Advances in Mineral Photography

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Shenandoah Valley Gem and Mineral Society

January 11, 2016

Advances by the Mineral Photography Community (and smaller advances by myself)

Hardware: New Cameras, New Lenses

- Compact Mirrorless Cameras with Removable Lenses
  - Electronic Shutters, with no mechanical vibration and remote control
  - Active Sensors, giving 40 MegaPixel photos (Olympus OMD Mark II)
- Lenses designed for photomicrography
  - Long working distances objectives like Luminar (old reliable)
  - Super MACRO lenses like Canon 50 mm with 5x true magnification
  - Infinite focus Objectives like Mitutoyo

Software:

- Image processing like Photoshop Elements version 14
  - Correct problems like shaking, incorrect exposure, cropping
- Stacking programs like CombineZP
  - Increase depth of field, cheating the laws of optics by computer
  - View images we cannot see with our eyes and a microscope
- 3D photography

As size of mineral decreases, difficulty of photography increases exponentially towards impossible.

If your rock is (FOV or Field-of-View):

25 mm (one inch) – Easy with a copy stand and MACRO lens, even with handheld pocket camera

10 mm – Macro lens or Stereo Microscope

5 mm – Stereo microscope or Bellows with MACRO lens

2 mm – Bellows and Extension Tube with Luminar lens OR Mitutoyo Lens and Telephoto Lens
(A quarter is 1.75 mm thick)

1 mm – Bellows and Extension Tube with Luminar lens OR Mitutoyo Lens, Telephoto Lens, Bellows

0.2 mm – My limit with Bellows and Extension Tube, after cropping and expanding, fuzzy results

Every rock is different! Like people, some rocks are photogenic. Colorless and Black rocks are difficult.

Lighting is critical. Shadows provide 3D clues to the brain.

Panasonic
DMC-GF3
Compact
Mirrorless
Camera

Minolta
50 mm
MACRO
Lens

1:1 Extension

Mounted
on a
Copy Stand

Looking into Electronic View Finder

Sensor works In low light (Like the Fastest Film)

If the mineral is one inch or more, the MACRO lens Works well.

Here is a Smithsonite (light green) with pink unknown (also Smithsonite?) with scattered yellow Mimetite.

Field of View = FOV = width of specimen plus a little.

FOV 50 mm = ~2 inches

Zooming-in a bit also works, because the MACRO lens has good resolution.

FOV 20 mm = ~¾ inch

Camera
With
Microscope
Adapter

Basically, a
Microscope
Eyepiece
Held Captive

Camera and Adapter mounted on Stereo Microscope, in place of one eyepiece

Further zooming-in using
Stereo microscope,
and stacking 4 images

FOV 5 mm

Photo is fair, but not great.

Microscope is good for live viewing,
but for photographs the Bellows is better.

Luminar Lens
Extension Tube
Bellows
Camera

All pointed at
a micromount
box

Luminar
Lens

Photo taken with Bellows
and Luminar Lens

Pyrargyrite

Ag_3SbS_3

Nabob Mine,
Clear Creek County,
Colorado

FOV 1 mm = ~ 1/20th inch

NEW:

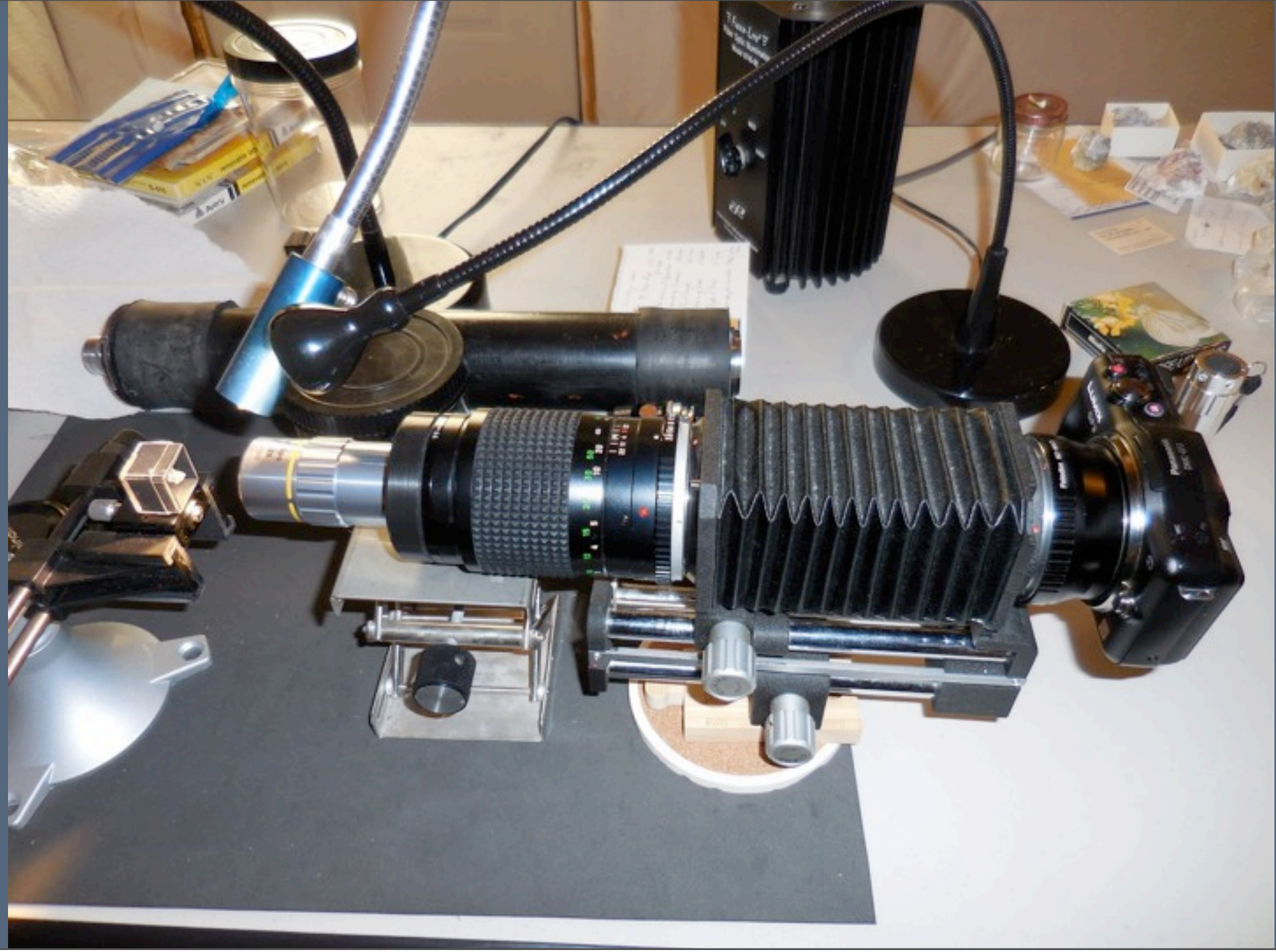
Mitutoyo
Infinite Focus
Lens

Adapter

Minolta
135 mm
Telephoto Lens

Camera

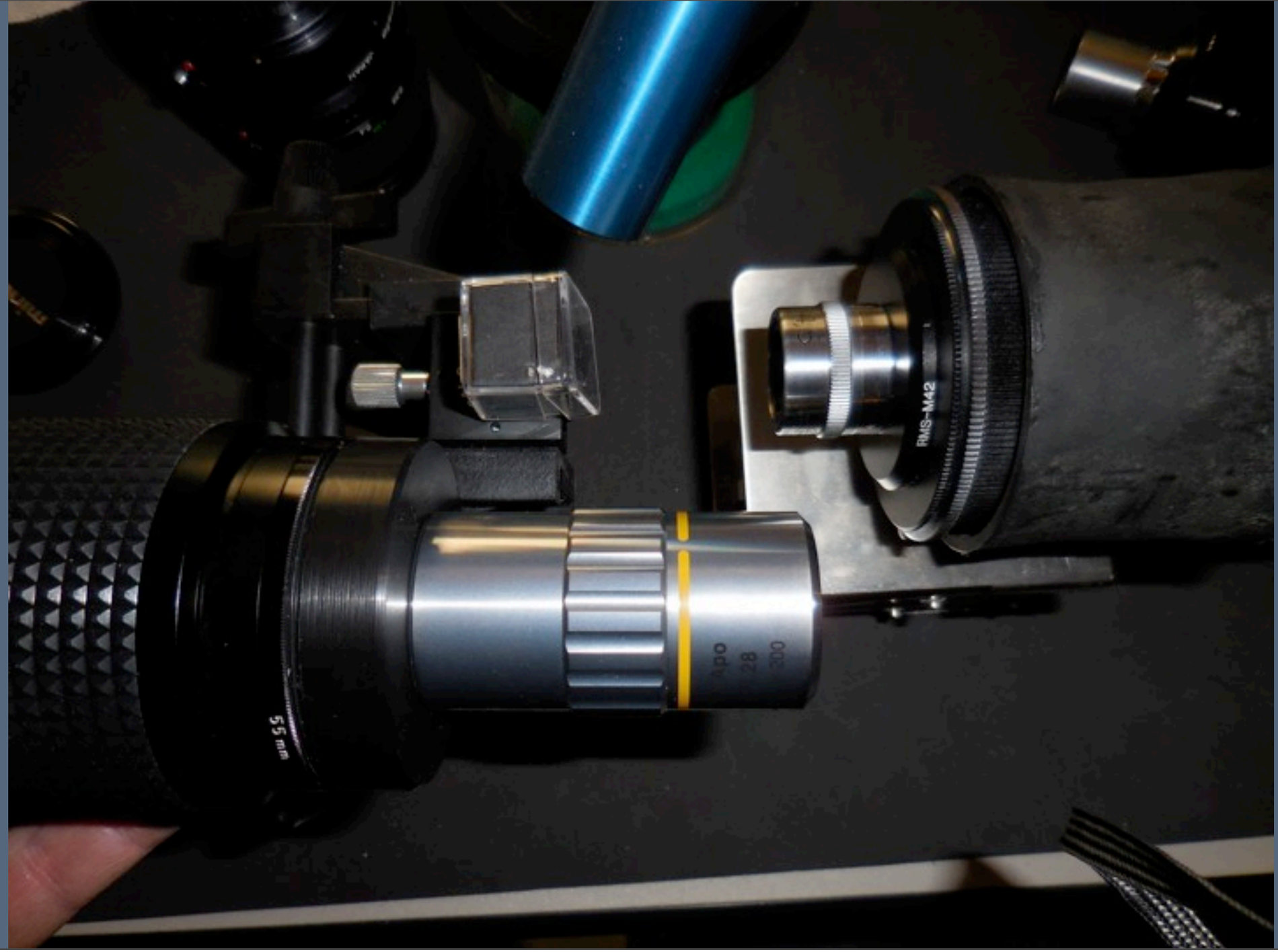
Mitutoyo Lens, adding Bellows to increase magnification



Close-up of
Mitutoyo Lens

Mitutoyo
Lens is
Big

Compared
with
Luminar Lens
or with a
Micromount
Box

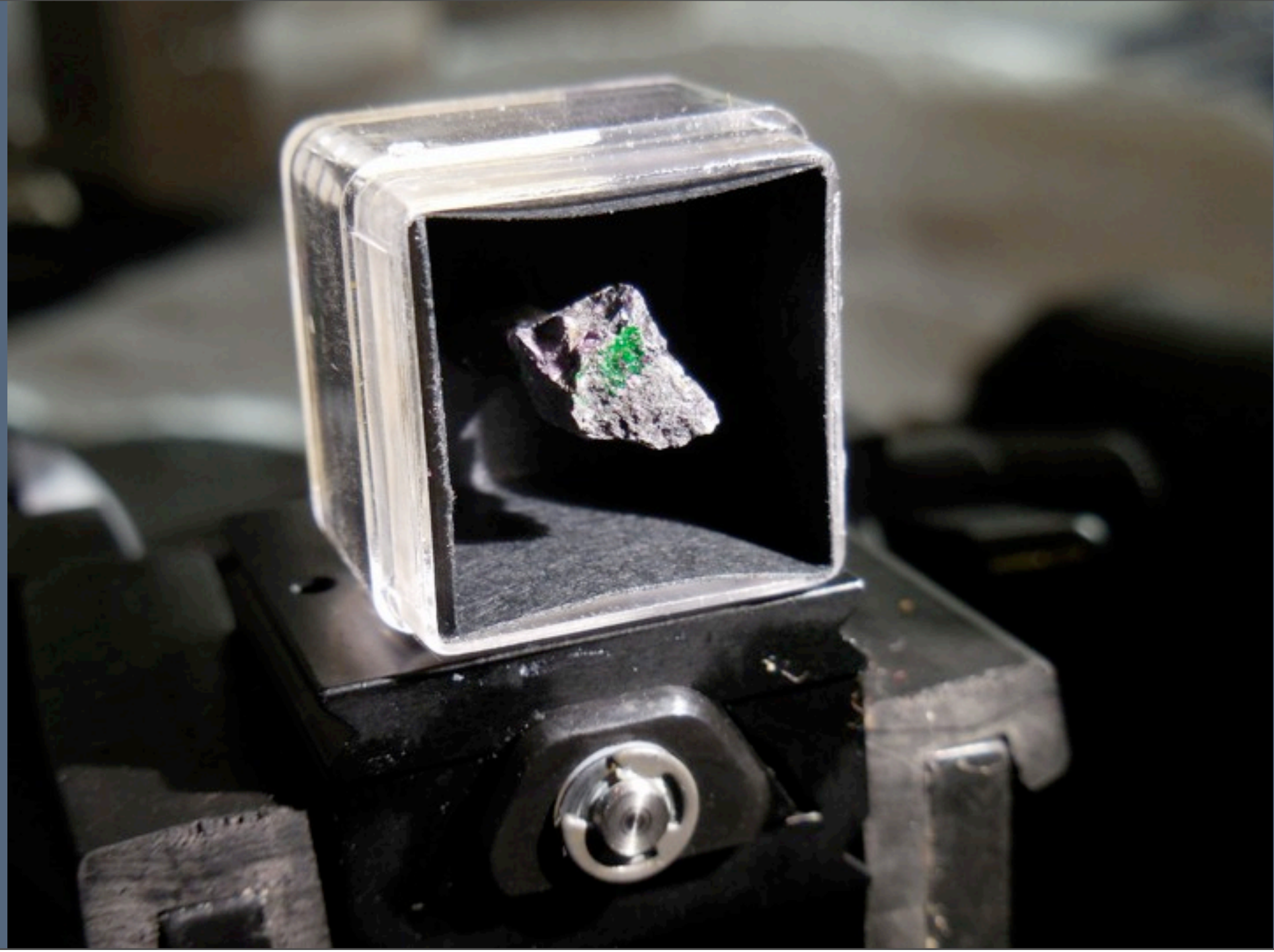


A Micromount
in a 20 mm box,
mounted on a
Micrometer Stage

Allows Tiny
Movements
Fore and Aft

Useful for taking
a series of photos
at different
Depths-of-field

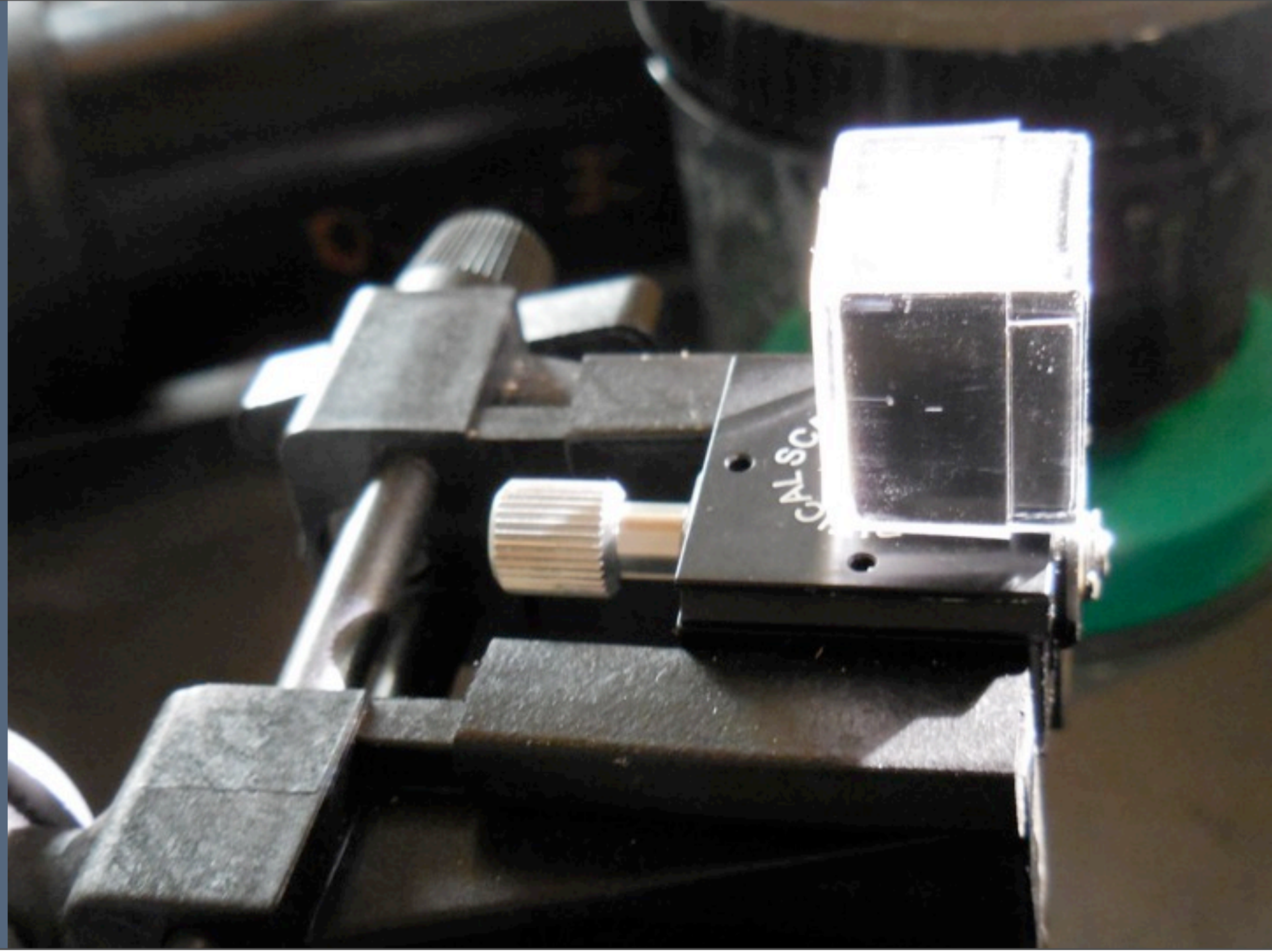
Series of photos
are then Stacked
by CombineZP
computer program
to increase
Depth-of-Field
beyond limits of
Optics



Side view of Micrometer Stage

Take a picture,
Turn the screw
1/8th of a turn,
Take next picture,
Repeat

Process needs to be automated, with computer control of stage and camera shutter



Hand-held Pocket Camera Photo of Micromount, cropped to the size of the mineral itself, thereby removing the box

Resolution 640 x 480 pixels. FOV 10 mm.

Looks OK at this size, But…

Attempt to crop and expand hand-held photo to fill a PowerPoint “slide”

Or : This is why all this fancy equipment is needed!

FOV 10 mm

Using the MACRO lens and the copy stand

Better than hand-held pocket camera, but the mineral is really too small for the MACRO lens

FOV 5 mm

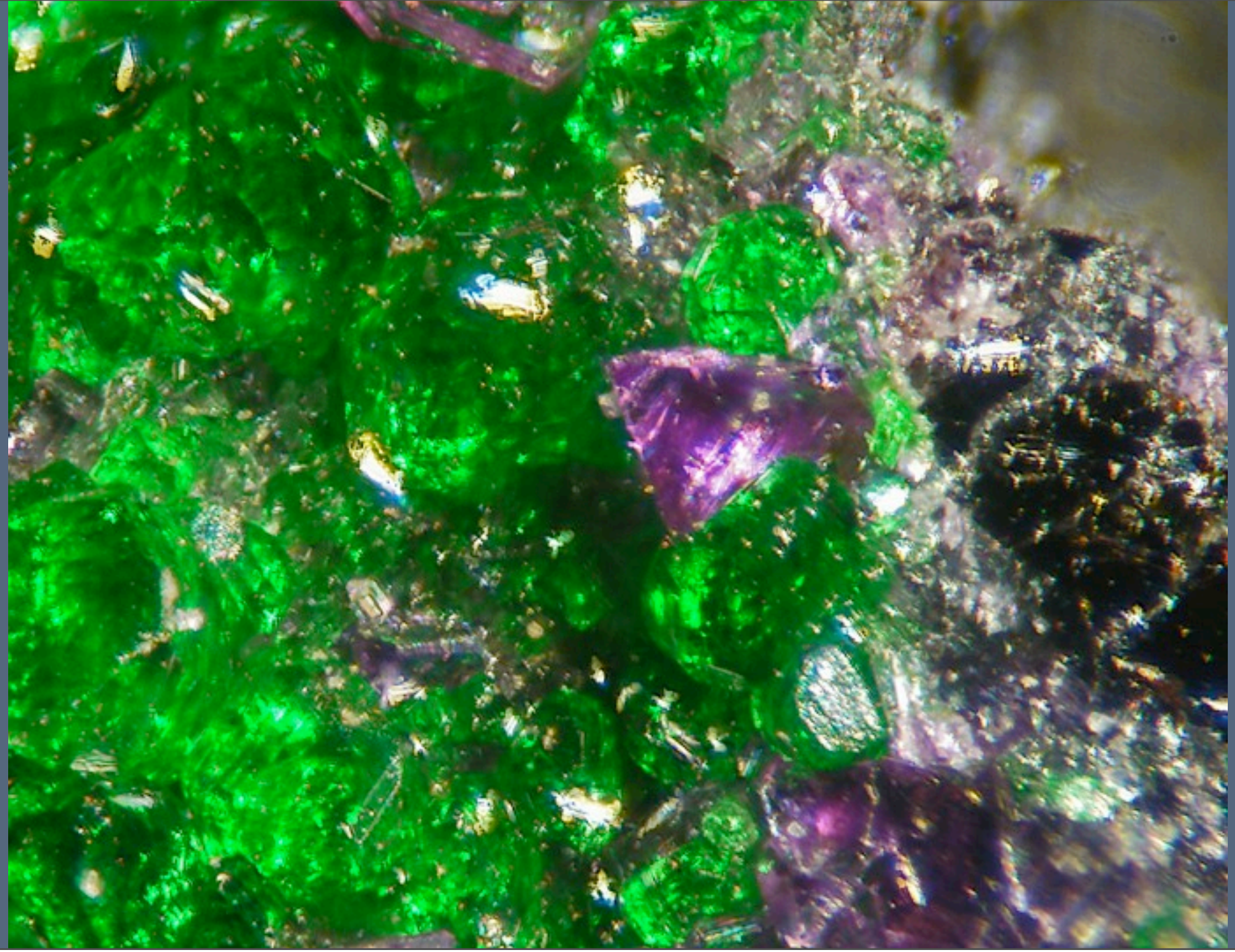
Stereo Microscope

140 X
(20 X eyepiece and
7X zoom objective

Stacked 5 images

Field of View 1 mm

High magnification,
but looks odd



Mitutoyo Lens

Stacked 41 images
Re-stacked 3 groups

Fixed shake and flares
with Photoshop

Field-of-View 2 mm

Two Chromium Minerals:

Uvarovite (green Garnet)

$Ca_3Cr_2(SiO_4)_3$

Kämmererite (purple),
properly called
Chromian Clinochlore

$Mg_5(Al,Cr)_2Si_3O_{10}(OH)_8$


Previous photo
Expanded
FOV 1.2 mm

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$Ca_3Cr_2(SiO_4)_3$

Kämmererite (purple), properly called Chromian Clinochlore

$Mg_5(Al,Cr)_2Si_3O_{10}(OH)_8$

From near Coalinga, California. Possibly:

Dallas Gem Mine area, San Benito River headwaters area, New Idria District, Diablo Range, San Benito Co., California, USA

This is my latest photo, and I am reasonably pleased.

I spent $500 on the Mitutoyo lens (half off with a friend in Japan buying it there)

My Smallest Mineral,
improved with Photoshop Elements
Version 14 (half-off at Costco)

Cloncurryite

$Cu_{0.5}(VO)_{0.5}Al_2(PO_4)_2F_2 \cdot 5H_2O$

A mineral containing vanadium

Great Australia Mine
Cloncurry, Queensland, Australia

FOV 1 mm

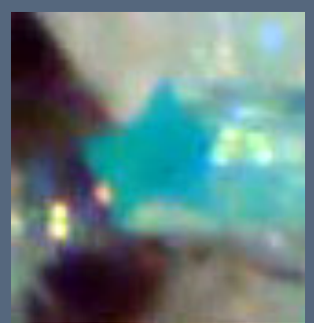
The Limits of Magnification with my Stereo Microscope

Cross-section of a Pentagonite crystal From Owyhee Dam, Oregon

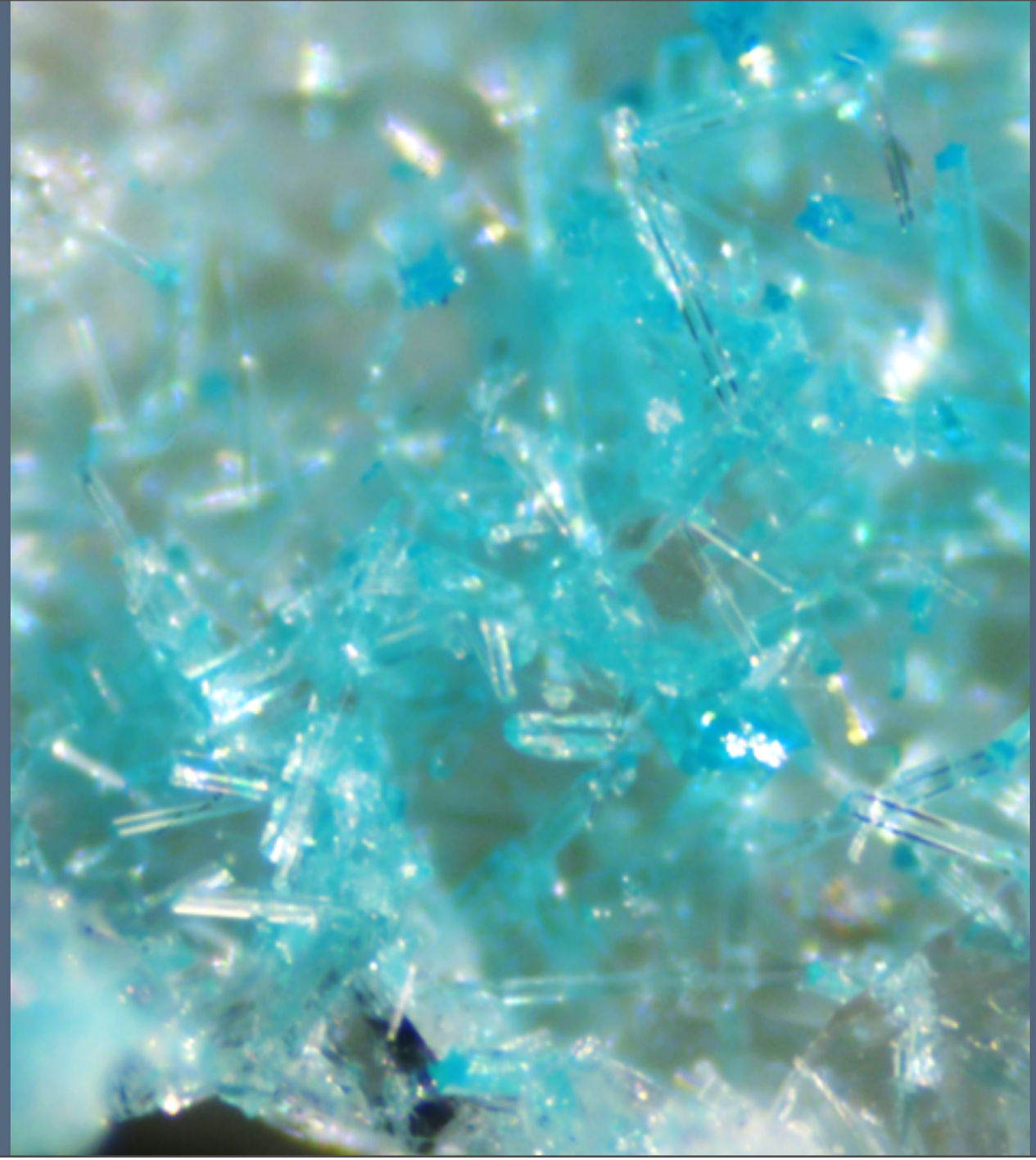
You can just make out a **Pentastar**.

Another vanadium mineral

$Ca(VO)Si_4O_{10} \cdot 4H_2O$



FOV 2 mm at right, ~0.15 mm above



A better picture of a
Not-so-tiny
Pentagonite
crystal cluster

$Ca(VO)Si_4O_{10} \cdot 4H_2O$

From Poona, India

FOV 6 mm

Cavansite

$Ca(VO)Si_4O_{10} \cdot 4H_2O$

A Dimorph of Pentagonite (same chemical composition, but different crystal structure)

Poona, India

FOV 2.5 mm

Another vanadium mineral:

Vanadinite

$Pb_5(VO_4)_3Cl$

Hamburg Mine, La Paz County, Arizona

FOV 2 mm

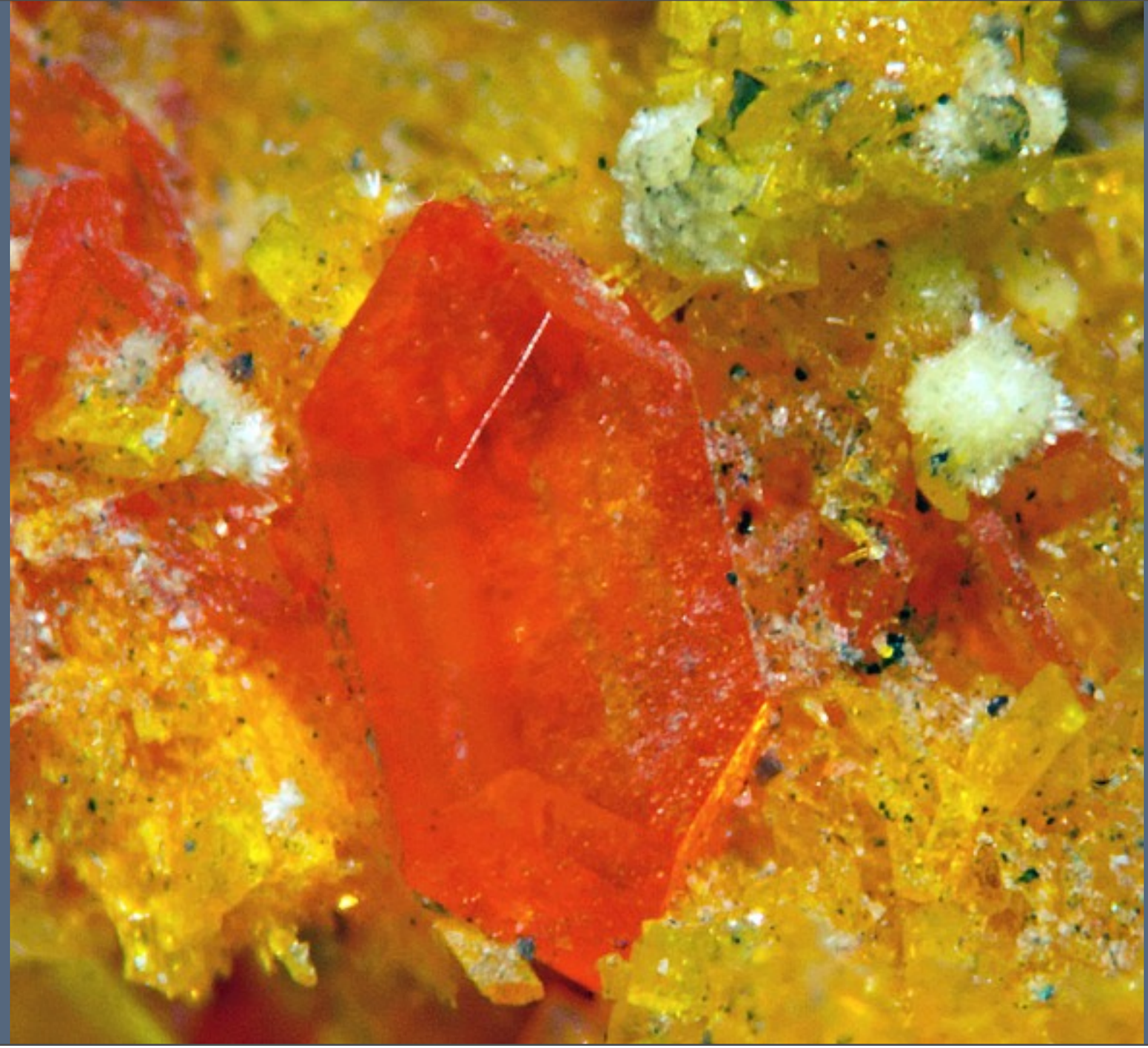
Fourmarierite

$Pb(UO_2)_4O_3(OH)_4 \cdot 4H_2O$

Uranium mineral from

Shinkolobwe,
Katanga,
Zaire, aka PR Congo

FOV 2.5 mm



Three more uranium minerals:

Cuprosklodowskite (green)
$Cu(UO_2)_2(SiO_3OH]_2 \cdot 6H_2O$

Rutherfordine (tan)
$(UO_2)CO_3$

Schoepite (yellow)
$(UO_2)_8O_2(OH)_{12} \cdot 12H_2O$

Musonoi, Katanga, Zaire

FOV 4 mm

Linarite
$PbCu(SO_4)(OH)_2$

on

Anglesite
$PbSO_4$

Grand Reef Mine,
Grand County, Arizona

FOV 10 mm

MACRO lens on Bellows

Hemimorphite

$Zn_4Si_2O_7(OH)_2 \cdot H_2O$

Santa Eulalia,
Chihuahua,
Mexico

Hemimorphic means top differs from bottom
Orthorhombic Pyramidal Class *mm*2

FOV 1 mm

Luminar lens and Bellows

Descloizite

$Pb(Zn,Cu)(VO_4)(OH)$

Berg Aukas, Namibia

FOV 8 mm

A Copper and Aluminum Mineral

Turquoise
$Cu(Al,Fe^{3+})_6(PO_4)_4(OH)_8 \cdot 4H_2O$

From Lynch Station, Virginia

A photo rescued by Photoshop Elements “Auto Shake Reduction”

FOV 2 mm

Two Manganese Minerals

Shigaite
$Mn_6Al_3(OH)_{18}[Na(H_2O)_6][SO_4]_2 \cdot 6H_2O$

on

Rhodochrosite
$MnCO_3$

Colorful Uranium and Copper Minerals
from Musonoi, Katanga, Zaire

Wulfenite (orange)
$Pb(MoO_4)$

Kasolite (yellow)
$Pb(UO_2)[SiO_4] \cdot H_2O$

Cuprosklodowskite (green)
$Cu(UO_2)_2(SiO_3OH]_2 \cdot 6H_2O$

Malachite (green grass)
$Cu_2(CO_3)(OH)_2$

FOV 2.5 mm

Senegalite

$Al_2(PO_4)(OH)(OH)_2 \cdot H_2O$

on

Turquoise

$Cu(Al,Fe^{3+})_6(PO_4)_4(OH)_8 \cdot 4H_2O$

Mount Kourou Diakouma,
Saraya, Falémé River District,
Tambacounba Region,
Senegal

FOV 1 mm

Hemimorphic

Luminar and Bellows, stack 3

Two Chromium Minerals

Chromian Titanite
$Ca(Ti,Cr)[SiO_4](O,OH)$

on

Chromian Amesite
$Mg_2(Al,Cr)(AlSiO_5)(OH)_4$

Saranovskii Mine,
Saranovskaya Village (Sarany),
Gornozavodskii area,
Permskaya Oblast',
Middle Urals, Urals Region,
Russia

FOV 8 mm

Microscope, stack 12 images

Dioptase “Bow-Tie”

$CuSiO_3 \cdot H_2O$

on

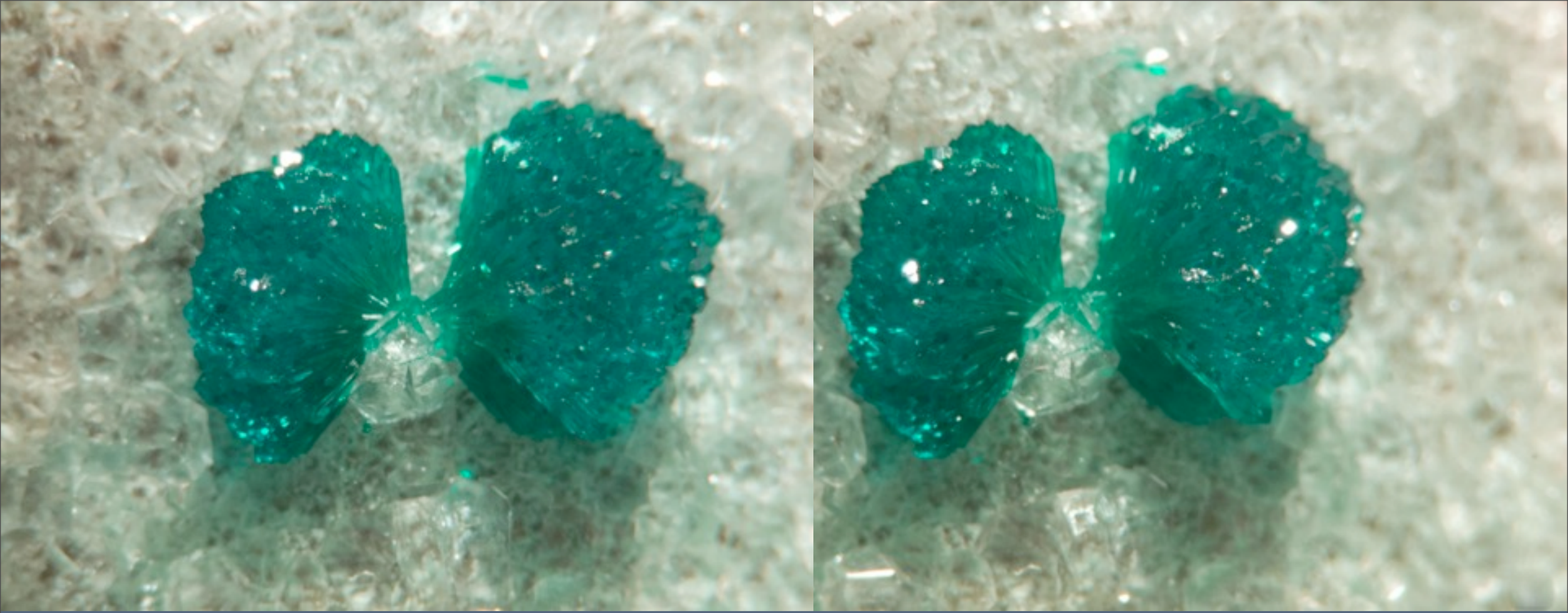
Apophyllite

$KCa_4(Si_8O_{20})(OH,F) \cdot 8H_2O$

Christmas Mine,
Gila County
Arizona

FOV 8 mm

Stereo Microscope



The views from the left eyepiece and the right eyepiece of the Stereo Microscope

Try Cross-Eyed 3D viewing!

A photo I took in the 1970's with Kodachrome, tidied up with modern Photoshop

Wulfenite (yellow)
$Pb(MoO_4)$

Hemimorphite (colorless)
$Zn_4Si_2O_7(OH)_2 \cdot H_2O$

Ojuela Mine, Mapimi, Durango, Mexico

FOV 8 mm

MACRO lens on Bellows

Have I really made any Progress in Photography of Minerals???