

Manchester Microscopical & Natural History Society

Microscopy

Present & Future?



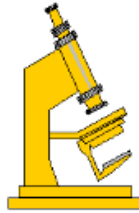
141st Year !



Mike Mahon
(President)
December 2020
On Zoom



MMS Website



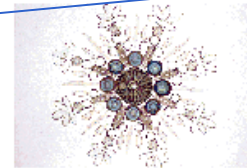
Manchester Microscopical & Natural History Society



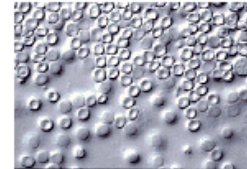
Established 1880
www.manchestermicroscopical.org.uk



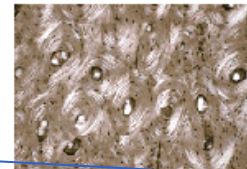
- [Welcome](#)
- [History](#)
- [What's New](#)
 - [Butterfly Eye Scans \(Simon Berry\) 2020](#)
 - [Microscope Setup Award Winner 2008](#)
 - [Microscopy FAQs - 2020 \(Recommended\)](#)



- [Meetings \(2020-2021\) 141st year!](#)
Meetings on Zoom due to Covid-19 pandemic



- [Officers / Members](#)
- [How to Join](#)
- [Publications](#)
- [Micro Miscellanea Newsletter](#)
 - [May 2020](#)
- [Library](#)
- [Images & Slide Collection](#)



- [JB Dancer \(MM Talk 11mb\)](#)
- [Books / References](#)
- [WWW Links](#)

Covid-19 Warning
[Dancer \(1869\) says ...](#)
TAKE CARE there are GERMS in the AIR!

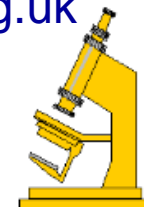
NEW! Whole Website Updated 2020 **NEW!**

www.manchestermicroscopical.org.uk



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Last Updated 9 November 2020 ([MM](#))



Updates

Updates

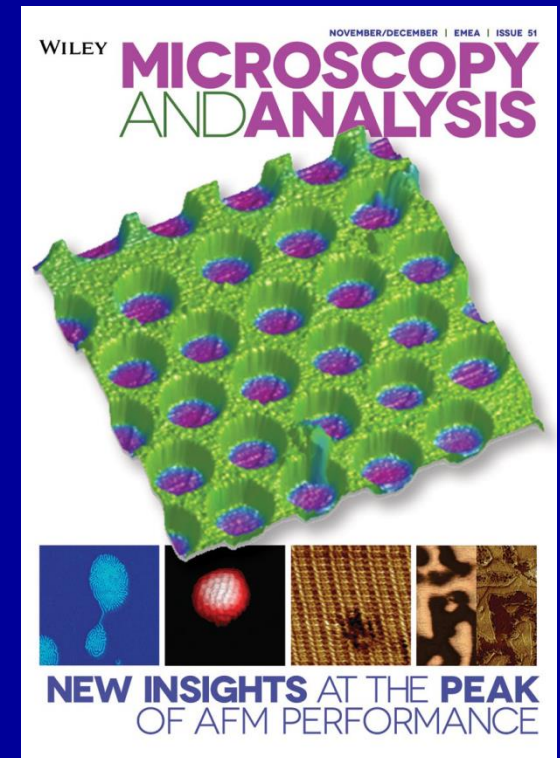
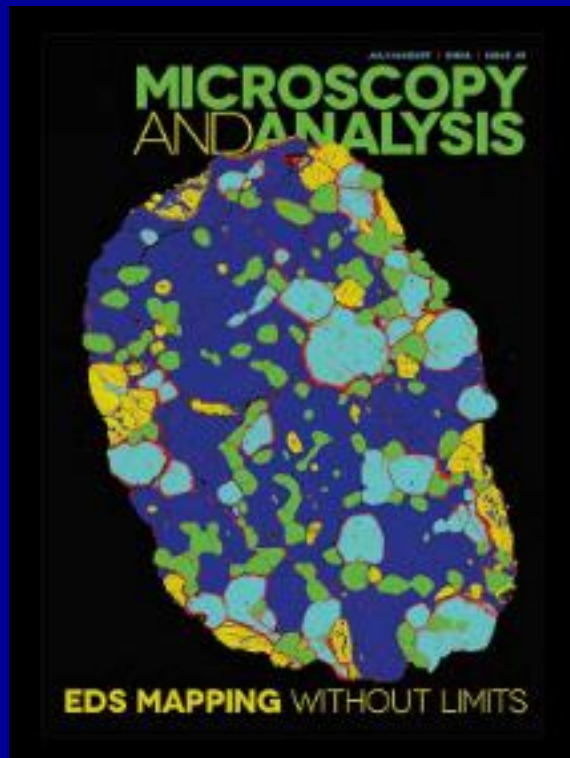
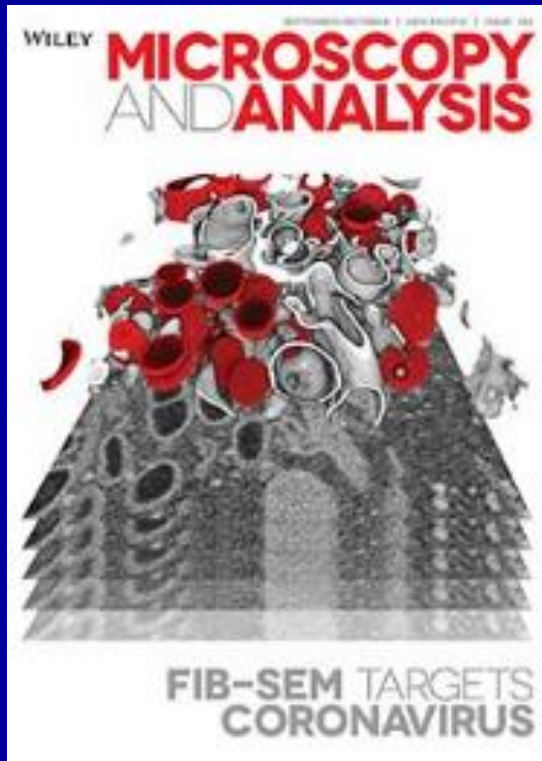
Keeping up to date ...



Microscience Microscopy Congress



Royal Microscopical Society



Microscopy Landmarks

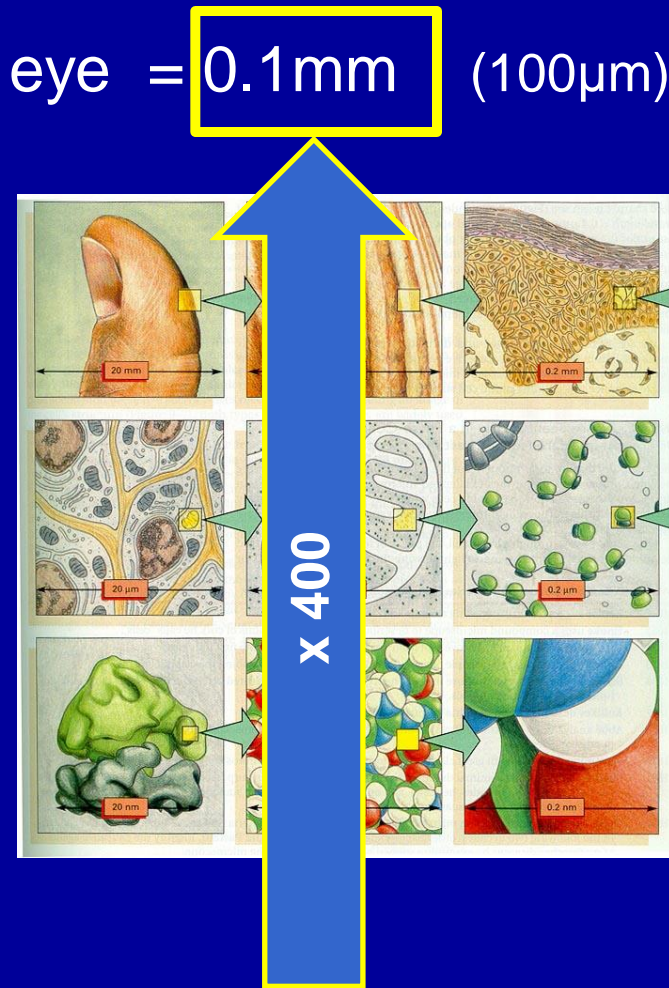
- <1600s magnifying lens
- 1600s simple microscopes
- 1650s compound microscope
- 1830s expansion of light microscopy+dg/pol
- 1900-60 UV & fluorescence microscopy
- 1930s+ phase and interference microscopes
- 1930-60 electron microscopes developed
- 1980s confocal microscopy
- 1990s-2010s scanning probe microscopies
- 2010s μ CT, super-resolution, X-ray, ???

Resolution & Magnification

Keep in mind what it is possible to see by eye = **0.1 mm** (100 μ m)

Remember Scale

			<u>Magnification</u>
m			
mm	10^{-3}		
μ m	10^{-6}	0.001 mm	x 100
nm	10^{-9}	0.000001 mm	x 100,000
(\AA)	10^{-10}	0.1 nm)	
pm	10^{-12}	0.000000001 mm	x 100,000,000
fm	10^{-15}	0.000000000001 mm	x 100,000,000,000



Best resolution of an optical microscope was ~ 0.00025 mm

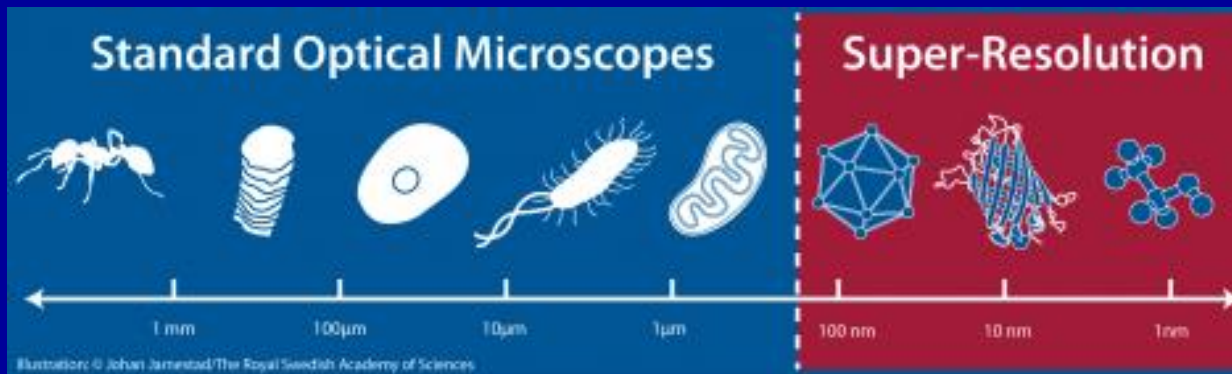
0.25 μ m

250 nm

$$r = 0.61\lambda / NA$$

-scopy

- **Macroscopy**
 - endoscopes, stereomicroscopes
- **Microscopy**
 - optical microscopes
- **Nanoscopy**
 - electron microscopes
- **Picoscopy**
 - scanning probe microscopies
- **Femtoscscopy**
 - gas ion microscopes



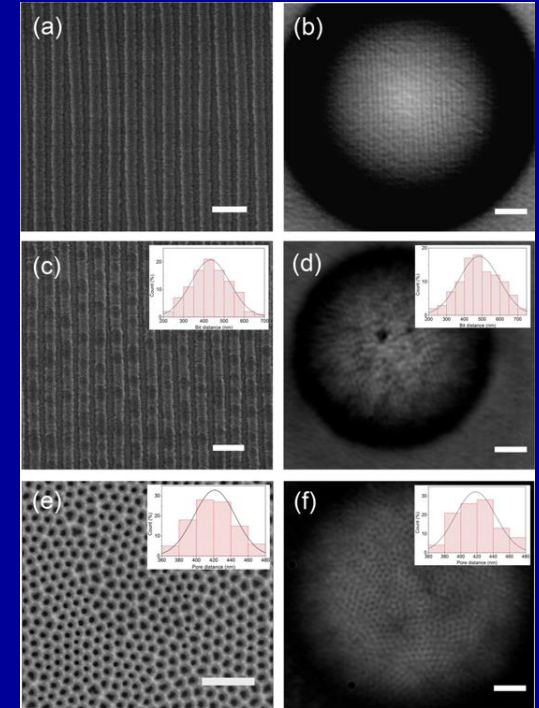
Future / or Present ?

- **Stereo > 3D**
 - tilting objectives, miniature endoscopic microscope, > mesolens ***
- **Superresolution staining** (2014 Nobel Prize) $r = < 25\text{nm}$, +VR
- **Superresolution lenses**
 - globular/microsphere, silk, metal, $n_i = 5.4$, $\times 400$, $r = 50\text{-}100\text{nm}$ / mesolens + 300mpx camera
- **4D, whole body or organ**
 - Lightsheet (multiple / correlative), CLARITY, DISCO
- **Massive Image datasets in realtime**
 - Fast 3D/4D, Holotomography, VR, 300gb/h / UV camera 0.5trillion frames /s
- **Computational Microscopy**
 - Cryo-EM***** $r = 1.2\text{\AA}$ 0.12nm,
- **Machine Learning, Artificial Intelligence, Multimodal** $\times 20 > \times 1500$ 'neural lens'
Remote Microscopy
- **Photo-Acoustic Microscopy** *** deep, 3D, living, $r = 0.2\text{-}10\mu\text{m}$, > femtosecond lasers!
- **X ray & Gas Ion microscopes** solid objects $r = 30\text{nm}$, FIB, Lithography $1.7\mu\text{m}$
- **Optical tweezers** - (2018 Nobel Prize) cell dissection
- **Nanotechnology** - microswimmers

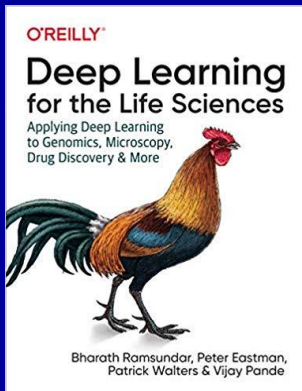
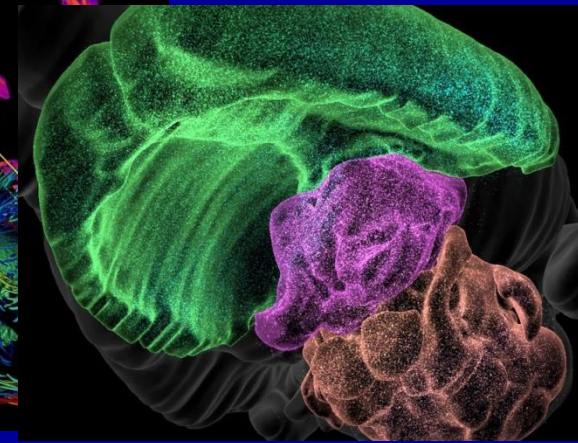
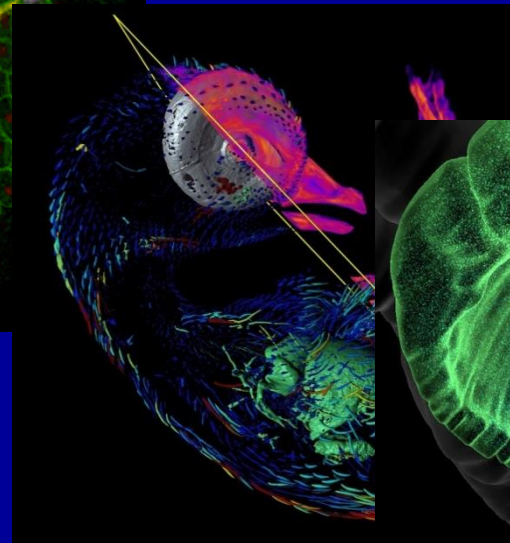
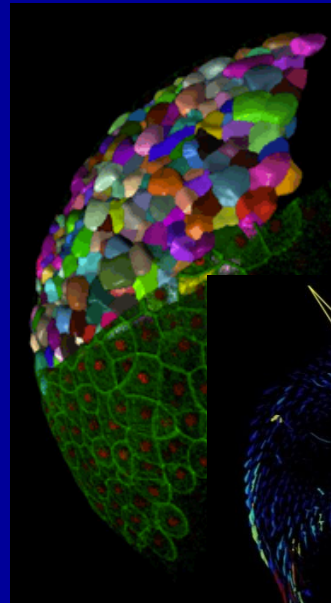
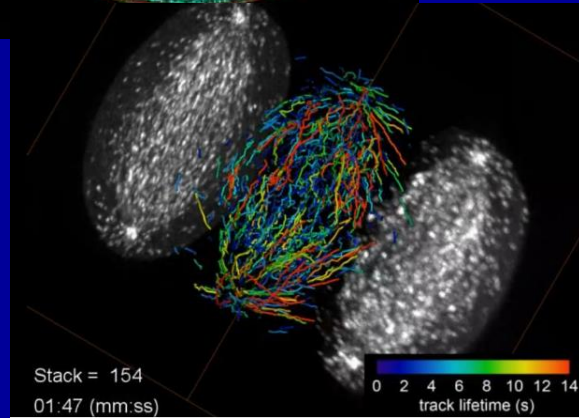
Light Sheet Microscopy



Microsphere Nanoscope



Big Image Data

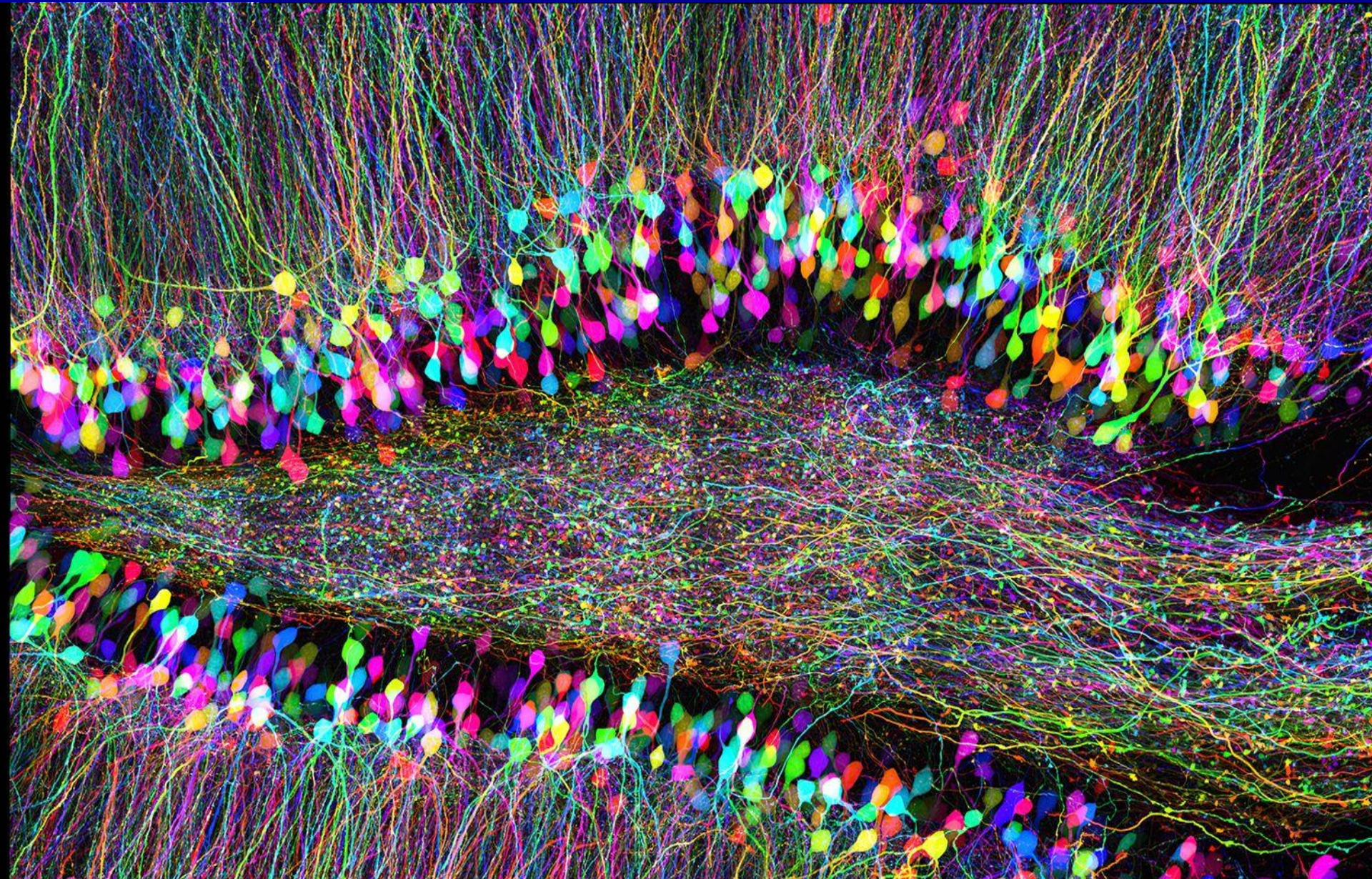


AI Microscopy



Mouse embryo in RC147

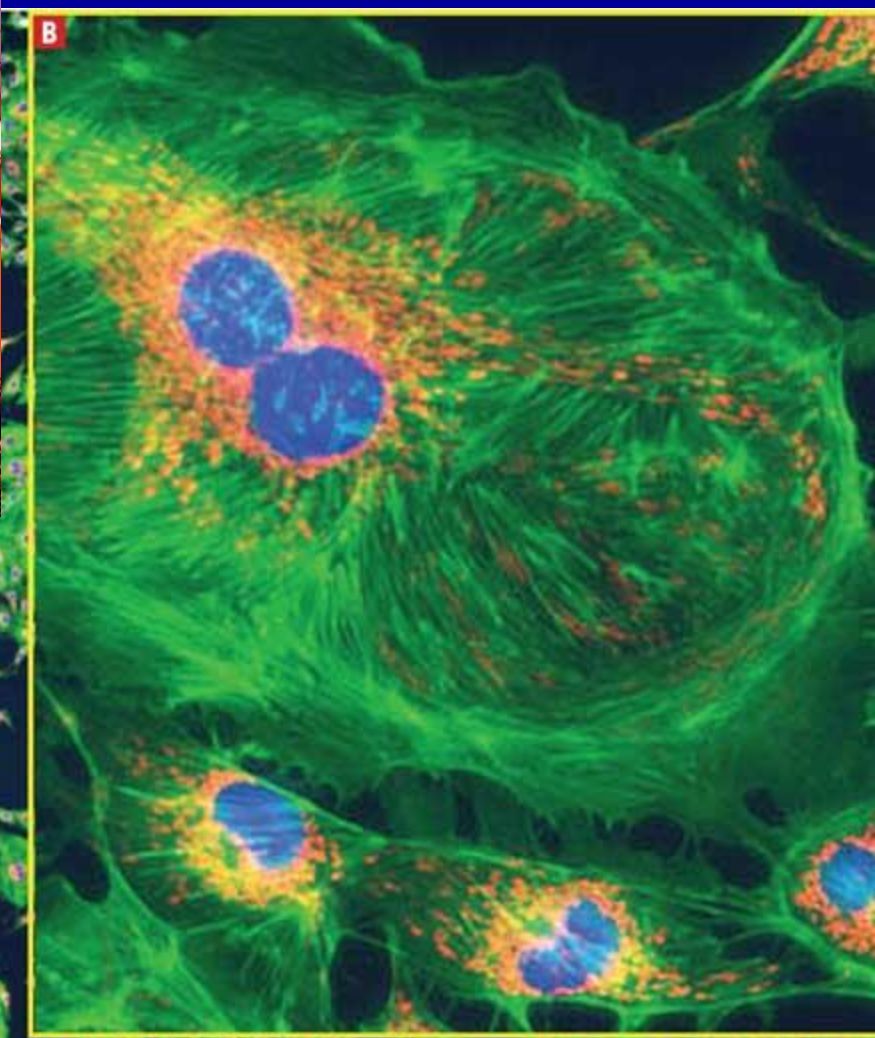
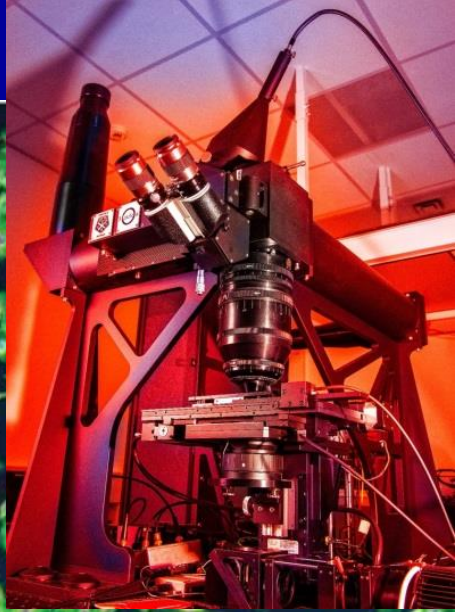
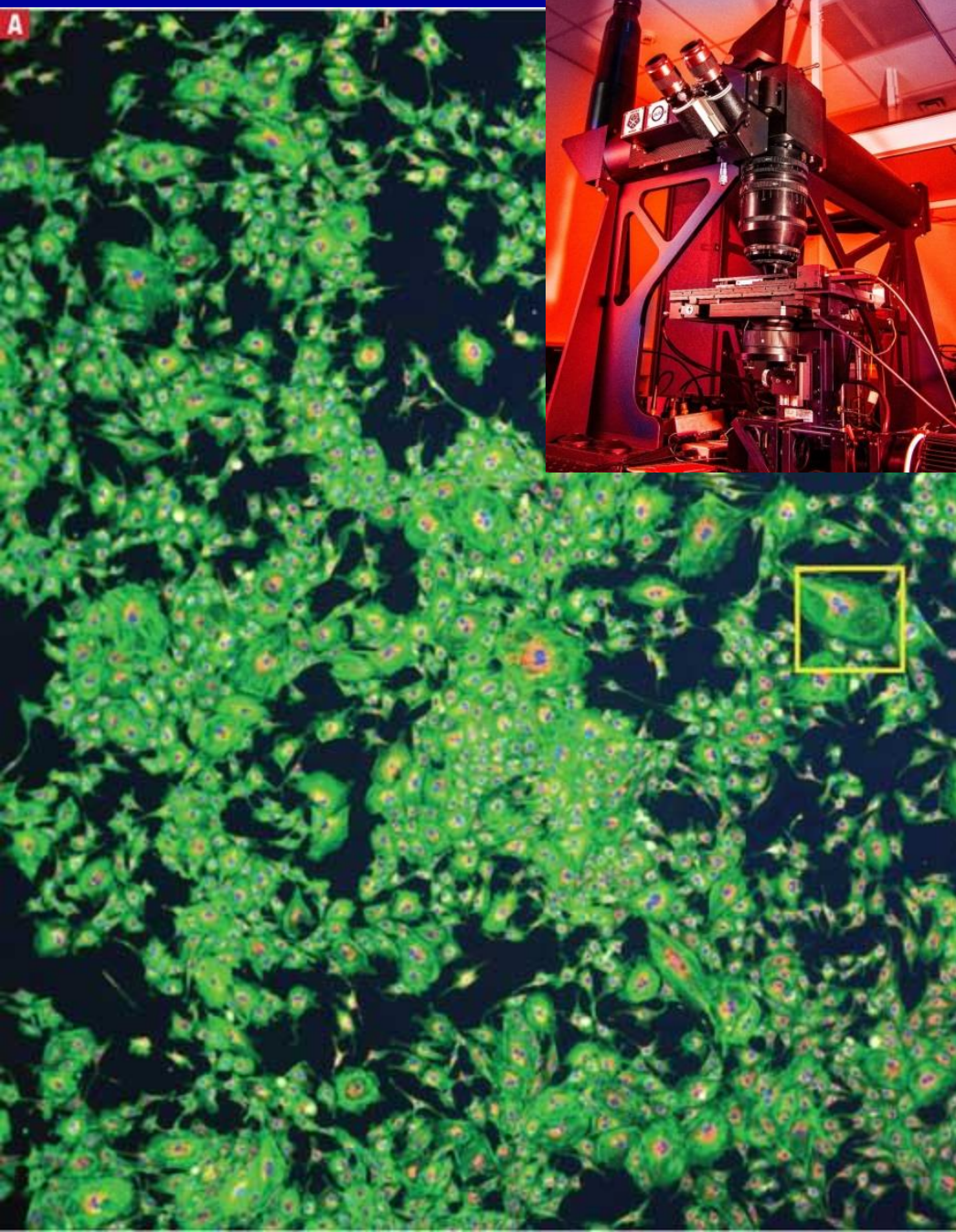
Depth coded projection image shows the E13.5 mouse embryo neuronal circuitry labeled with anti-TUJ1 antibody and cleared with CLARITY- RapiClear 1.47 reagent.



Mouse hippocampus in RC152

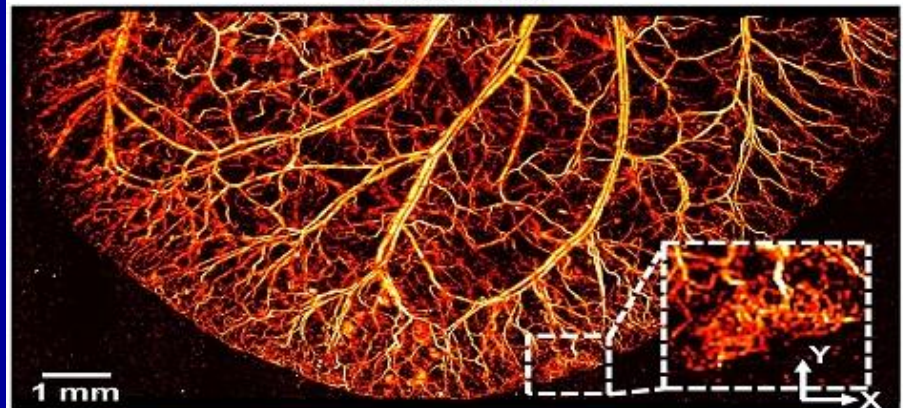
Depth coded projection image shows YFP-expressing hippocampal neurons in 550um mouse brain slices. Sample cleared with RapiClear1.52 and imaged with 63x oil lens.

Mesolens



0.5 mm

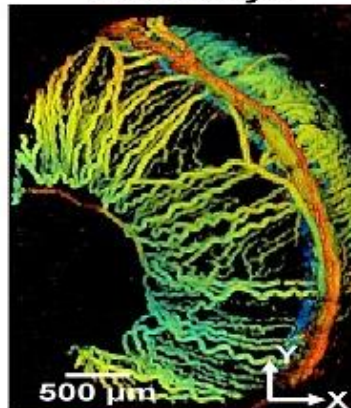
Mouse ear



1 mm

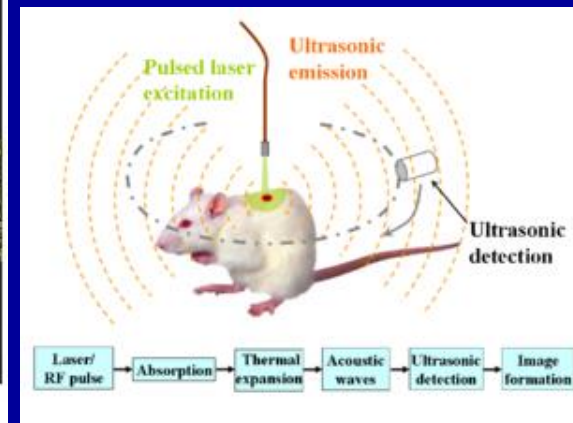
Min PA amp. (a.u.) Max

Mouse eye

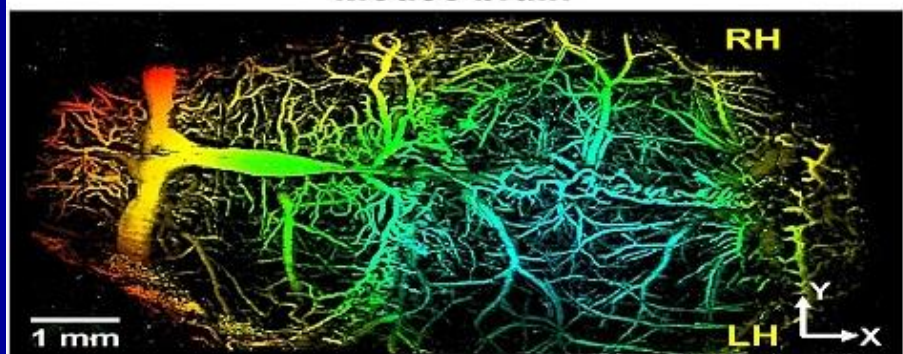


500 μm

-100 Height (μm) 200



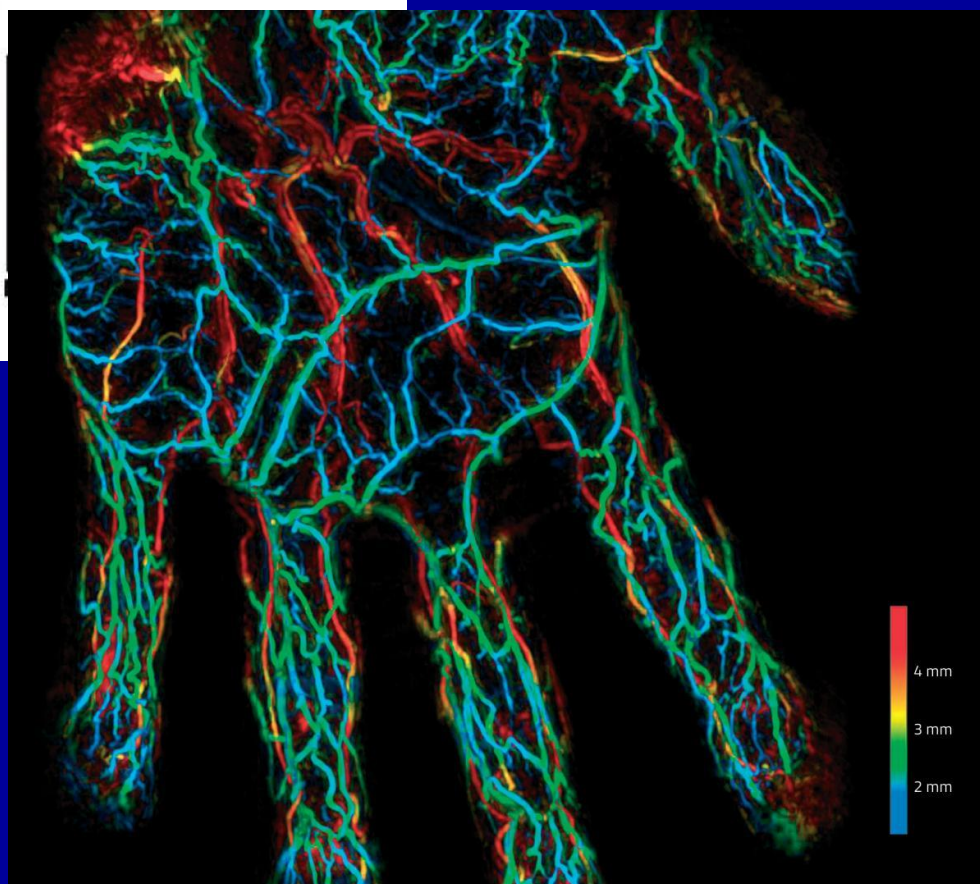
Mouse brain



1 mm

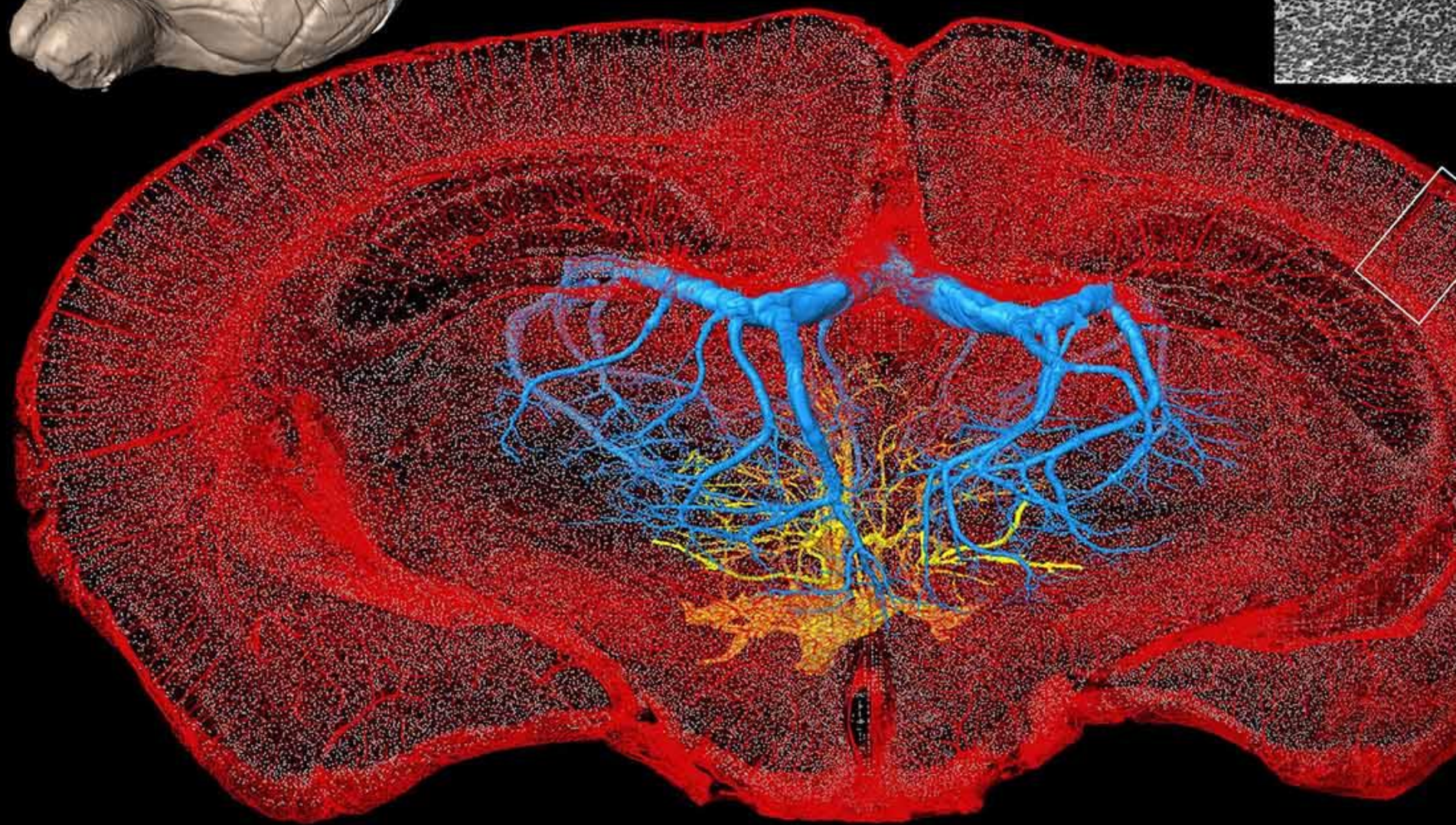
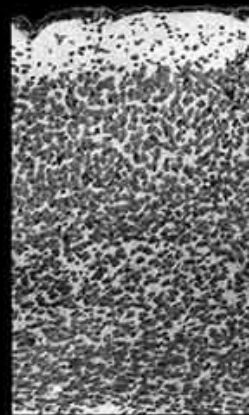
RH

LH

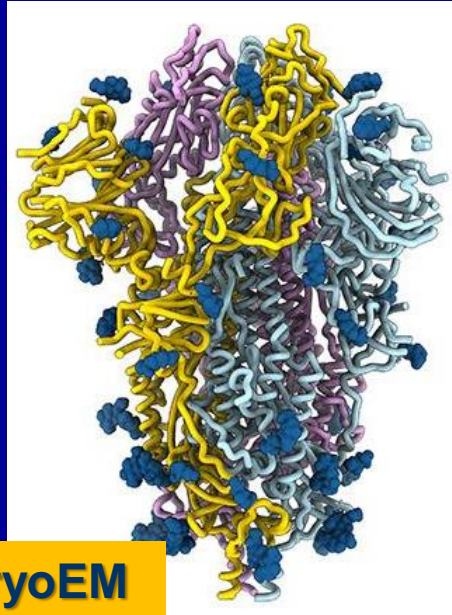
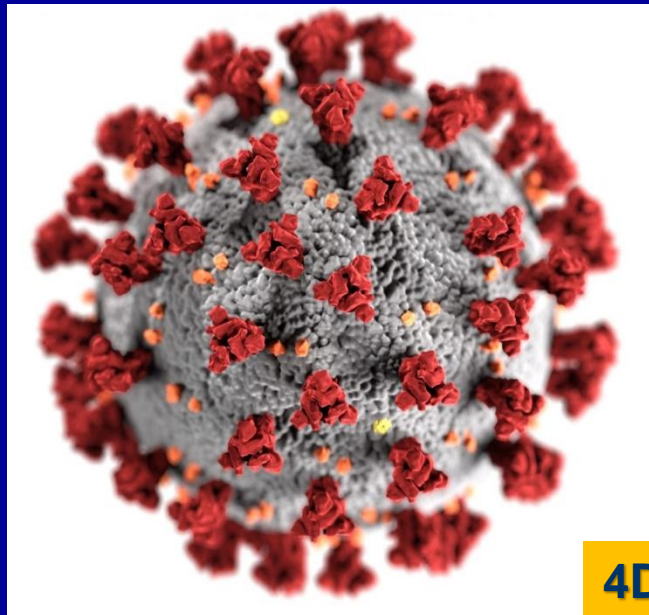
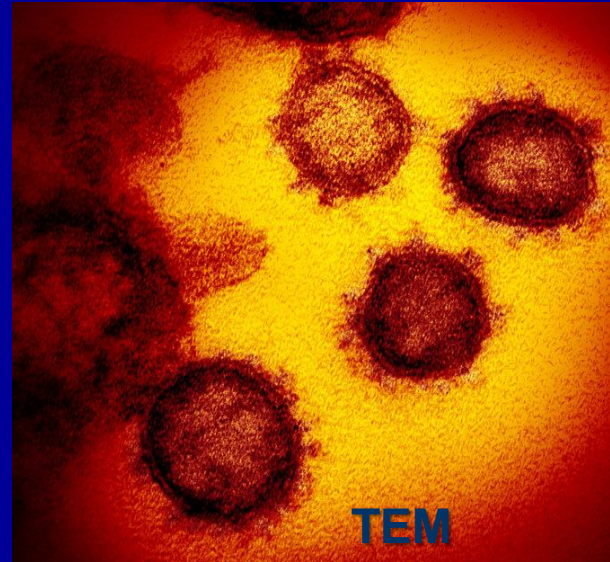
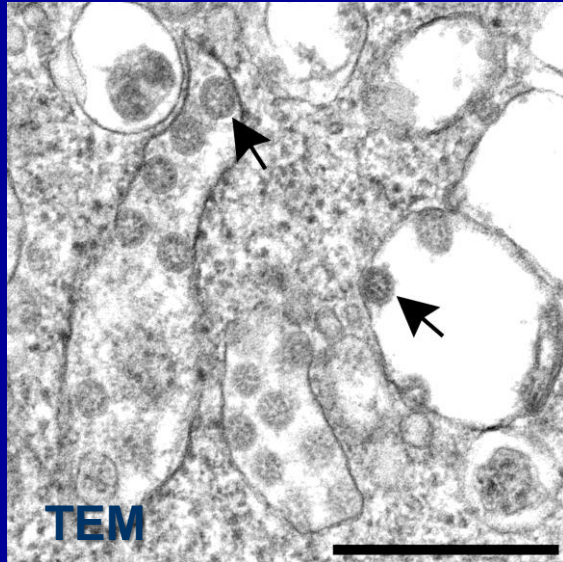


4 mm
3 mm
2 mm

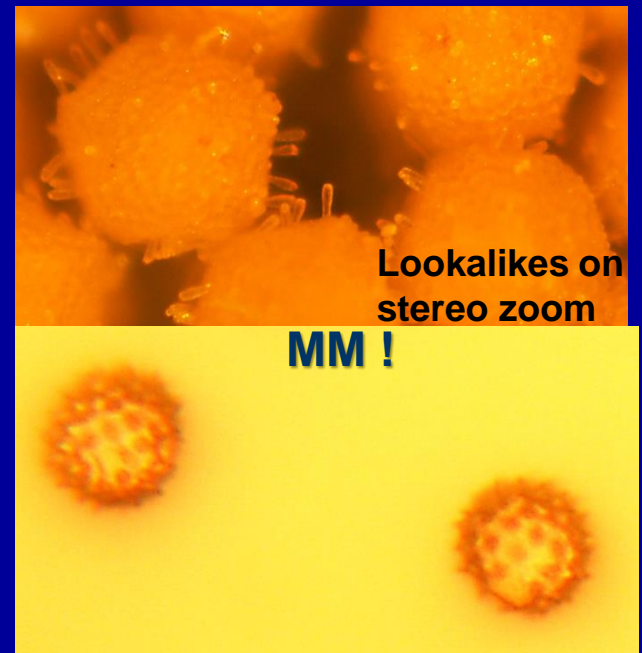
Photo-acoustic Microscopy



2020 Coronavirus (TEM, SEM, CryoEM, 4D)



4D cryoEM



The Ultimate Microscope ???



Diamond Light Beamline Facility

2007-2018 -

<https://www.diamond.ac.uk/Instruments.html>



Diamond Light Source is the UK's national synchrotron. It works like a giant microscope, harnessing the power of electrons to produce bright light that scientists can use to study anything from fossils to jet engines to viruses and vaccines.

The machine accelerates electrons to near light speeds so that they give off light 10 billion times brighter than the sun. These bright beams are then directed off into laboratories known as 'beamlines'. Here, scientists use the light to study a vast range of subject matter, from new medicines and treatments for disease to innovative engineering and cutting-edge technology.

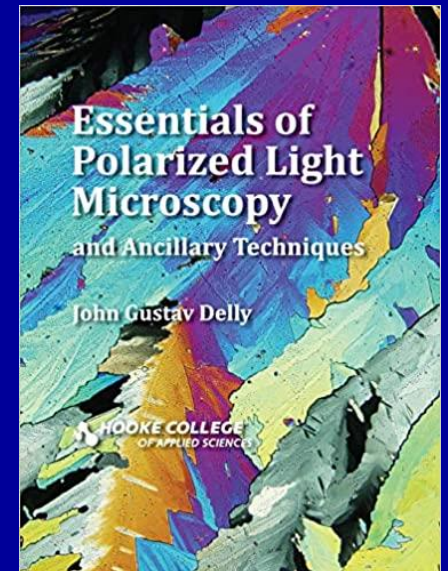
.... a machine that is 10,000 times more powerful than a traditional microscope.

How a microscope specimen sees you !!



New Reference Books ...

- Essentials of Polarized Light Microscopy and Ancillary Techniques
JG Delly
(2017) 620pp McCrone Group, £220



- Understanding Light Microscopy
J Sanderson
(2019) 848pp, RMS/Wiley, £120

