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THE PROCEEDINGS OF THE ROYAL MICROSCOPICAL SOCIETY

MAGAZINE

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Under the Microscope: an account of setting up a new public engagement initiative

Revealing the secrets of the Sands

At the heart of bioimaging: The RMS Life Sciences committee

Plus... News, Calendar, Reviews, Reports

At the heart of bioimaging: The RMS Life Sciences committee

Steven G Thomas and committee members

Microscopy and biology have always been intimately linked together. One of the driving forces for the development of the very earliest microscopes was our curiosity of the basis of life and our desire to understand it. It was a passion to discover more that drove pioneers such as Robert Hooke and Anton van Leeuwenhoek to use their simple microscopes to observe and describe cells, microscopic organisms, and structures. This curiosity still drives today's cell biologists to dig deeper into the workings of cells to better understand human health and disease, and the vital role that plants and micro-organisms play in our world.

To support and nurture this link between microscopy and biology, in 1911 the Society established the Biological Section which continued until the 1960s, when the predecessor of the current section, the Histochemical and Cytochemical Section, was formed. Today's Life Sciences section has evolved from this and it continues to promote microscopical studies of cells including the behaviour of cells and their sub-cellular components. A key aim is to recognise how the plethora of modern microscopy techniques can be used to expand our understanding of biology.

The current Life Science committee draws together a range of scientists from across bioimaging who work with a broad range of microscopes and techniques. However, they have one thing in common: a passion for biological discovery. We are always looking out for people who share this passion to join the committee - and more details can be found on the RMS website.

Below, some of our current committee members introduce themselves to you.

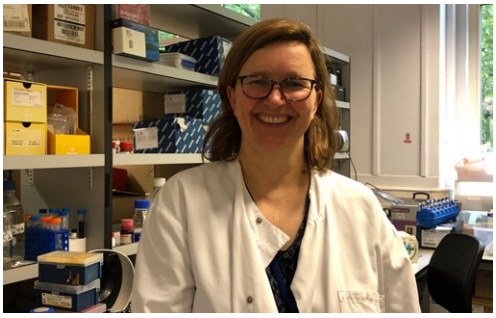
Name: Steve Thomas (Section chair)

Affiliation: University of Birmingham

Area of interest/expertise: My lab focuses on the formation and function of blood platelets and their progenitor cells, the megakaryocyte. I am interested in how the body regulates the production of ~175

billion new platelets every single day and how these cells are produced with such a high level of consistency to ensure that when blood vessels are damaged, your platelets can respond appropriately. More recently we are studying the interactions of these cells when forming blood clots and how different triggers can drive thrombi with different structures. My lab uses a range of microscopy techniques including live cell imaging, super-resolution and light-sheet microscopy to address these challenges.

What I like doing when I'm not doing microscopy: When I'm not in the lab I love being outdoors, camping and hiking in the wild places of the UK. I'm slowly working my way through visiting as many of the Mountains in England, Wales and Scotland as I can, but the list doesn't seem to be getting any shorter!

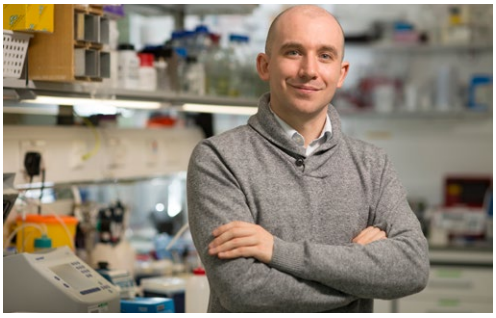


Name: Theresa Ward

Affiliation: London School of Hygiene & Tropical Medicine

Area of interest/expertise: I started my PhD at the time of emergence of GFP and capturing organelles in motion is still as potent today. We use different imaging modalities to follow host-pathogen interactions across scales, from molecules to cells to tissues to whole organisms, to better understand disease progression, host response and to investigate therapeutic avenues. Different imaging techniques include confocal microscopy, super-resolution microscopy, correlative microscopy, fluorescence molecular tomography, and whole-organism in vivo imaging. The range of infectious diseases that we investigate needs to take into account considerations of pathogen containment and how to best enable imaging of the organisms, especially live cell imaging, while ensuring the microscope users are kept safe.

What I like doing when I'm not doing microscopy: good food with good friends is always a winner. And just to sound a bit healthier like my busy colleagues in this feature, a spot of yoga - doing a handstand for the first time in 30 years was a moment of discovery.



Name: Emmanuel Derivery

Affiliation: MRC laboratory of Molecular biology, Cambridge

Area of interest/expertise: My lab focuses on the molecular mechanisms by which cells polarise their cytoskeleton, and this is used to put the right signalling molecules at the right place at the right time. Our approach is highly multidisciplinary, from reconstituted cytoskeleton systems in vitro to high-end quantitative imaging of trafficking in vivo during development in flies. To ensure we always have the right tool to address our questions, we also develop novel imaging and bioengineering tools. For instance, we have developed techniques to induce polarity in unpolarised cells using micropatterning and protein design. We also develop novel multispectral imaging modality to dissect the molecular interactome of fast cellular processes.

What I like doing when I'm not doing microscopy: I like to build stuff, in particular small electronic projects I can control with a computer.

Name: Jacquelyn Bond

Affiliation: University of Leeds (UoL) Faculty of Medicine and Health

Area of Interest/ expertise: Determining how the human brain develops and functions is one of the great scientific questions. I lead the Microcephaly and Neurogenesis Group, which explores the effects of gene mutation on the genes involved in primary autosomal recessive microcephaly (MCPH), a congenital disease of early neuronal development, characterised by reduced brain size and associated intellectual disability. As a cell biologist of >20 years, access to technology platforms that underpin our ability to understand disease processes is paramount. To this end and with the help of colleagues at UoL I have established a high-throughput, high-content library screening process for siRNA, miRNA and small molecule screens. In our investigations into the processes controlling neurogenesis we have relied heavily on confocal, widefield, super resolution, live cell imaging and high content, high-throughput microscopy. Resulting scientific contributions have included: identification of three centrosomal/spindle pole associated disease genes for MCPH including the assembly factor for spindle microtubules (ASPM) gene, mutations in which are the most common cause of MCPH; determining ASPM roles in cytokinesis and spindle orientation processes which are crucial in controlling the ratio of neuronal progenitor cell to neurogenic proliferation in early neurogenesis; identification of ASPM interacting proteins and regulatory proteins and how ASPM is dysregulated in epithelial ovarian cancer and correlates with tumour grade, cancer progression and survival.

What I like doing when I'm not doing microscopy: I spent my pre-university life living in Devon, so I love being by water or surrounded by hills. I enjoy open water swimming with my friends (but not in winter!), and body boarding/fossil hunting with my teenage sons.

Name: Mark Rigby

Affiliation: Advanced Imaging Manager, Nikon Healthcare UK

Area of interest/ expertise: I have a background in neuroscience research using electrophysiological and microscopy approaches in both London and Kyoto where my research centered around studying changes in voltage in neurons and how these changes impacted neuronal function. A transition to Nikon healthcare meant I provided high end microscopes, as well as application support, to researchers studying a variety of biological questions. This role has greatly expanded my knowledge of different scientific areas. I now relish the opportunity to help researchers make the most of their confocal/multi-photon/TIRF/SMLM experiments and incorporate smart analysis into their acquisition routines.

What I like doing when I'm not doing microscopy: Outside of microscopy I enjoy taking my young children to the trampoline park, and rides out on our bikes. I play squash, football and hockey at a very social level, and like meeting friends in London for runs along the river, and occasionally a beer afterwards.

Name: Alessandro Di Maio

Affiliation: University of Birmingham (Microscopy Facility)

Area of interest/

expertise: My Area of interest is mainly Light Microscopy with applications of LS Confocal, Widefield and Lightsheet microscopy. In my research career I have taken a multidisciplinary approach to science that has allowed me to acquire skills that range from histology to genomic. Those skills have been implemented by a number of microscopy and imaging applications (in vivo and in vitro) resulting in a good level of experience in scientific research. As a facility lead member, my interests widen between experimental design, imaging acquisition and analysis with several components of management and strategy plans. With a Cell Biology background, my main activities currently focus on biological and biomedical applications but with the benefit of working within a multidisciplinary environment, the interests also extend to more specialised microscopy applications within the engineering field.

What I like doing when I'm not doing microscopy: Outside the scientific world I'm an active musician. I'm currently involved in an indie-melodic music project which will soon lead into the publication of new material, and two jazz projects that often lead into live performances.

Name: Periklis (Laki) Pantazis

Affiliation: Imperial College London, Department of Bioengineering

Area of interest/expertise: I enjoy being able to see the processes of life unfold in real time. Much like a painting, sculpture, building or another form of art, it empowers us, as an audience, to understand and empathise with the subject matter. Developing imaging methods allows us to consume the inner workings of biology consciously and mindfully, from proteins to whole organisms. I am therefore very fortunate to be able to pursue my passion through my work: the introduction of advanced imaging tools and automated instrumentation is the main focus of my laboratory, which enables us to apply imaging for hypothesis-driven research and high-throughput analysis. Specifically, we develop advanced imaging technologies to establish an effective acquisition and interpretation workflow i) for the mechanistic analysis of biological systems in animal models such as mouse and zebrafish and ii) for use in novel diagnostic and therapeutic strategies. Notable contributions include precise conversion of non-toxic labels in 3D, GenEPi (mechanical force sensor reporting Piezo1 function) and bioharmonophores (biocompatible/ biodegradable nonlinear imaging probes).

What I like doing when I'm not doing microscopy: I love to go running with my wife in beautiful Richmond Park and Bushy Park which are close to where we live. Together with our kids we enjoy visiting art exhibitions, events in museums and great food in London as well as around the world.

Name: Morag Rose Hunter

Affiliation: AstraZeneca UK

Area of interest/ expertise: I specialise in designing and running high throughput, high content cell imaging assays. Currently I do this for target identification screens (mostly arrayed CRISPR in 384-well plates) with complex imaging and machine learning / artificial intelligence-based analysis techniques. I was trained as a molecular pharmacologist and used my first

automated microscope during an undergraduate research project. My experiments got larger and more ambitious during my PhD and postdoc years, cementing my love of automation. Nowadays I work on a wide variety of cell biology projects, but my favourites are those related to cellular membrane trafficking and RNA therapeutics. I also support a number of automated confocal microscopes and dozens of active users to ensure that imaging can run 24/7.

What I like doing when I'm not doing microscopy: I enjoy long-distance running, mostly half and full marathons. In the summer I'll go off-road, but I am not a fan of mud!

Name: Claire Wells

Affiliation: King's College London (KCL)

Area of interest/ expertise: I lead the Invasion and Metastasis Research Group at KCL which studies how cancer cells are able to dissociate from the primary tumour, invade the surrounding tissue and subsequently metastasise to distal sites. Tissue invasion and migration require cancer cells to reorganise their actin cytoskeleton as well as adhere to and degrade the surrounding extracellular matrix. It is well established that cytoskeletal rearrangement, cell adhesion formation and turnover is regulated by Rho GTPases, Rho, Rac and Cdc42. PAKs are serine/ threonine kinases that operate downstream of Rho GTPases to control cytoskeletal organisation and substratum adhesion. The PAK family can be sub-divided into two groups; Group I PAKs (1-3) and Group 2 PAKs (4-6) based on sequence homology and members of both groups are activated by growth factor signalling pathways. We use live cell imaging, biochemical and molecular approaches to investigate the role of PAK family kinases in cancer cell migration, adhesion and invasion. We use both brightfield and fluorescence microscopy to study cancer cells alongside more advanced imaging modalities such as confocal microscopy, super resolution microscopy and light sheet microscopy. My research work is balanced with teaching activities and my role as Faculty Associate Dean for Doctoral studies.

What I like doing when I'm not doing microscopy: When I'm not working, I like to attend Zumba dance classes, watch movies and spend time with my friends and family. We enjoy countryside walks and going to music festivals, although I'm not particularly keen on camping.

Name: Stefan Linder

Affiliation: University Medical Center Hamburg-Eppendorf, Germany

Area of interest/ expertise: I am a cell biologist by training and I am fascinated by observing and unravelling the inner workings of cells. My group studies molecular mechanisms of cell adhesion, migration, invasion and phagocytosis. Favourite cell type: the primary human macrophage. Favourite organelles: podosomes, the primary adhesion and invasion structures of macrophages, and phagosomes, particularly in the context of Borrelia internalization. Favourite structures: the actin and tubulin cytoskeletons, especially their interaction. Favourite techniques: live cell imaging and super-resolution microscopy, in combination with image analysis (often self-developed). Favourite motto: beautiful images and hard numbers.

What I like doing when I'm not doing microscopy: Running, reading, cooking (mostly not simultaneously).

Name: Ferran Valderrama (Section deputy chair)

Affiliation: St George's University of London

Area of interest/ expertise: Our lab is interested in understanding the biology behind the development and progression of cancers of glandular origin, particularly prostate cancer. Over the years we have developed three-dimensional (3D) cell culture systems that aim to mimic the glandular structures of the prostate and their modifications at the structural and molecular levels, as they acquire different malignant status. We use a wide range of cell and molecular biology techniques to interrogate our 3D models and visualise the outcomes via different imaging techniques including live bright field, widefield fluorescence, confocal and single plane illumination microscopy. We have identified a set of molecular pathways affecting cell polarity that appear to be key players in determining the progression of prostate cancer; our final aim is to identify possible targets for therapeutics that may reduce or potentially reverse the progression of the disease.

What I like doing when I'm not doing microscopy: When I'm not working, I like to spend time with my family – I have two boys that enjoy playing football so, my evenings and weekends tend to be invested in travelling across (mainly South) England to bring them to their training or matches. I also like running, so when I'm not taxiing, I like to go for a run!!

Name: Steve Briddon

Affiliation: University of Nottingham

Area of interest/expertise: I am a molecular pharmacologist, with a particular interest in the G protein-coupled receptor (GPCR) family. I ventured into microscopy around 20 years ago as a way of finding out how these cell surface receptors are organised in the membrane, and how their cellular location affects their interaction with signalling molecules, ligands and drugs. Initially this was focused on model systems, but increasingly we have been developing approaches with novel probes and genetics to look at endogenous receptors in cells and primary systems to look at receptor organisation at low levels of expression. To do this, in addition to pharmacological techniques and probe development, we use a range of live cell microscopy and spectroscopy approaches including fluorescence correlation spectroscopy and related techniques and confocal, TIRM and super-resolution microscopy.

What I like doing when I'm not doing microscopy: I'm a keen amateur photographer, so am never happier than when behind a lens (and never less happy than in front of one!). Reading, music, cricket and rugby (sadly now as a spectator) fill any remaining spare time.

Name: Liam Rooney

Affiliation: University of Strathclyde

Area of interest/expertise: My background is in mammalian cell and molecular biology, but since starting my PhD I fell in love with microbes - how they communicate across length scales, how they traverse their environments, and how they colonise their respective niches. However, routine imaging methods weren't suitable for a lot of the problems I was interested in answering. My main interests lie in the structures formed by dense microbial communities, called biofilms, which pose a significant threat in infection, industrial biofouling, and antimicrobial resistance (AMR). I discovered a system of complex transport channels deep inside these microbial cities during my PhD thanks to the application of the Mesolens to microbiology and, since then, I've continued to research these channels and their function alongside my funded research.

My current research aims to develop new manufacturing and characterisation methods for 3D printed lenses, capable of performing similarly to glass lenses, but at a fraction of the price and with open access principles at the forefront. The 3D printed lenses I've created have comparable transmissivity, optical performance, and surface profile to their expensive glass counterparts. Moreover, the barrier to entry for 3D printed optics remains low - using low-cost consumer-grade printers and commonly available resources to create high-quality lenses with open-source design specifications. We hope that 3D printed lenses will be combined with other open hardware initiatives to democratise access to high-quality optics for rapid prototyping and clinical diagnostics in low-resource settings.

What I like doing when I'm not doing microscopy: I find cooking and baking really therapeutic and a great way to tune out. We built a pizza oven in our garden last summer. I'm hoping to refine my skills before the good weather returns, then it's pizza parties all round! I also love skiing and try to get up to Nevis/Glen Coe/Cairngorm slopes as much as possible. I'm just back from a great trip to the Dolomites in Northern Italy, which was also a great excuse to buy a snazzy 1980s-themed ski suit!

Name: Anjali Kusumbe

Affiliation: University of Oxford

Area of interest/expertise: I investigate vascular-tissue and vascular-immune interactions during aging, regeneration, and metastasis. My research approach is highly multidisciplinary, and we utilise cutting-edge high-resolution tissue imaging techniques, including intravital imaging, and innovate novel methods for imaging. Notably, our pioneering work has advanced clearing and imaging methodologies tailored for large and calcified tissues. Moreover, my laboratory has built extensive tissue maps elucidating vascular and matrix markers across ages, offering an invaluable and freely accessible resource.

What I like doing when I'm not doing microscopy: When I'm not engrossed in microscopy, you'll find me indulging in the world of movies, cooking, or some much-needed sleep.