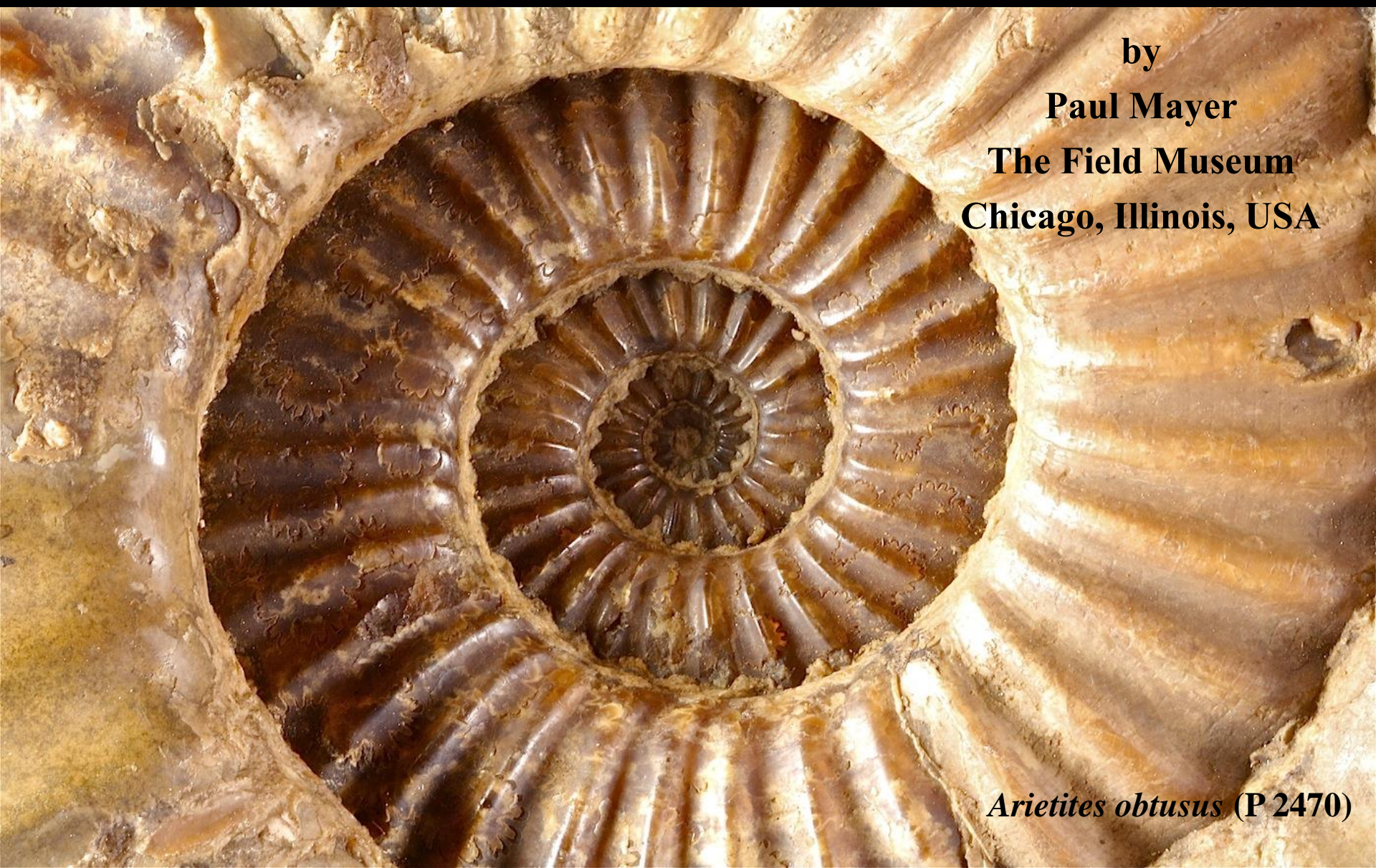


Photographic Equipment and Techniques



by
Paul Mayer
The Field Museum
Chicago, Illinois, USA

Arietites obtusus (P 2470)

Why are you imaging the specimen?

Research

Print

Education

Web

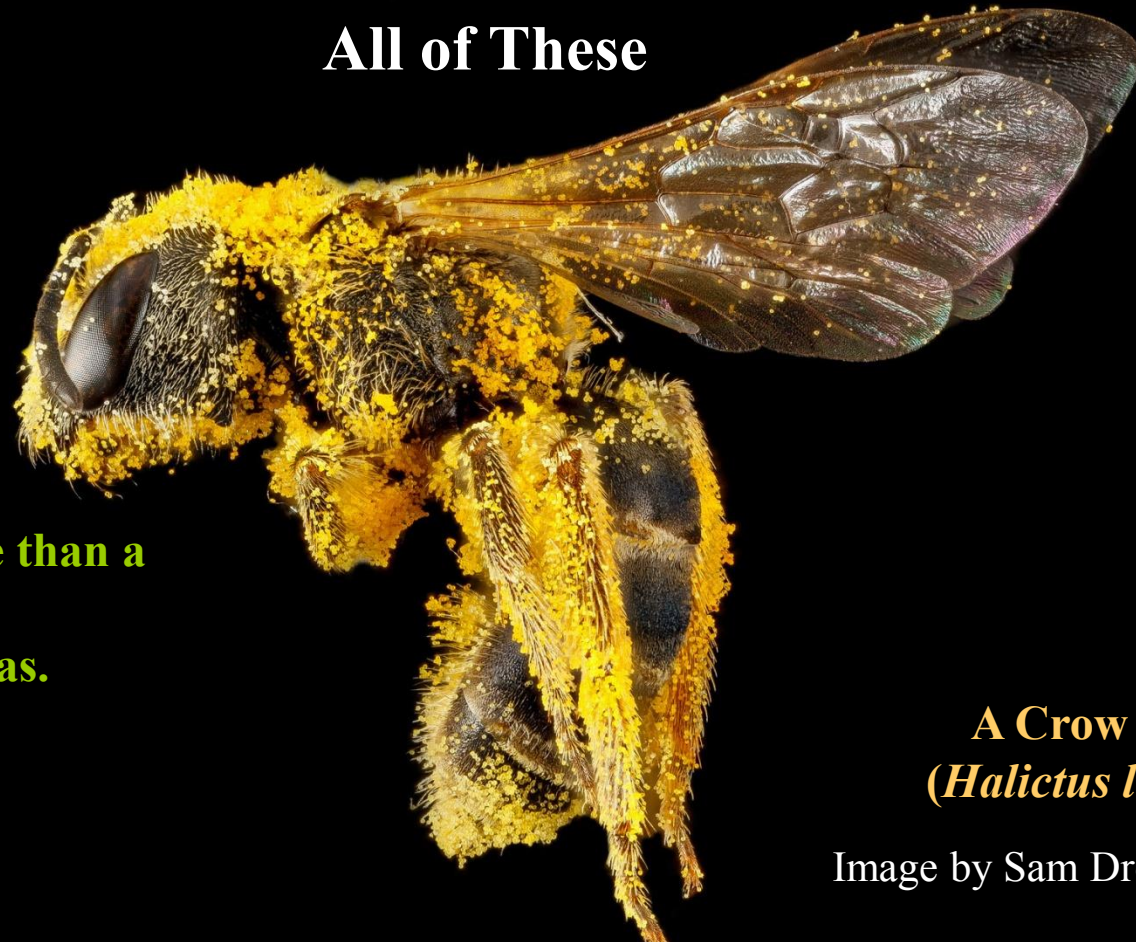
Public

Archive record

Exhibition

Facebook post

All of These



“Photography is more than a medium for factual communication of ideas.

It is a creative art.”

-- Ansel Adams

A Crow Bee
(*Halictus ligatus*)

Image by Sam Droege, USGS

The Camera Body

Megapixels

vs

Sensor Size

“Photography is the simplest thing in the world, but it is incredibly complicated to make it really work.”

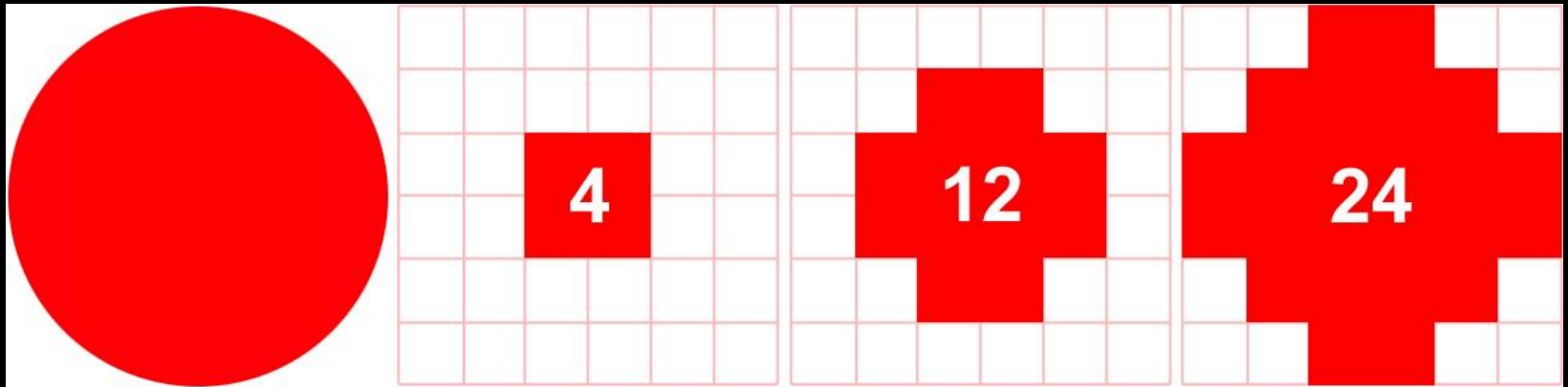
--Martin Parr



A Crow Bee (*Halictus ligatus*)

Image by Sam Droege, USGS

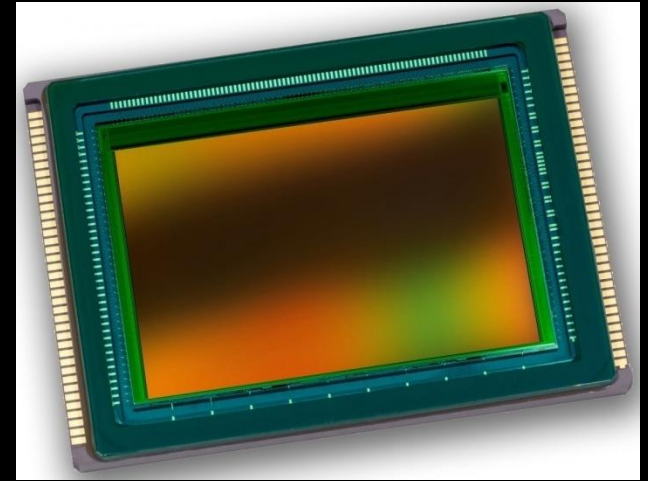
What is a Pixel?



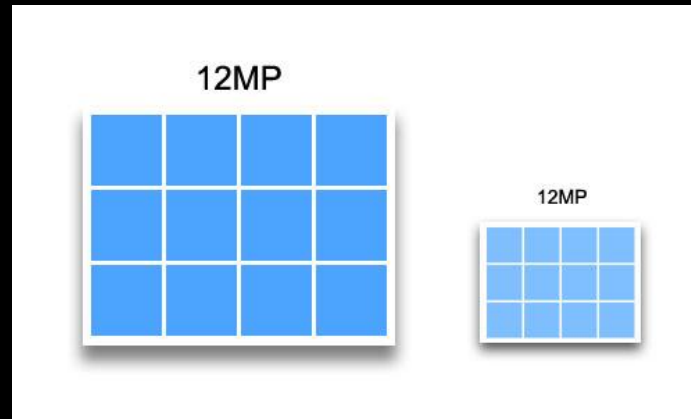
- Digital photographs are actually mosaics of millions of tiny squares called “picture elements”—or pixels.
- Pixels are just a number they have no shape or size.
- One million pixels equal one Megapixel
- Sensor size, image format, lens quality, ISO, and megapixels all are important for resolution.
- High megapixel count sensors render high resolution files
- More pixels, more problems
 - Huge files
 - Expensive lenses needed
 - More noise at higher ISO settings

Sensor Size
















- The larger the sensor
 - the more light used
 - the more information stored
 - better dynamic range
 - less noise
 - improved low light level performance
 - increase resolution
- Why? Because photosites on larger sensors are general larger than on smaller sensors.
- Needs a larger lens, costs more, crop factor
- Balance between efficiency of sensor technology, lens quality, and image sensor size,



What is a Sensor's Photosite?



- A camera's sensor has millions of small pores or photosites that record photons.
- Photosites on larger sensors are generally larger than on smaller sensors.
- When you take a picture, each photosite on the sensor records the amount or brightness of the light striking it.
- The more light that strikes a photosite, the more photons it records and the brighter the pixel it creates.
- In general there are more photosites on a sensor than pixels, but each pixel is formed from one photosite.

Name	Full Frame	APS-C	Four Thirds	1/1.7"	1/2.3"
Area					
Size	36 x 24 mm	23.6 x 15.8 mm	18 x 13.5 mm	7.6 x 5.7 mm	6.1 x 4.6 mm
Relative size	31	13	8.6	1.5	1
Camera type	High End DSLRs	Entry level DSLRs Midrange DSLRs	Olympus DSLRs Large Compacts	High End Compacts	Low-mid Compacts
Examples	 Nikon D700	 Canon D500	 Olympus E-420	 Canon G11	 Nikon S640
	 Canon D5 MK II	 Nikon D40x	 Panasonic GF-1	 Nikon P6000	 Canon SX120

The Crop Factor

Full Frame sensor vs APS-C sensor



- Crop factor is 1.6x
- Advantages for APS-C
 - Uses center of lens, less distortion
 - Depth of field better on cropped sensor because with full frame you need to be closer.
 - Wide angle lens vs macro

Canon EOS 5D Mark III, Full Frame Sensor, 22.3 Megapixels Mark III ISO =100 from DP Review



Canon Powershot SX260, 1/2.3" (6.1 x 4.6 mm) Sensor, 12.1 megapixels, ISO =100 from DP Review



Canon Powershot G7 X, 1 inch (13.2 X 8.8mm) Sensor, 21 Megapixels, ISO =125 from DP Review



Canon EOS 5D Mark III, Full Frame Sensor, 22.3 Megapixels Mark III ISO =100, from DP Review





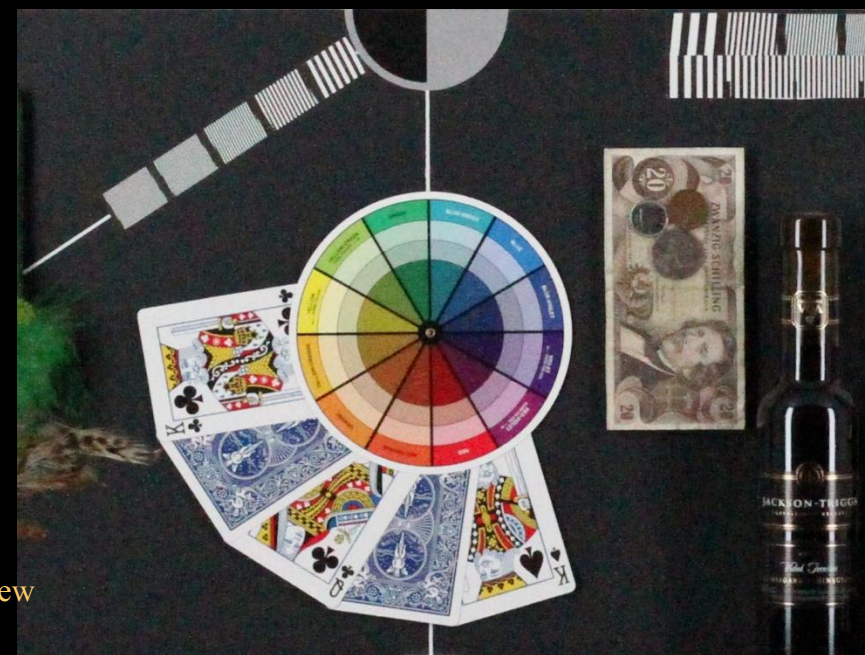
Canon EOS 5D Mark III, 22.3 megapixels ISO =100



Canon EOS 7D, 18 megapixels, ISO =100



Canon EOS 5D Mark III, ISO =12800



Canon EOS 7D, ISO =12800

From DP Review

Macro Lens

- 1:1 ratio or larger
- No Zoom
- Fixed Focal Lengths
50mm, 60mm,
100mm, 180mm



Macro Lenses: how much magnification do you need?

0.2x

At the bottom end, some zoom lenses only give an image on the sensor that is a fifth of life-size, when focused as close as possible.



1:5



0.34x

Some kit lenses do rather better, and can produce an image that's one-third of life-size of the object shot at the minimum focus level.



1:3



0.5x

Lenses like the Canon 50mm f/2.5 and Zeiss 100mm f/2 are both 0.5x macro lenses, offering a half-size image.



1:2



1.0x

The vast majority of macro lenses produce a life-size image on the sensor when focused as close as possible.



1:1



5.0x

Canon's MP-E 65mm gives a bellows-like magnification, giving images on the sensor that are up to five times life-size.

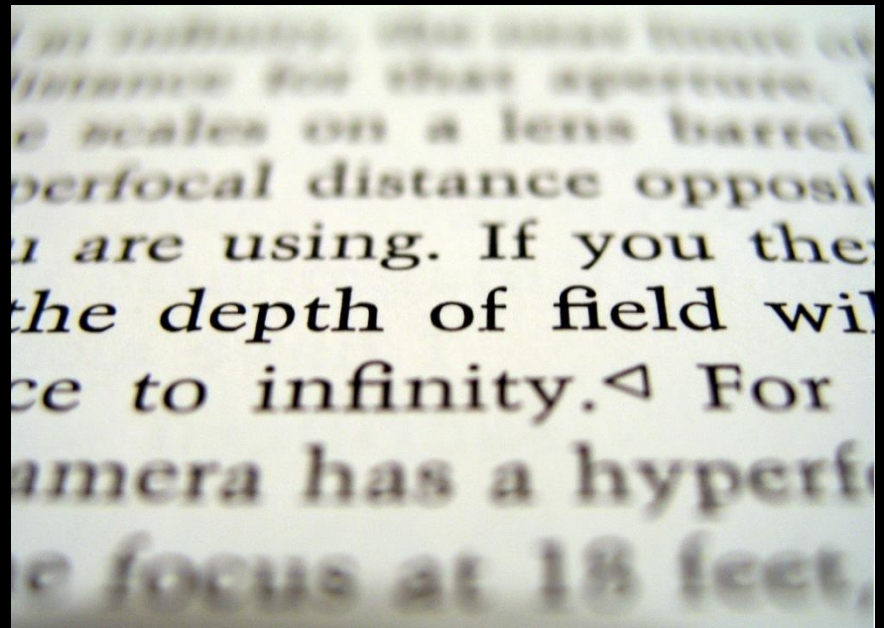


5:1



Depth of Field Determined by Three Factors

- Aperture Size
 - Larger the aperture opening the smaller the depth of field
- Distance from Lens
 - Closer the lens to the subject the smaller the depth of field
- Focal Length of Lens
 - The bigger the focal length the smaller the depth of field



Lighting

- Equipment
 - Even lighting
 - Ring Lights
 - Light boxes
 - Diffusers
 - Flash
 - Copy stands
 - Low angle lighting
- Techniques
 - UV lighting
 - Cross Polarized

“Light makes photography. Embrace light. Admire it. Love it. But above all, know light. Know it for all you are worth, and you will know the key to photography.”

-- George Eastman --

Light Box



Inside the Light Box



Light Box Image of Trilobite



PE 6110
***Calymene celebra* Raymond**
Wenlock, Silurian
Chicago, Illinois

Low-Angle Lighting Setup

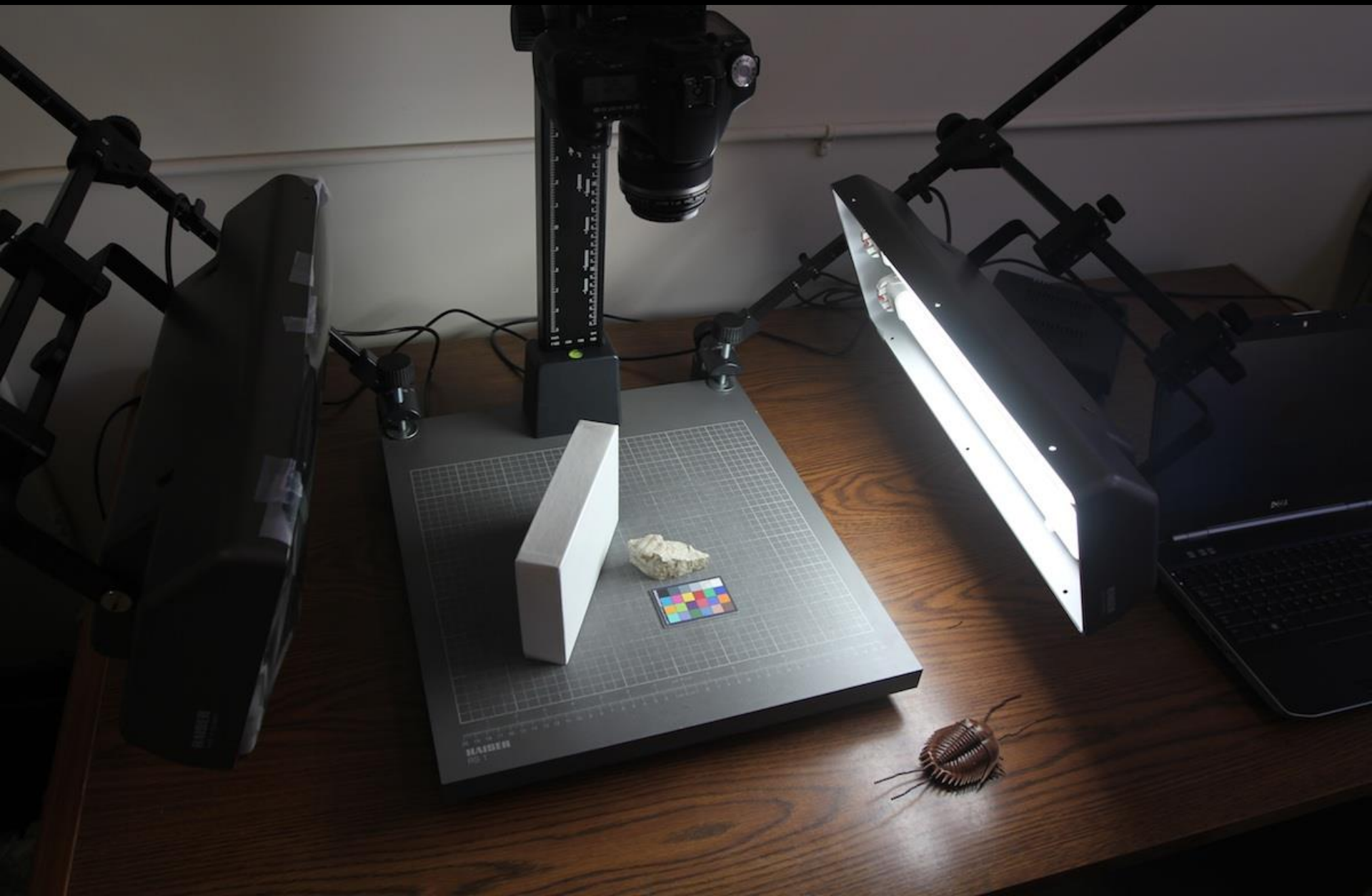


Low-Angle Lighting



PE 6110
Calymene celebra Raymond
Wenlock, Silurian
Chicago, Illinois

One-Directional, Low-Angle Lighting Setup



Low-Angle, One-Directional Lighting



PE 6110
Calymene celebra Raymond
Wenlock, Silurian
Chicago, Illinois



Macrofossil Photography Techniques Designed to Enhance Contrast and Emphasize Detail

Ultraviolet Lighting

Low-Angled (Textural) Lighting

Polarized Lighting

Color Filters

Immersion in Water (or Alcohol)

(Lund, 1980)

Normal Lighting



Ultraviolet Light Fluorescence



PE 7210
Terebra sp. and *Scaphella floridana*
Pleistocene
Loxahatchee, Florida

Normal Lighting



Ptychoparia striata
Middle Cambrian
Jince Formation
Czech Republic

Ultraviolet Light Fluorescence



Ptychoparia striata
Middle Cambrian
Jince Formation
Czech Republic

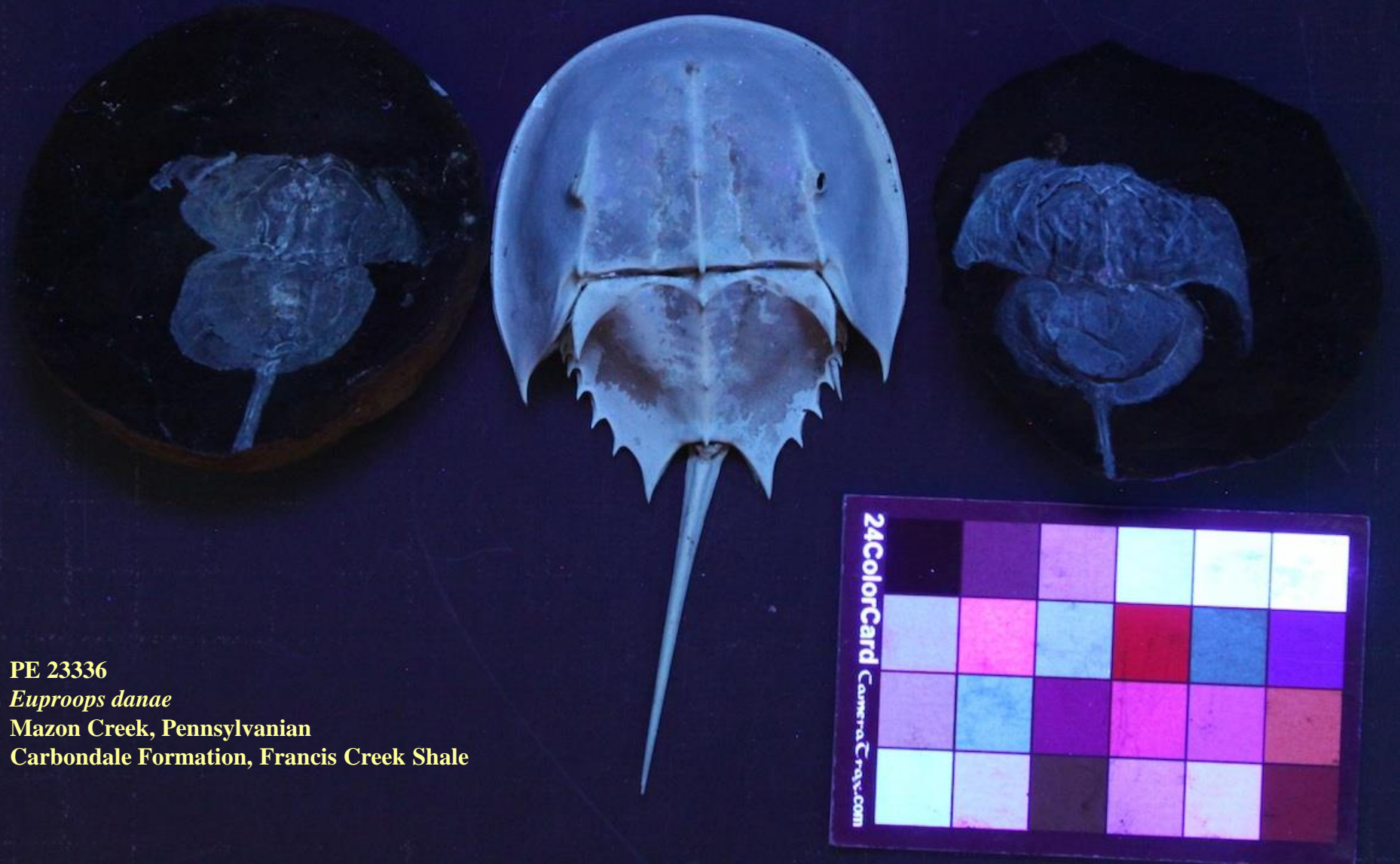
Normal Lighting



PE 23336
Euproops danae
Mazon Creek, Pennsylvanian
Carbondale Formation, Francis Creek Shale

Ultraviolet Light Fluorescence

10 out of 683 specimens of *Euproops danae* fluoresce



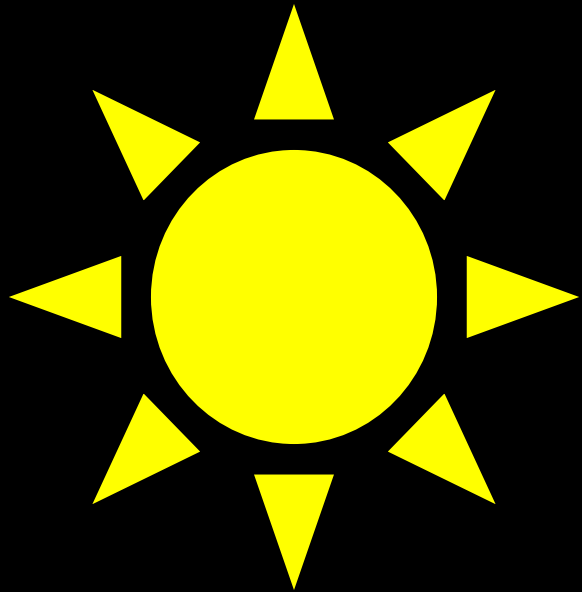
PE 23336

Euproops danae

Mazon Creek, Pennsylvanian

Carbondale Formation, Francis Creek Shale

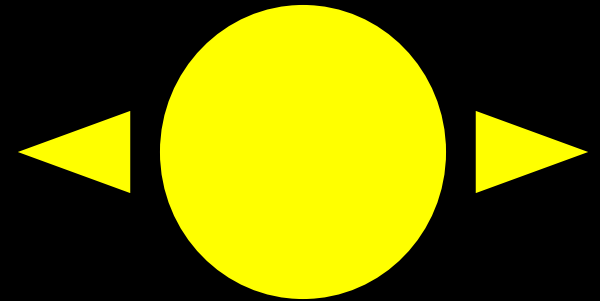
Normal Light



Polarizing Filter



Polarized Light



Light from the sun or a light bulb is non-polarized. This means that the waves of light vibrate in all directions perpendicular to the axis of its path. Light is partly polarized when reflected off objects. Light can be completely polarized when it passes through an optical filter, The polarizing filter only allows light waves vibrating in one plane to pass through it.

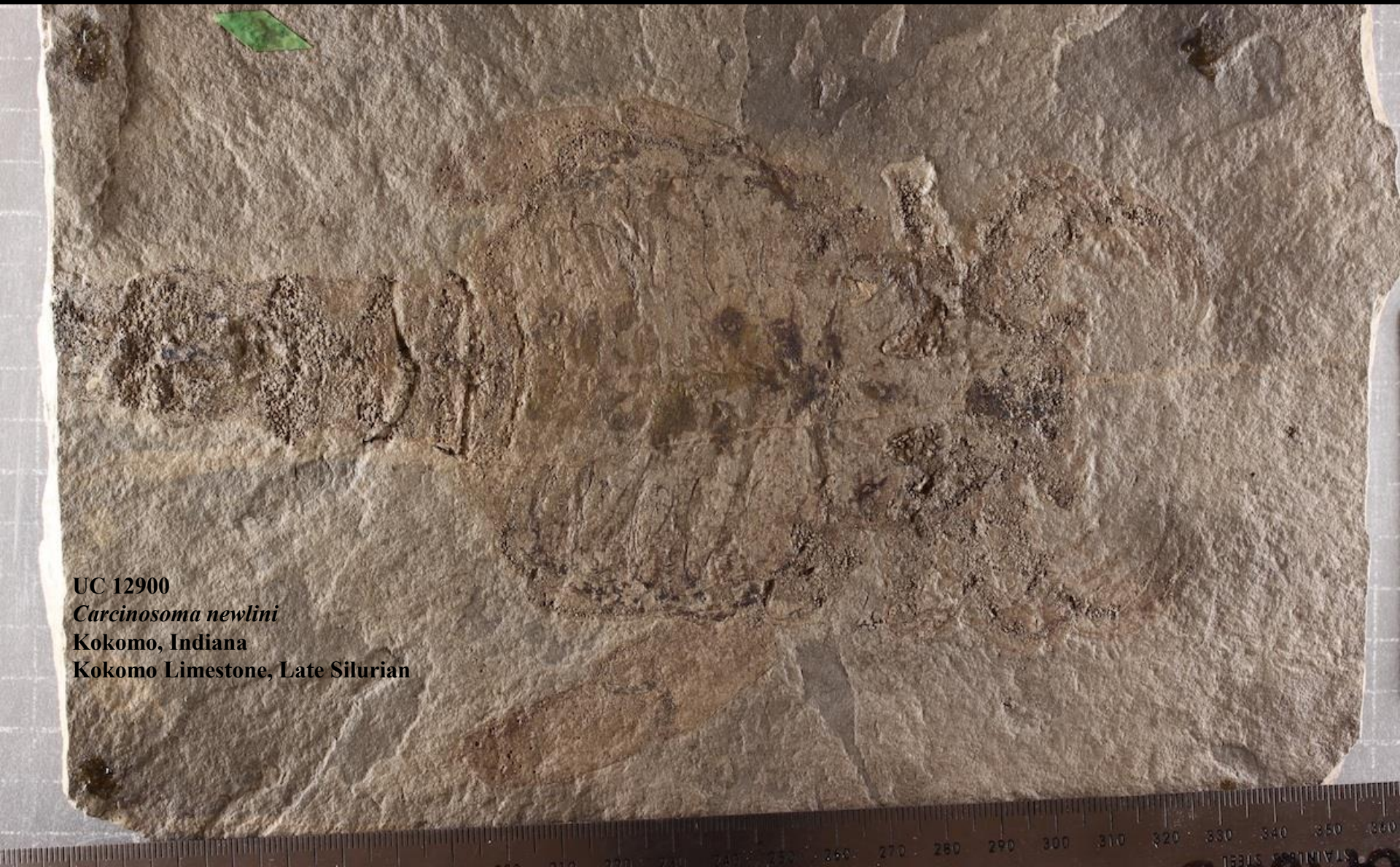
Low-Angle, Non-Polarized Light

UC 12900

Carcinosoma newlini

Kokomo, Indiana

Kokomo Limestone, Late Silurian



Polarized Light with Crossed Polarizing Filters



UC 12900
Carcinosoma newlini
Kokomo, Indiana
Kokomo Limestone, Late Silurian

How/Why Does Polarized Lighting Work?

“Polarized light is reflected back directly by the fossil material while the matrix reflects a more chaotic form of light, enabling the second polarizing filter to increase the contrast between the fossil and the matrix.”

THE USE OF POLARISED LIGHT IN PHOTOGRAPHY OF
MACROFOSSILS

by PHILIP CRABB, 2001,
Palaeontology Volume 44 issue 4

Low Angle,
Non-Polarized Light



PE 57188
Eubleptus maculosus
Mazon Creek, Pennsylvanian
Carbondale Formation, Francis Creek Shale



Polarized Light
with Crossed

Polarizing Filters



Non polarized Light
100mm macro lens
F/10, ISO 100

Long-Horned Beetle
Prionus pocularis



Polarized Light
100mm macro lens
F/10, ISO 100

Camera at same distance



100mm, F/16



60mm, F/16



100mm, F/16

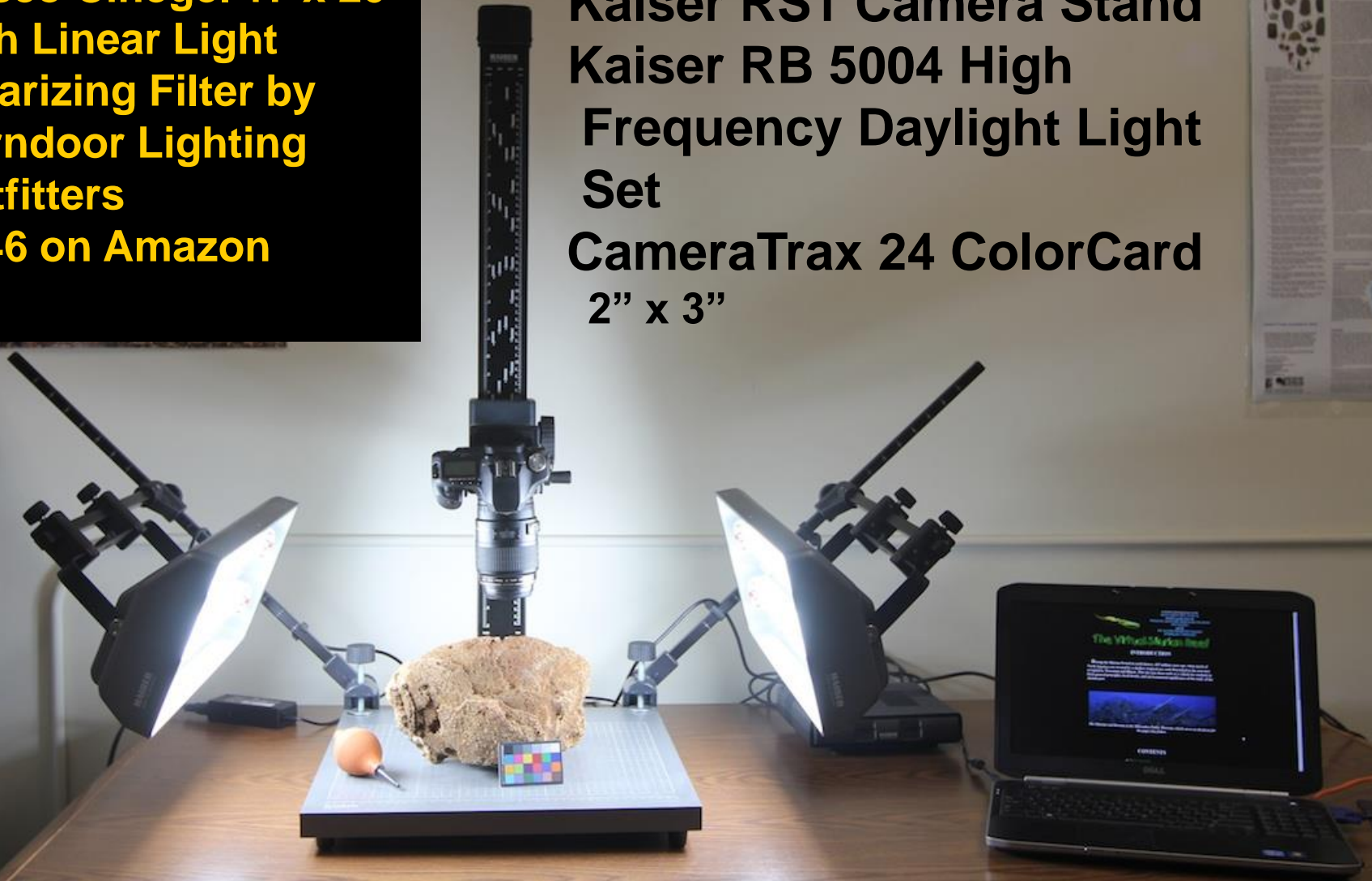


60mm, F/16

My set up

**Rosco Cinegel 17 x 20
inch Linear Light
Polarizing Filter by
Barndoor Lighting
Outfitters
~\$46 on Amazon**

**Canon EOS 60D + lenses
Kaiser RS1 Camera Stand
Kaiser RB 5004 High
Frequency Daylight Light
Set
CameraTrax 24 ColorCard
2" x 3"**



Thank you

A Crow Bee (*Halictus ligatus*)



Image by Sam Droege, USGS

Carpenter Bee from the Dominican Republic
known as *Xylocopa mordax*.



honeybee's head (*Apis mellifera*)



Image by Sam Droege, USGS

A Sweat Bee *Augochloropsis metallica*

- Four years ago, Gutierrez came up with a system that consisted of a camera fitted with a macro lens, a mount with a slider, and digital software suitable for stitching pictures together.
- Taking images at the level of magnification needed for bees or mosquitoes meant that there was absolutely no depth of field, says Droege. Only portions of an insect would be in focus at any one time.
- So if researchers or Army personnel wanted a picture of an insect that was completely in focus, they would have to take several pictures—each one focused at different points—of the specimen and combine the photographs for one in-focus image.
- Mounting a camera with a macro lens on a slider programmed to step through those various focal increments enabled anyone to take the photographs.



A Sweat Bee, *Augochloropsis sumptuosa*



Nikon D7000 camera and a Nikon 105mm AF f/2.8D lens. To get those creepy cool close-ups, he uses Raynox super macro conversion lenses. Lighting comes from a Nikon R1C1 wireless close-up speedlight system, which attaches to his

lens



Yudy Sauw image

Tiger Beetle,
Cicindelinae

- Once you have your 48 bit images in hand, make whatever exposure or color corrections you need and feel free to save the final version as a normal 24 bit TIFF or even JPEG when you feel it is ready for display/print. Remember that nothing is lost in having the final/edited version saved as a 24 bit file to make it available to other software such as photo editors, printing software, and email programs: it saves space and your monitor/printer will want a 24 bit image anyway as they don't understand 48 bit data.

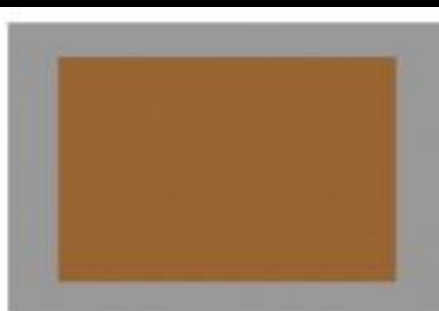
“Light makes photography. Embrace light. Admire it. Love it. But above all, know light. Know it for all you are worth, and you will know the key to photography.” -- George Eastman

“What makes photography a strange invention is that its primary raw materials are light and time.”
-- John Berger

“Photography is the simplest thing in the world, but it is incredibly complicated to make it really work.”
--Martin Parr



Full Frame
36.00 x 24.00 mm



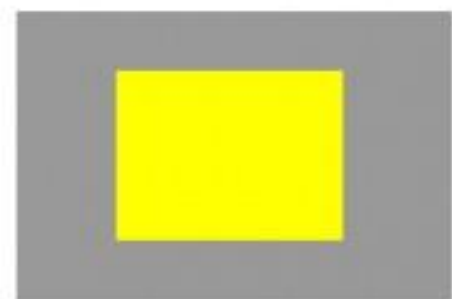
APS-H
27.90 x 18.60 mm



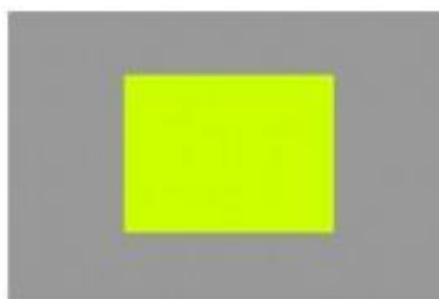
APS-C
23.60 x 15.60 mm



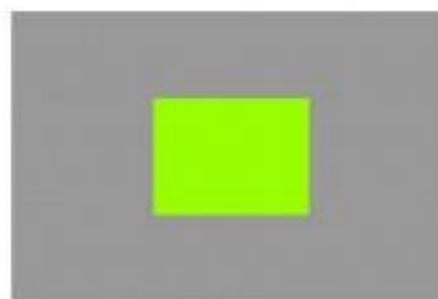
APS-C (Canon)
22.20 x 14.80 mm



1.5"
18.70 x 14.00 mm



Micro Four Thirds 4/3"
17.30 x 13.00mm



1"
12.80 x 9.60 mm



1/1.2"
10.67 x 8.00 mm



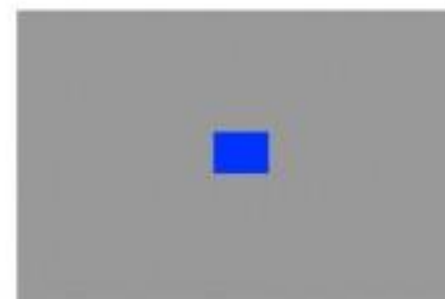
2/3"
8.80 x 6.60 mm



1/1.7"
7.60 x 5.70 mm



1/2.3"
6.17 x 4.55 mm



1/3.2"
4.54 x 3.42 mm

Wide Angle Lenses

- Full-frame camera
- positioned very close to your subject.
 - foreground objects appear very large in the frame, and distant objects very small
 - exaggerate the distance between objects, making subjects at moderate and far distances seem further away than they really are.
- subjects appearing elongated, distorted
- very narrow apertures, light diffraction can also cause edges to appear slightly fuzzy.
- greater apparent depth of field
- vignette is a darkening of the image towards the edges and corners. It is common in all wide angle lenses, although it is particularly noticeable in the cheaper ones.

