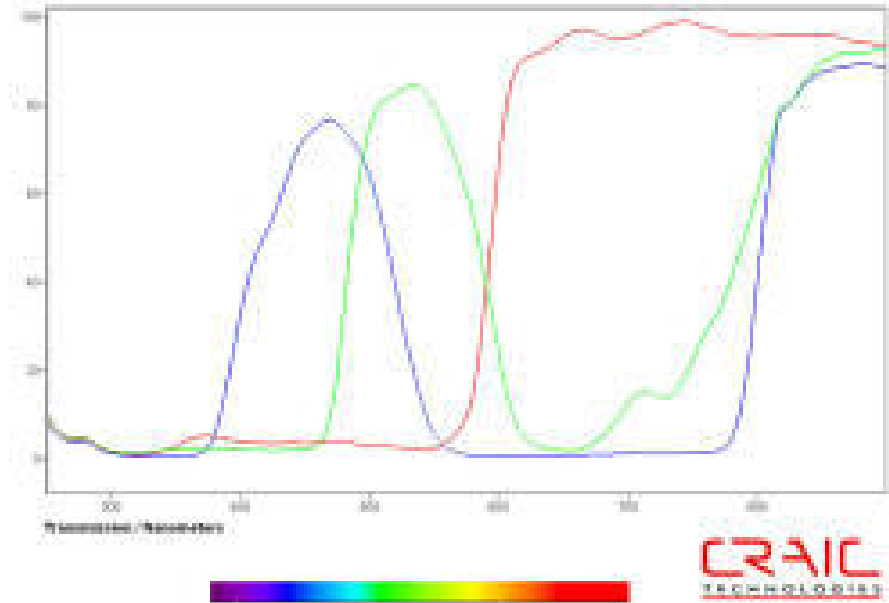
Polarizing



Microspectro

Microspectrophotometer

Outcome associated with this microscope:



HOW: to measure UV-visible-NIR range transmission, absorbance, reflectance, emission and fluorescence spectra of sample, you need the CRAIC software.

6. The Scanning Electron Microscope: (SEM)

The image formed by the scanning electron microscope is produced by targeting, with electromagnets, a beam of electrons onto the specimen and studying the electron emission on a closed TV circuit. **The primary electron beam, emitted from a hot tungsten filament, causes the emission of electrons from the element making up the outer layer of the specimen.** The emitted electrons are collected, and the integrated and amplified signal is displayed on the TV circuit.

SEM

- The major attractions of the SEM image are its high magnification, high resolution, and great depth of focus.
- In its usual mode the SEM has a magnification range of 10X to 100,000X.
- Its depth of focus is some 300X better than optical systems at similar magnifications, and the resultant picture is almost stereoscopic in appearance.
- Its great depth of field and magnification are invaluable in determining structural relationships over a contextually broad area.

Scanning Electron Microscope can cost up to \$350,000

