The CURSE of the Light Microscope

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Historical Development of the Compound Microscope

- ca. 1590 Hans and Zacharias Janssen combine two simple microscopes to form a compound microscope.
- ca. 1665 Robert Hooke devised a compound microscope to observe opaque objects.
- ca. 1681 Christian Huygens invented an ocular for the telescope which was later adopted universally for the compound microscope.
- ca. 1800 Thomas Young corrected lenses for astigmatism.
- ca. 1873 Ernst Abbe designed a chromatic substage condenser which is still furnished with many of today’s microscopes.
- ca. 1886 Abbe, Schott, and Zeiss collaborated to perfect apochromatic objective lenses.
- ca. 1900 The compound microscope had essentially evolved to its present form.

Microscope Museum at The McCrone Group
(The Brooks Collection)

• Approximately 200 microscopes on display and another 200-300 in storage. Earliest microscope in the collection is ca. 1680.
• Includes approximately 2,500 volumes of books on microscopy and optics dating back to 1630.

ca. 1870
ca. mid 1700’s
The **CURSE** Begins and Intensifies:

- When you buy (or inherit) any microscope
- As you start using it to examine objects
- As you learn more about microscopy through:
  - “brute force” experience
  - reading microscopy literature
  - participate in formal training classes
  - attend microscopy conferences/seminars/webinars
What is the CURSE?

It is LIGHTING!!!!
Basic Compound and Stereo Microscopes
(ca. late 1980s)
Stereo Microscope and Lighting Accessories
Compound Microscope and Lighting Accessories
“Fully” Equipped Compound and Stereo Microscopes
Examples from the Stereo Microscope
Illumination Systems* for the Stereo Microscope

- Oblique
- Reflected Coaxial
- Ring Light
- Transmitted Brightfield/Darkfield

* Suggested minimum requirements
Crater Defect in Paint
(Original Magnification: X64)
“Comet” Defects on Polished Brass

(Original Magnification: X50)

Oblique Illumination

Ring Light Illumination

Coaxial Illumination
Deposit on Polished Beryllium Plate

(Original Magnification: X64)

Coaxial Illumination

Coaxial Illumination with $\frac{1}{4} \lambda$ plate rotated for “extinction”
Burned Circuit Board

(Original Magnification: X35)

Oblique illumination from left

Ring Light illumination
Examples from the Compound Microscope
Illumination Systems* for the Compound Microscope

• Polarized Light - Transmitted and Reflected

•Reflected Brightfield/Darkfield

•Interference Contrast

•Fluorescence

* Suggested minimum requirements
Foreign Material Embedded in Polyethylene Film
(Original Magnification: X50)

Plane polarized transmitted light - Brightfield
Transmitted light - Crossed Polarizers
PLM Glass and Quartz

Plane Polarized Transmitted Light

Crossed Polarizers

Slightly Uncrossed Polarizers
Electrolytic Tin Plated Steel
(Original Magnification: X100)

Reflected Light - Crossed Polarizers

Rotated 90°
Painted Aluminum Panel - Polished Cross Section
( Original Magnification: X800 )

Reflected Light - Brightfield

Reflected Light - Darkfield

Reflected Light - Crossed Polarizers

Reflected Light - Crossed Polarizers with 1st Order Red Plate and Rotating Analyzer
White Particle Dispersion on Smooth Black Carbon Tape

Reflected light

Oblique light
White Particle Dispersion on Glass Microscope Slide

**Plane polarized transmitted light**

**Transmitted light – fully crossed polarizers**
White Particle Dispersion on Glass Microscope Slide

Transmitted light - Darkfield
Fluorescence Lighting
(Original Magnification: X40)
Fluorescence Lighting
Dye/Resin Penetration into Plastic

No Penetration

450 - 500 µm Penetration
Plastic Surface

( Original Magnification: X800 )

Reflected Light - Brightfield

Nomarski Differential Interference Contrast (NDIC)
NDIC Polymer Surface Defects
NDIC/ Adhesion Failure Substrate

Oily Film
NDIC Glass Surface Defects

1) Physical defects
2) Refractive index variations

Normal Surface
For microscopists striving for perfection
the **CURSE** is **UNAVOIDABLE**

Initiate budgeting battle plans early!
So, we know that every microscope and every objective is slightly different. In this webinar, Nicole is going to discuss how to calibrate your microscope so you can properly measure a particle.
Thank you for joining us.

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