

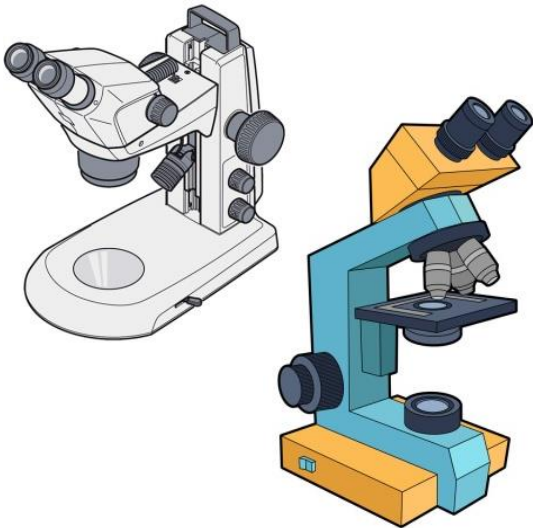
Manchester Microscopical & Natural History Society



Established 1880

www.manchestermicroscopical.org.uk

Micro ... Macro ... or both ...?



Mike Mahon, March 14th, 2024

Last meeting ...



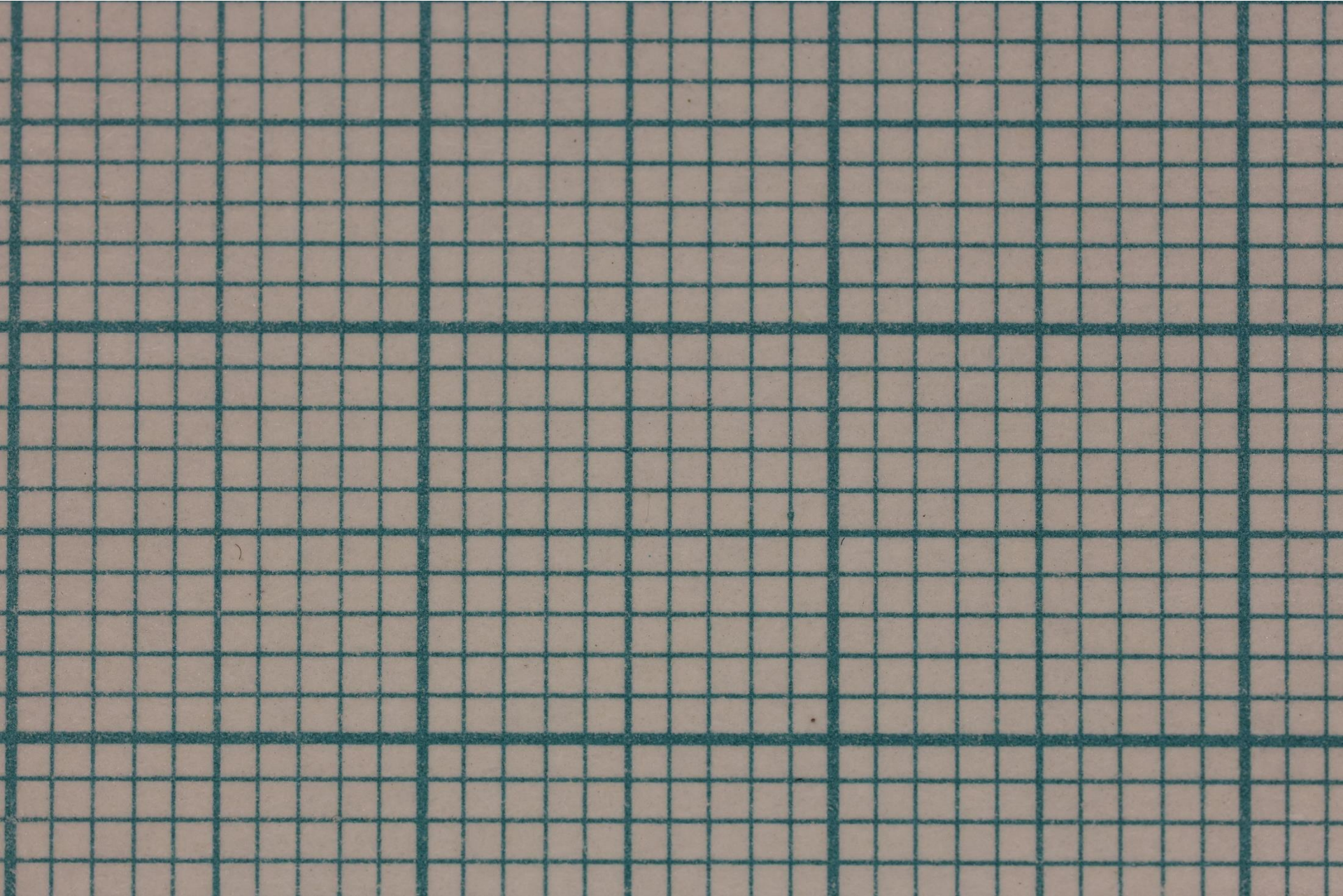
RMS to T2 adapter about £8-£18

Online ... SRB Photographic, AliExpress, ...



36 mm
24 mm

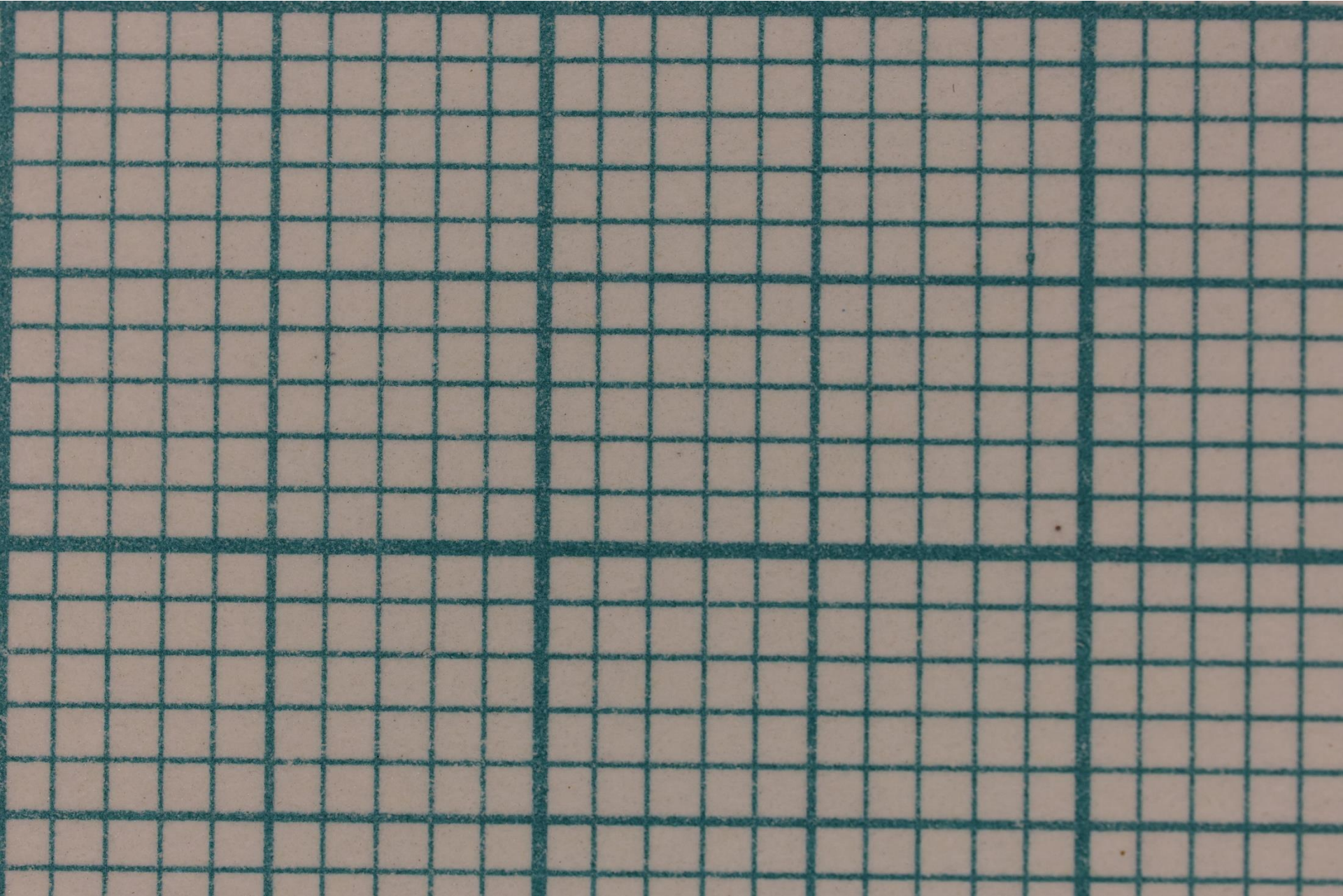
Full frame camera sensor



Macro: <36mm> or mag x1.0 1:1

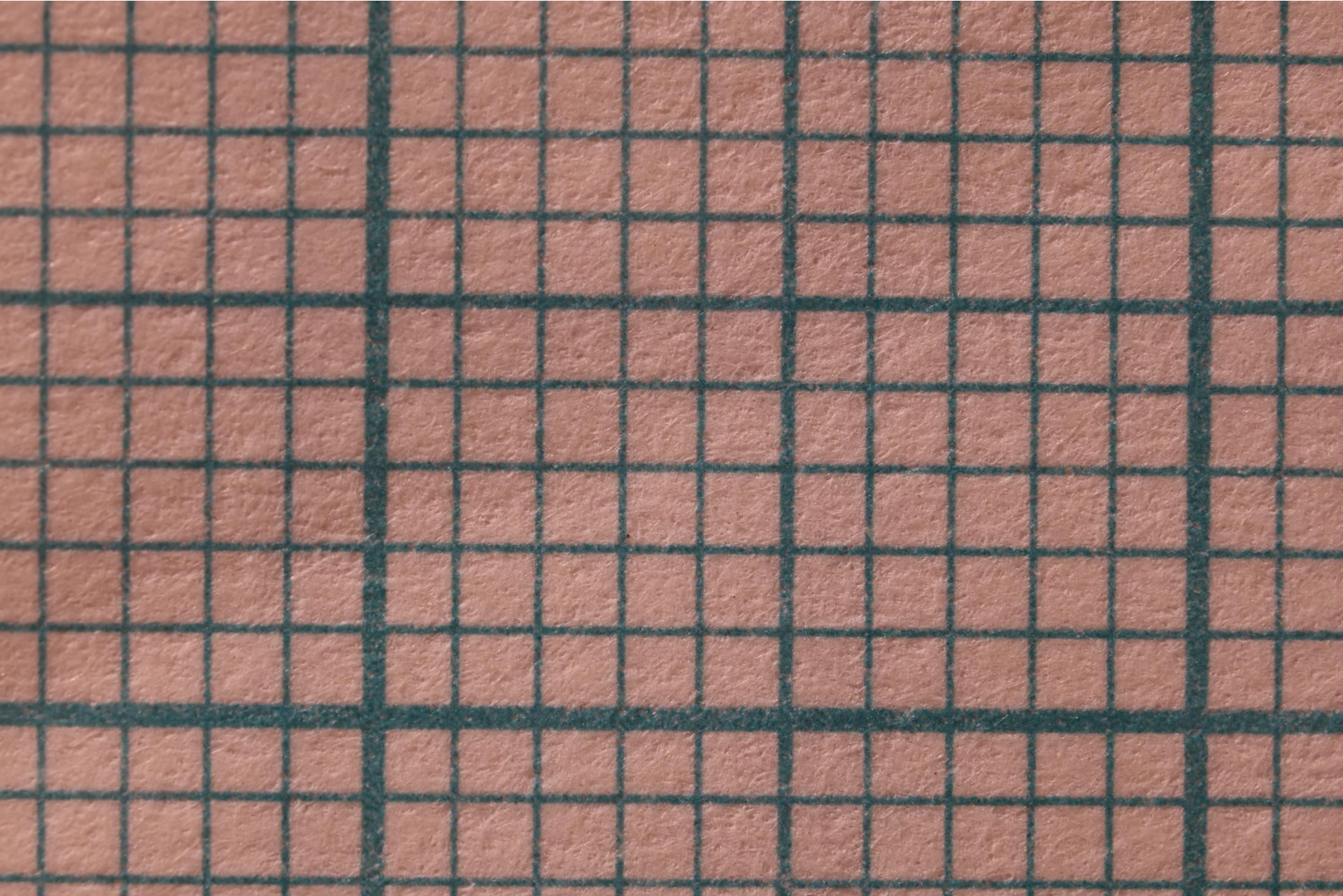


Macro: <25mm> or mag x1.4



Macro: <25mm> or mag x1.4

1mm squares



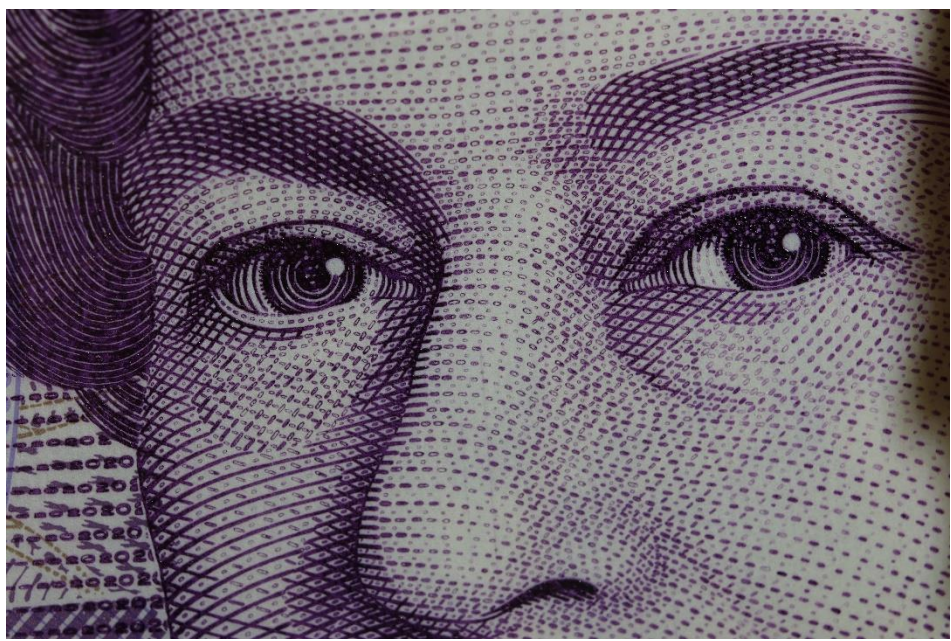
Macro + extension tubes: <20mm> or mag x1.75



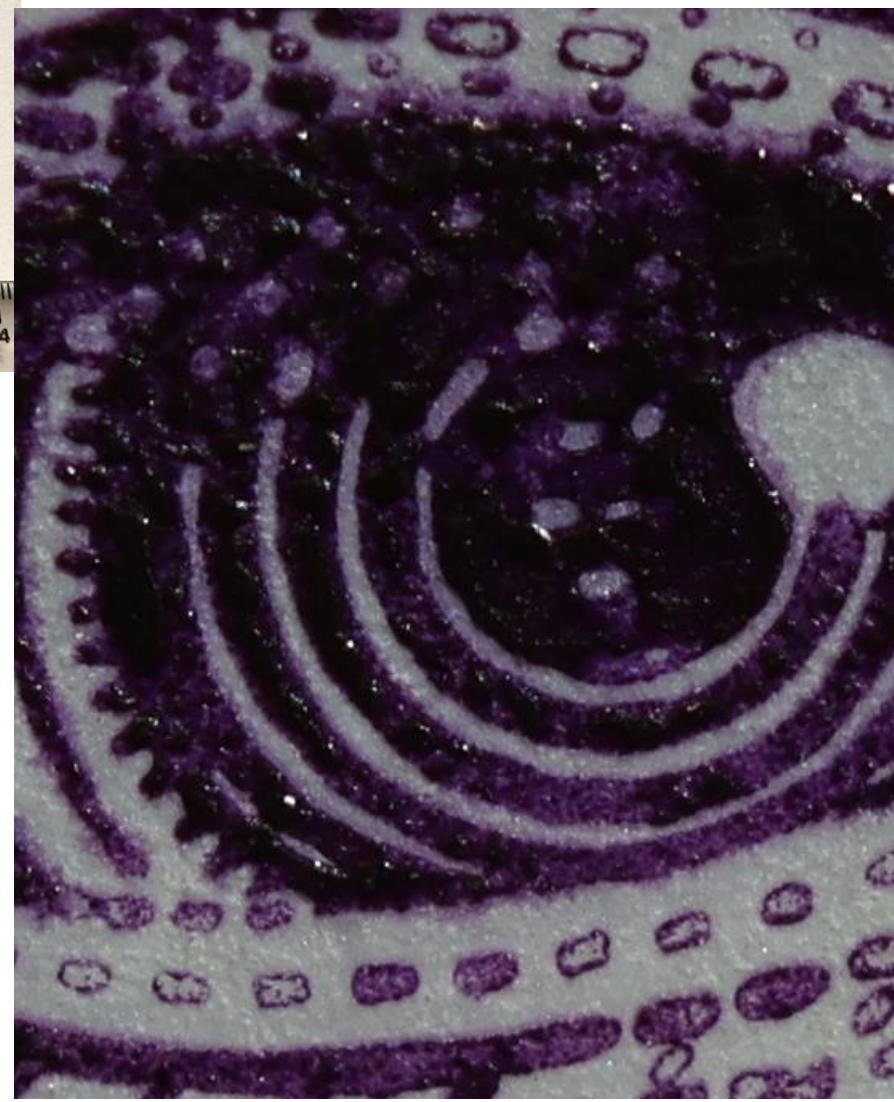
● 10μm



0.1mm ————— 100μm



————— 1cm



1mm —————

1 Copyright © by Enrico Savazzi, 2009-2010 (www.savazzi.net). DoF equation originally published by Lefkowitz (1979, p. 258), equation used in this sheet is an equivalent

2

3 Table 1 (below): DoF and effective aperture (E) based on nominal aperture and magnification.

4 Green: optimal settings, resolution is limited by CoC ($C \geq \text{Airy}$). The best compromise between DoF and diffraction is the cell at the bottom of each green column.

5 Yellow: use if higher-than-optimal DoF is required or if the image will be printed at a small absolute size. Resolution is slightly limited by diffraction ($C < \text{Airy} < 2C$).

6 Red: avoid, resolution is visibly reduced by diffraction ($2C < \text{Airy}$).

7	Nom. aperture →	1		1.2		1.4		2		2.8		4		5.6		8		11		16		22		32	
8	Magnification ↓	DoF	E	DoF	E	DoF	E	DoF	E	DoF	E	DoF	E	DoF	E	DoF	E	DoF	E	DoF	E	DoF	E	DoF	E
9	0.1	8.3	1.1	9.9	1.3	12	1.5	17	2.2	23	3.1	33	4.4	46	6.2	66	8.8	91	12	130	18	180	24	260	35
10	0.2	2.3	1.2	2.7	1.4	3.2	1.7	4.5	2.4	6.3	3.4	9	4.8	13	6.7	18	9.6	25	13	36	19	50	26	72	38
11	0.3	1.1	1.3	1.3	1.6	1.5	1.8	2.2	2.6	3	3.6	4.3	5.2	6.1	7.3	8.7	10	12	14	17	21	24	29	35	42
12	0.4	0.66	1.4	0.79	1.7	0.92	2	1.3	2.8	1.8	3.9	2.6	5.6	3.7	7.8	5.3	11	7.2	15	11	22	14	31	21	45
13	0.5	0.45	1.5	0.54	1.8	0.63	2.1	0.9	3	1.3	4.2	1.8	6	2.5	8.4	3.6	12	5	17	7.2	24	9.9	33	14	48
14	0.75	0.23	1.8	0.28	2.1	0.33	2.5	0.47	3.5	0.65	4.9	0.93	7	1.3	9.8	1.9	14	2.6	19	3.7	28	5.1	39	7.5	56
15	1	0.15	2	0.18	2.4	0.21	2.8	0.3	4	0.42	5.6	0.6	8	0.84	11	1.2	16	1.7	22	2.4	32	3.3	44	4.8	64
16	1.5	0.083	2.5	0.1	3	0.12	3.5	0.17	5	0.23	7	0.33	10	0.47	14	0.67	20	0.92	28	1.3	40	1.8	55	2.7	80
17	2	0.056	3	0.068	3.6	0.079	4.2	0.11	6	0.16	8.4	0.23	12	0.32	17	0.45	24	0.62	33	0.9	48	1.2	66	1.8	96
18	2.5	0.042	3.5	0.05	4.2	0.059	4.9	0.084	7	0.12	9.8	0.17	14	0.24	20	0.34	28	0.46	39	0.67	56	0.92	77	1.3	110
19	3	0.033	4	0.04	4.8	0.047	5.6	0.067	8	0.093	11	0.13	16	0.19	22	0.27	32	0.37	44	0.53	64	0.73	88	1.1	130
20	4	0.023	5	0.028	6	0.033	7	0.047	10	0.066	14	0.094	20	0.13	28	0.19	40	0.26	55	0.38	80	0.52	110	0.75	160
21	5	0.018	6	0.022	7.2	0.025	8.4	0.036	12	0.05	17	0.072	24	0.1	34	0.14	48	0.2	66	0.29	96	0.4	130	0.58	190
22	7.5	0.011	8.5	0.014	10	0.016	12	0.023	17	0.032	24	0.045	34	0.063	48	0.091	68	0.12	94	0.18	140	0.25	190	0.36	270
23	10	0.0083	11	0.0099	13	0.012	15	0.017	22	0.023	31	0.033	44	0.046	62	0.066	88	0.091	120	0.13	180	0.18	240	0.26	350
24	15	0.0053	16	0.0064	19	0.0075	22	0.011	32	0.015	45	0.021	64	0.03	90	0.043	130	0.059	180	0.085	260	0.12	350	0.17	510
25	20	0.0039	21	0.0047	25	0.0055	29	0.0079	42	0.011	59	0.016	84	0.022	120	0.032	170	0.043	230	0.063	340	0.087	460	0.13	670
26	30	0.0026	31	0.0031	37	0.0036	43	0.0052	62	0.0072	87	0.01	120	0.014	170	0.021	250	0.028	340	0.041	500	0.057	680	0.083	990
27	40	0.0019	41	0.0023	49	0.0027	57	0.0038	82	0.0054	110	0.0077	160	0.011	230	0.015	330	0.021	450	0.031	660	0.042	900	0.062	1300



Limited depth of field



Stacked – 5 shots



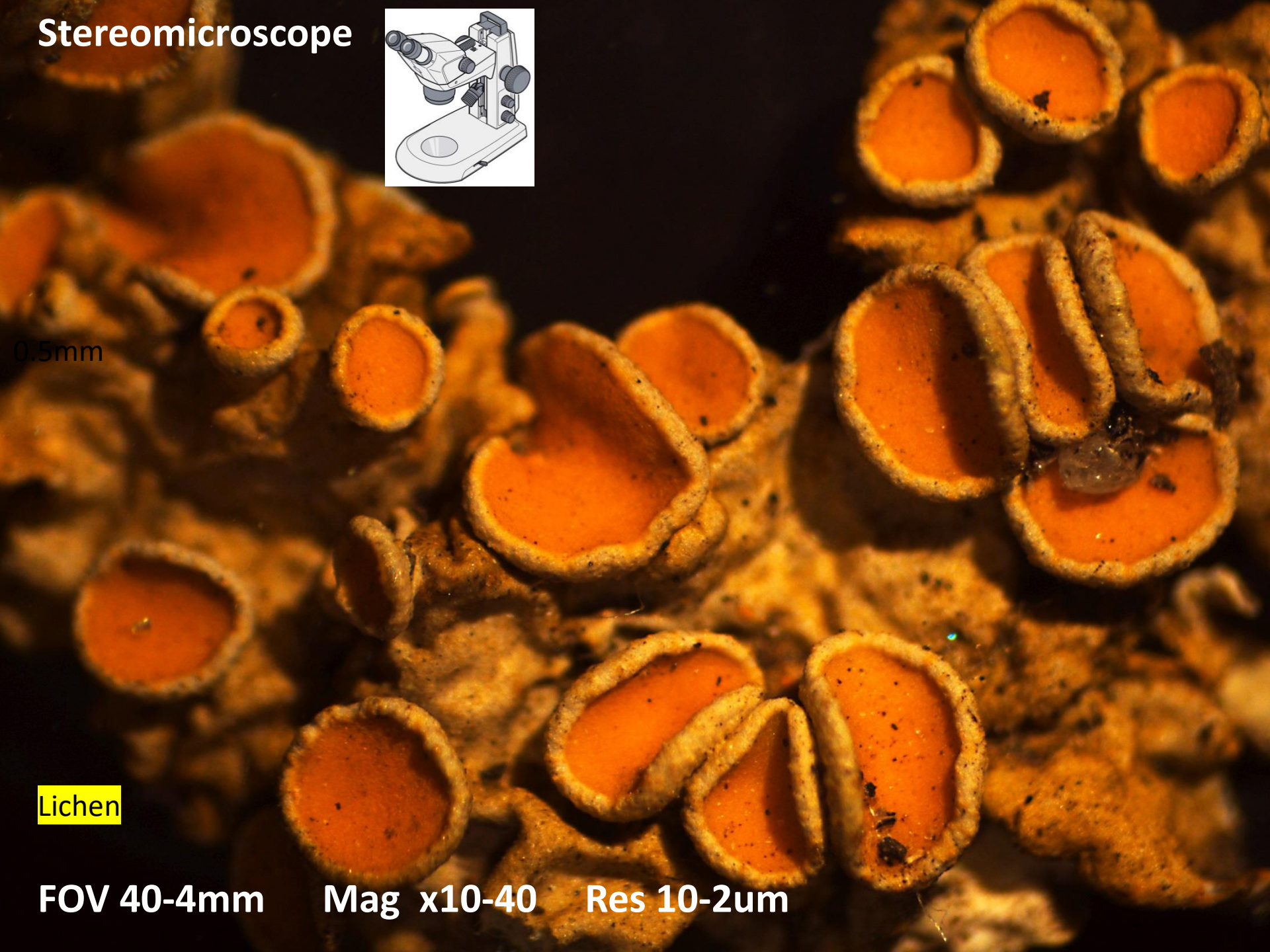
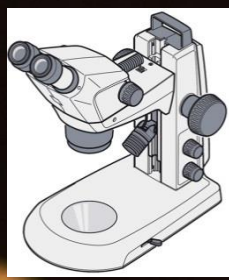
Close-up/Macro – 1 shot



Close-up/Macro – 5 shots



Stereomicroscope



0.5mm

Lichen

FOV 40-4mm

Mag x10-40

Res 10-2um



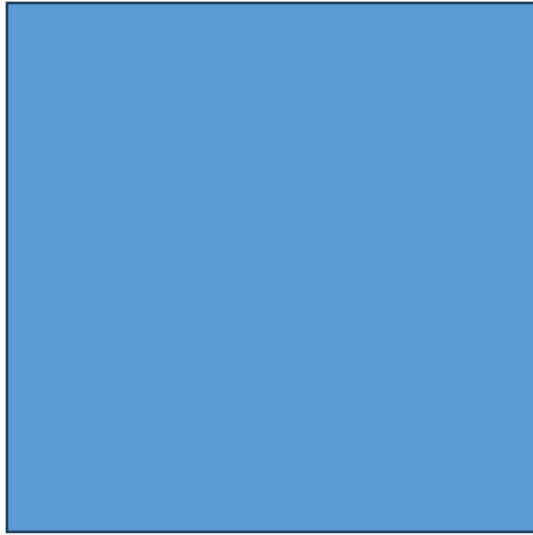
RMS-T2 adapter



T2-camera mount

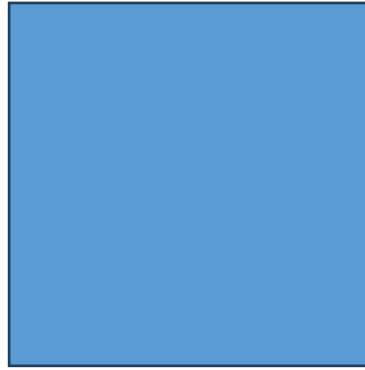
MMS Stereomicroscope x17 – x45

X 0.7



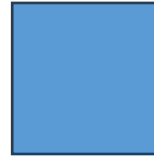
FOV 35 mm

X 1



25 mm

X 2



10 mm

X 3



7 mm

X 4



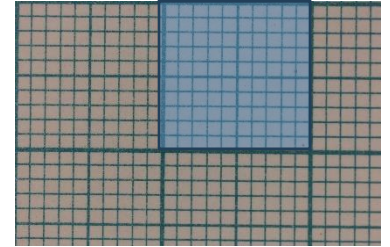
5 mm

X 4.5



4.5 mm

Scale - 1cm -



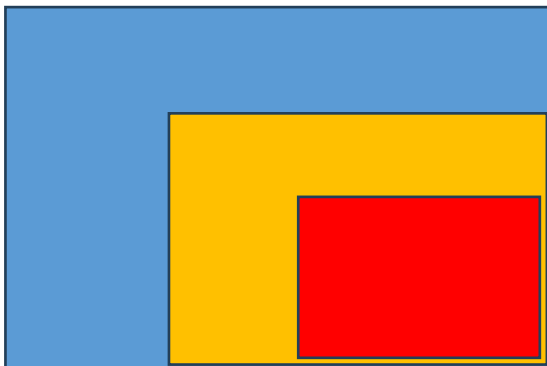
Macro 1:1

Macro 1:1.4

+ Ext Tubes

FOV 35mm

25, 16



X4 Obj

x10 Obj

x20 Obj

x40 Obj

x100 Obj

10

4

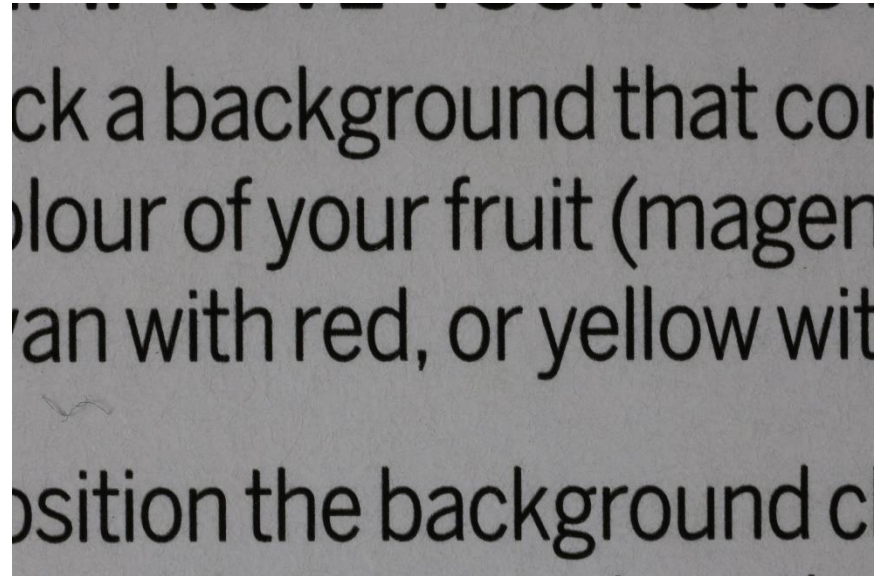
1.8

0.9

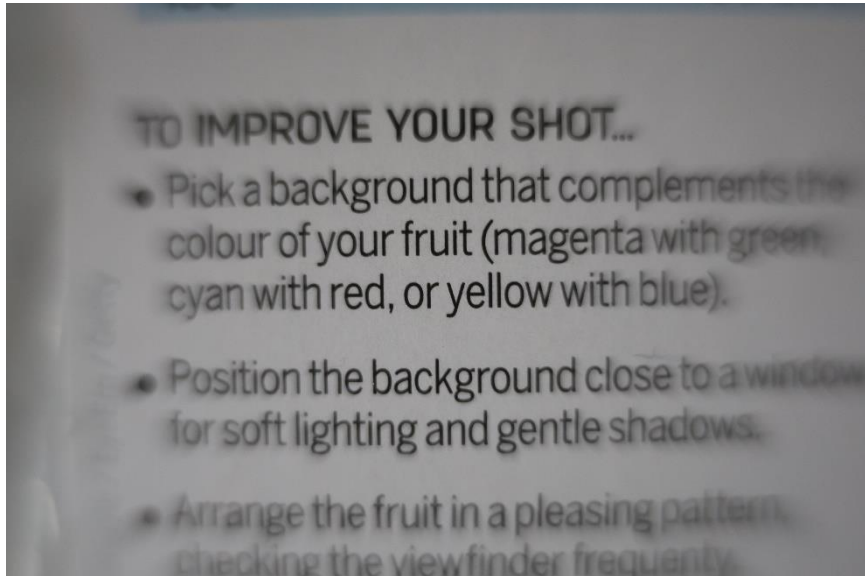
0.4



Compound Microscope Objectives



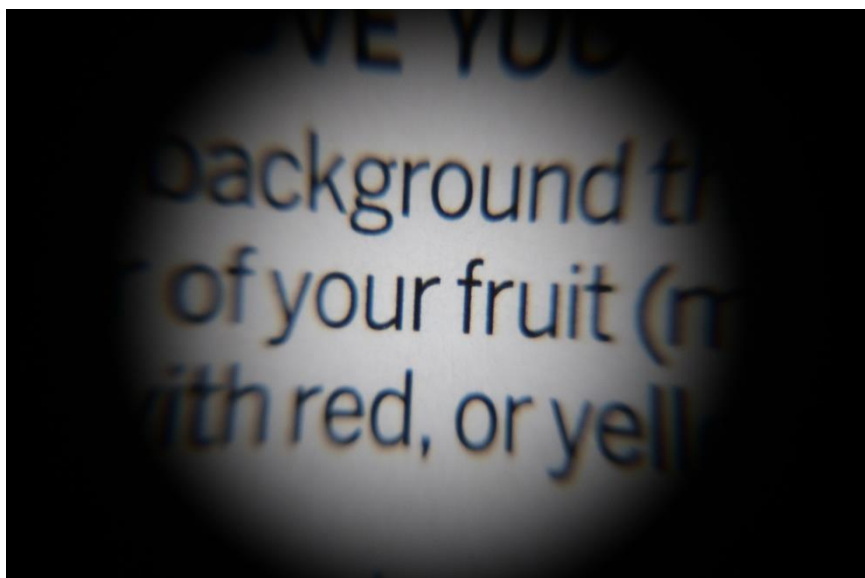
Macro x2



x3



x10

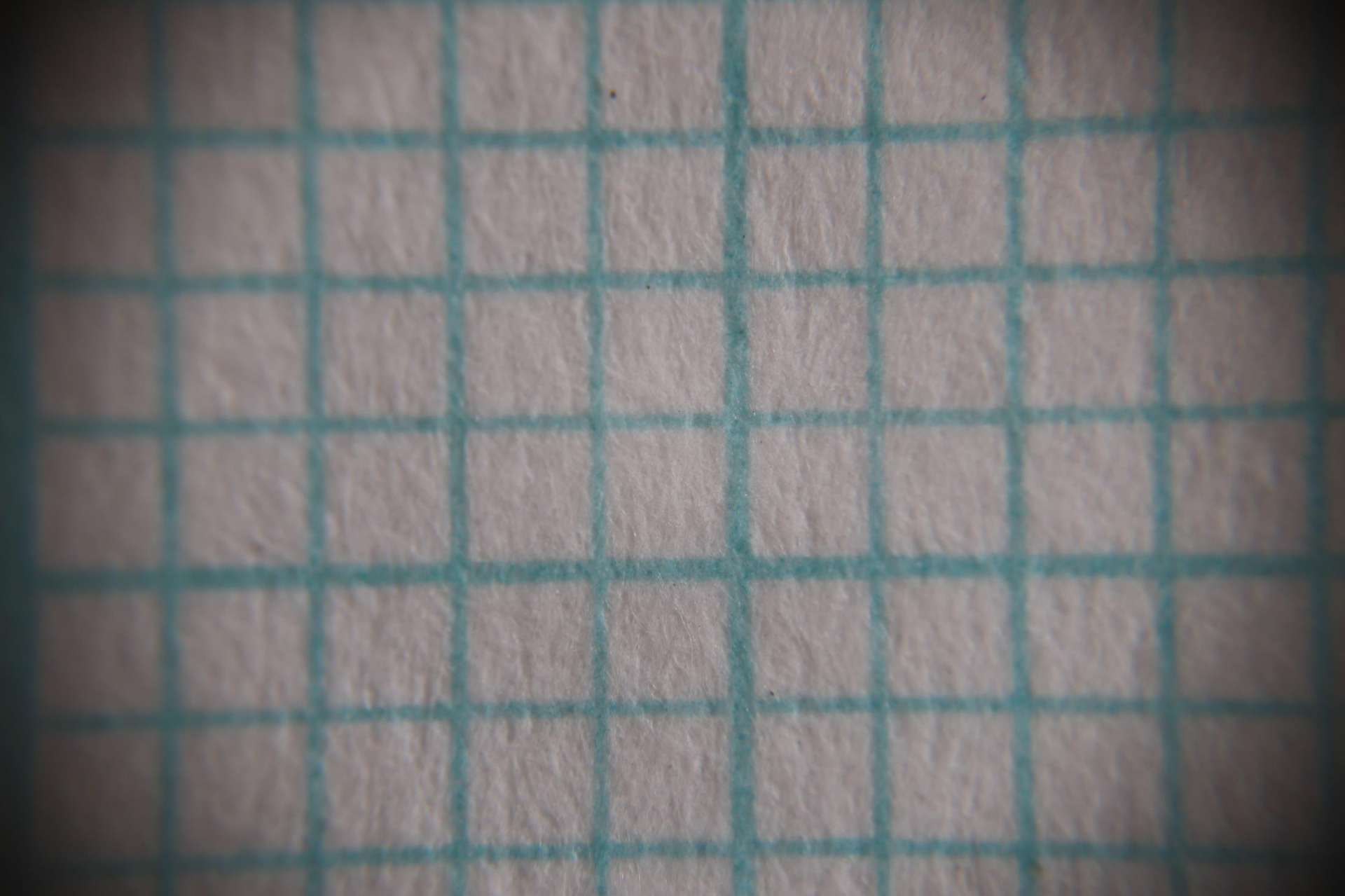


x4



Vx4

--- 1 mm ---



Vx4

--- 1mm ---

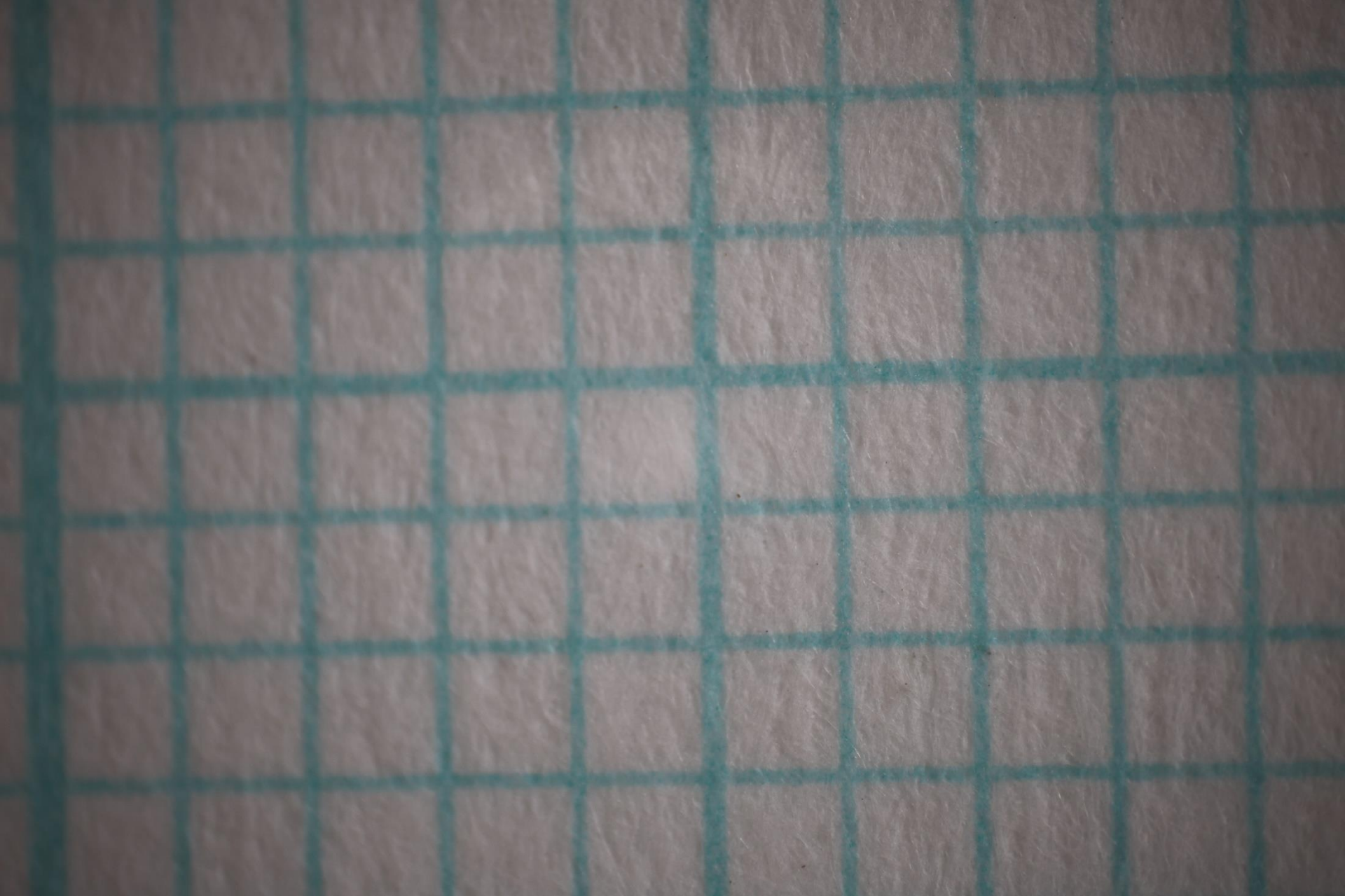
Tried lots of objectives

- Vickers
- Olympus
- Leitz
- Zeiss

-, Swift !



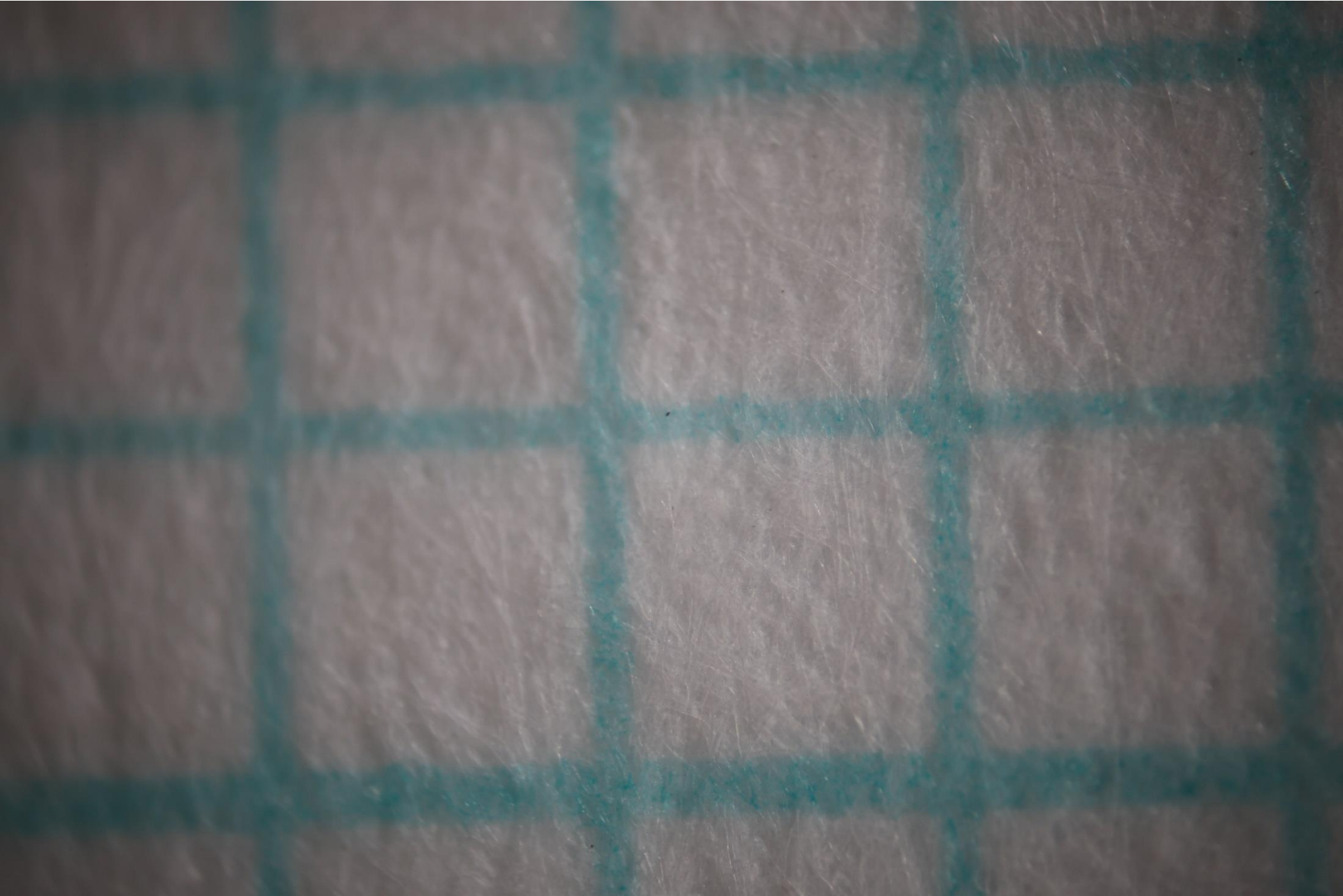
Sx4 Mag x3.6 FOV 10 mm



Sx4 FOV 10 mm Mag x3.6



Sx10 FOV 4mm Mag x9



sx10

Microscope Objectives

- **Make**
 - Zeiss, Nikon, Olympus, Leitz, ...
- **Magnification**
 - x1 x4 x10 x20 x40 x100
- **NA (numerical aperture)**
 - 0.04 0.1 0.2 0.4 0.6 1.3
- | | | | | | | |
|--------------------------|---|----|-----|-----|-----|------|
| Res μm | 8 | 3 | 1.7 | 0.8 | 0.5 | 0.25 |
| WD mm | 2 | 18 | 7 | 2 | 0.5 | 0.2 |
- **Tube length**
 - Var 160 170 210 ∞
- **Coverslip thickness**
 - 0.17 mm, --
- **Thread size**
 - RMS-W 20.3, M24, M25, M26(BD), M27, M32
- **Field Number**
 - ??
- **Quality**
 - achromat, apochromat, plan, ..., oil, phase, pol, fluor, LWD, ...



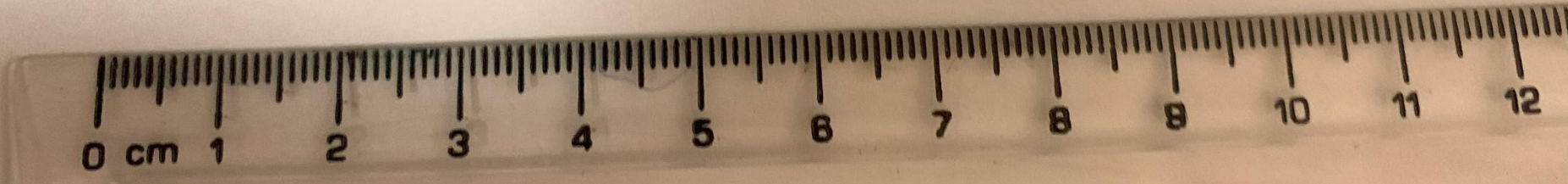


~ 160 mm

Obj RMS-T2 Ext Tubes T2-Camera Ext Tubes Camera !!



Swiftx4 +tube +ext = x4.5 FOV 8 mm

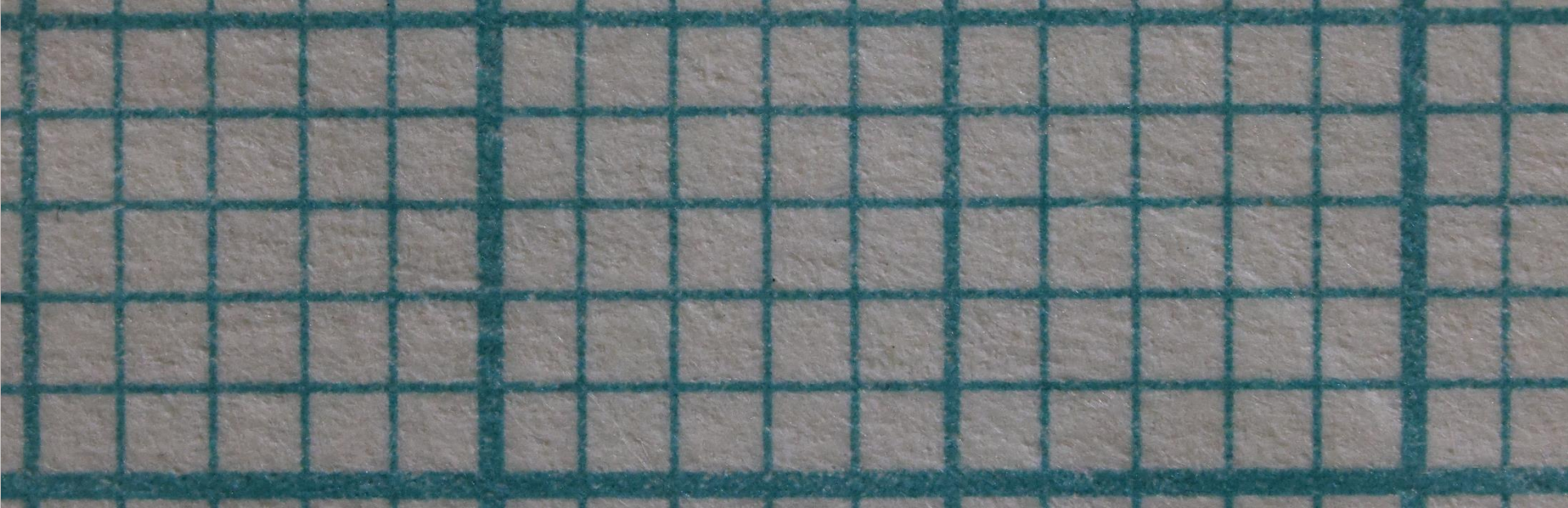




Swiftx4 +tube +ext = x4.5



Swiftx4 +tube +ext = x4.5 Stacked (10)



Macro lens + ext tubes



Focussing / Macro Rail



Swift objective x10 +tube +ext = x11

FOV =3.3 mm



Swift objective x10 +tube +ext = x11



Macro Stand





Swift objective x4 Mag x3.6

FOV 10mm ~ ½ 5p coin



Swift objective x4 Mag x3.6

FOV 10mm ~ ½ 5p coin

Fruiting body = ¼ mm



Swift objective x4 Mag x3.6

FOV 10mm ~ ½ 5p coin



Swift objective x4 Mag x3.6



FOV 10mm ~ ½ 5p coin



Swift objective x10 Mag x9

FOV 4mm $\sim 1/5$ 5p coin

Fruiting body = $\sim 1/4$ mm or 250 μm !



Swift objective x10 Mag x9

FOV 4mm $\sim 1/5$ 5p coin

Strand = ~ 0.015 mm or $15 \mu\text{m}$!



Swift objective x10 Mag x9

FOV 4mm ~ 1/5 5p coin

Fine hairs = ~ 0.025 mm or 25 μ m !

Macro 1:1.4 + Ext Tubes <16x11mm> or Mag x2.25

WD 6cm

WD ~2cm

WD ~1cm

WD 0.2cm

X4 Obj 1:1.4 <10x7mm> Mag x3.6

X10 Obj
<4x2.6mm>
Mag x9

X10 Obj +ext
<3x2mm>
Mag x10

x20



Macro: <25x17mm> or mag x1.4

WD 8cm

1mm squares

10p



1p



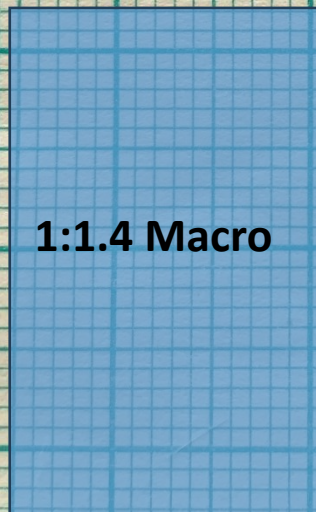
5p



1:1.4 Macro
+ ext

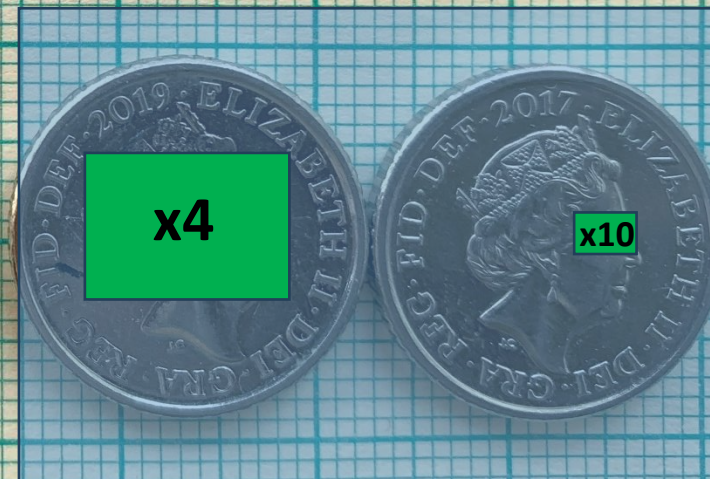
**Handy
Guide !**

1 mm squares



1:1.4 Macro

2 x 5p



x4

x10

24 mm

36 mm

1:1 Macro (Full Frame Sensor)

**+ Closeup Lens Filters
(1-10 dioptries)
~£20**



Example: telephoto Zoom 100-400mm ... Closeup 6 dioptries ... WD 15 cm

FL	Mag	FOV mm	
X100	0.6	60	... = close-up
X200	1.3	27	... = macro plus
X400	2.4	15	... = macro plus ext tubes

? Chromatic errors, require Raynox lenses





----- 36 mm -----

Zoom x100 Closeups 6D FOV 60mm Mag x0.6



----- 10 mm -----

Zoom x200 Closeups 6D FOV 27mm Mag x1.3



----- 10 mm -----

Zoom x400 Closeups 6D FOV 15mm Mag x2.4



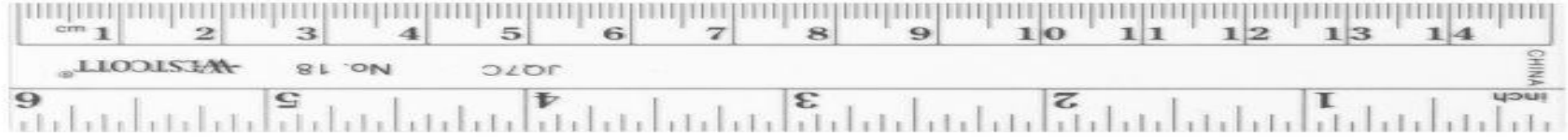
----- 10 mm -----

Zoom x400 Closeups 6D FOV 15mm Mag x2.4



t can be achieved , by others ... FOV ~ 6cm

[Difference Between Dragonflies and Damselflies \(thoughtco.com\)](http://thoughtco.com)



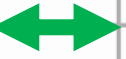
15 cm (6 inch ruler)



6 cm (Zoom + Closeups)



2-4 cm (Macro)



1 cm (x4 Obj)



0.5 cm (x10 Obj)

Comparisons

Equipment	FOV	Mag	Res	+/-
Macro	∞ -16 mm	∞ -2.2	??18 μ m	- flat/portability/Dof
Stereomicroscope	40-4 mm	10-40	10-2	Pol, Df
Camera + Obj Lens	10-4 mm	3-11	??6 μ m	- portability
Compound Mic	4-0.5 mm	40-1000	4-0.2 μ m	Pol, Df, Ph, DIC

Choices ...

- Long lenses + closeup filters
- Wide lenses + ext tubes
- Reverse lens & bellows*
- Macro lenses
- Adapters + microscope objectives !
- Microscopes !!

.... Next experiment-attach a Dancer / Davis diaphragm between objective and camera ...

References

- Closeupphotography.com
- Ultramacro.co.uk
- Extreme-macro.co.uk
- Savazzi.net

- PMS – Chapman
- [Macro Photography Lens Tests \(coinimaging.com\)](#)
- Evennett – Digital Photomicroscopy
- Photometrics – camera resolution
- Lumenera – resolution in digital microscopy

- SRB photographic,

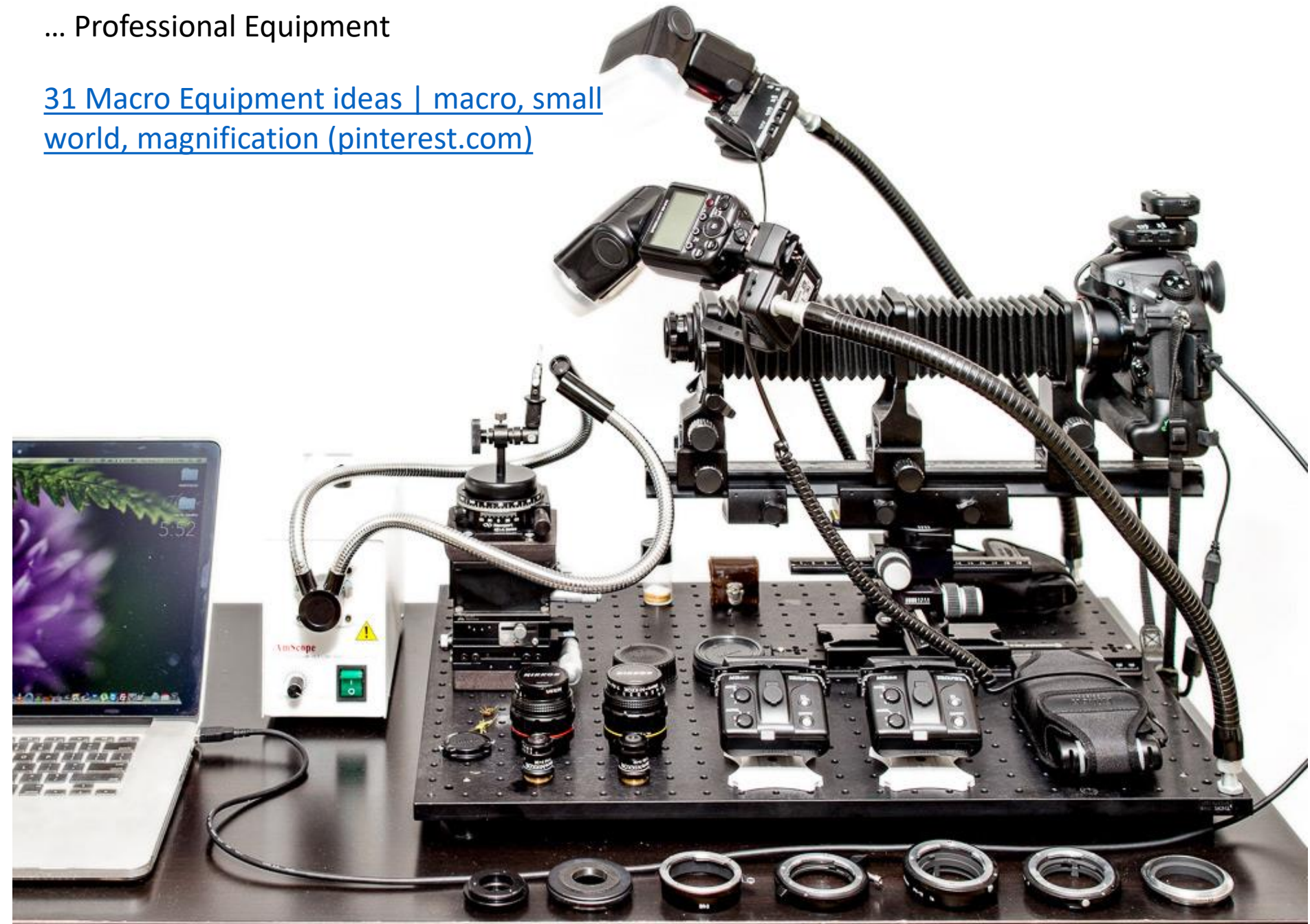
... Professional Equipment



[Super Macro Photography - Up Close with Greater Depth. | Macro photography equipment, Super macro photography, Macro photography \(pinterest.co.uk\)](#)

... Professional Equipment

[31 Macro Equipment ideas | macro, small world, magnification \(pinterest.com\)](#)



End