UK SCIENCE AND INNOVATION NETWORK IN USA

A Special Scientific Relationship: Strengthening the Eight Great Technologies through International Collaboration

Earlier this year, David Willetts, the Minister for Universities and Science, identified "Eight-Great Technologies" in which the UK can become a global leader: Agri-Science, Big Data, Regenerative Medicine, Advanced Materials and Nanotechnology, Synthetic Biology, Robotics and Autonomous Systems, Energy and Energy Storage, and Commercial Applications of Space. Ensuring the UK is at the forefront of these technologies will require strong international collaboration and UK scientists working together with the best in the world. The UK Science and Innovation Network (SIN) supports this by working with eminent scientists abroad to try and help remove some of the barriers to international scientific collaboration. A reflection of the strength of UK science is that there are many British scientists in prestigious positions abroad. This helps SIN tremendously in achieving its goals of promoting UK science and facilitating collaborative research in support of HMG's agendas for prosperity and growth. Los Angeles and SIN Chicago interviewed two leading British scientists who are currently working in the United States in the "Great Technologies" of Regenerative Medicine and Nano-Technology.

Dr Andrew McMahon
Director, University of Southern California Broad Center for Regenerative Medicine and Stem Cell Research

Interview by Sally Mouakkad, SIN Los Angeles

Q: What attracted you to your current post at the Broad Center?

A: The opportunity to harness the full potential of the University towards a collective goal of regenerative medicine. At a scientific and translational level, regenerative medicine engages basic researchers, engineers, clinicians and computational scientists. The biological processes involved provide compelling examples for our educational mission that resonate from high school student to clinician. Questions raised by research and its application have ramifications well beyond biomedicine to business, law and public policy. Regenerative medicine is the type of global challenge that is the lifeblood of a great University.

Q: What are the greatest challenges in US-UK collaboration in this field of research?

A: The simplest is funding. Why should any investigator put time and effort into developing any partnership that has no sustainable future? If there is to be success in fostering collaborations, this has to be underpinned by funding that is earmarked for this. Given a means by which collaboration might be fostered, other issues raise their head – intellectual property sharing, regulatory body oversight and of course distance – there remains no substitute to face-to-face meetings for cementing collaborations.

Q: Where is there the greatest opportunity to strengthen US-UK relations in this field, and what mechanisms would you recommend?

A: A Funding mechanism that challenges UK and US scientists to develop teams that are greater than the sum of the parts with translational regenerative medicine as the clear target. The difficulty here is what is this word "translational". Not all regenerative medicine is ready for the patient. Retinal pigment epithelial implants for macular degeneration are. Cell transplantation for chronic kidney disease is not. We should not hobble the development of new therapies for the broad range of degenerative diseases by insisting that all funding ends up at an in patient end-point. At the same time we should ensure that the patient is clearly part of the basic research strategy. Meetings help to develop funding mechanisms to support trainees moving across countries. Clinical research is generally stronger in the US where the physician scientist has been a strength of the medical system. Enabling young clinicians in the UK with a strong interest in the research pipeline to train in the US would be particularly useful. Regenerative medicine should be a target for bringing in the brightest of this group.

Q: What project are you currently undertaking?

A: Personally, developing approaches to tackle kidney disease. There are no effective therapies aside from a kidney transplant to treat chronic kidney disease. We know how the kidney works, we know how the machine is formed during development, but we don't know as much about the normal systems that maintain kidney function and repair acute damage. The normal mechanisms of kidney development, maintenance and repair, provides knowledge for designing new therapeutic approaches to treat kidney disease.

Q: What's the greatest future challenge in the regenerative medicine and stem cells field?

A: To turn knowledge into cures. To change the therapeutic options available to treat injury and disease. Regenerative medicine may employ cells directly to treat disease – the bone marrow transplant is a familiar example. But, equally, regenerative medicine utilises stem cell approaches to model disease, increasingly with the use of patient specific cell types that can replicate disease in a dish. There is enormous potential to gain insights from this type of disease modelling and to develop screens for drugs and biologics in well controlled laboratory conditions with the right model. The approaches underpinning regenerative medicine have made man the primary model system. Up until now we have used surrogate systems in the hope that they reproduce human biology. The limit is our ingenuity to model our own systems ex vivo.

Dr Amanda Petford-Long
Director, Centre for Nanoscale Materials, Argonne National Lab

Interview by Jack Westwood, SIN Chicago

Materials scientist Dr Petford-Long moved from Oxford to Argonne National Laboratory in 2005 and has been Director of the Center for Nanoscale Materials (CNM) for 3½ years. Dr Petford-Long is a Fellow of the Royal Academy of Engineering and maintains strong ties to the UK.

Q: What attracted you to Argonne and your current position?

A: Argonne was looking to expand their electron microscopy efforts to maximise their strong research in magnetic materials. The opportunity was a great fit for me as there is a large concentration of this research at Argonne and at nearby Northwestern University and the University of Chicago. I was lucky enough also to be able to take a Professorship at Northwestern that allowed me to continue teaching, which is something I loved at Oxford. The CNM has been a perfect fit for me – I have my own research group, which works on magnetic and ferroelectric nanostructures and microscopy and I am close to many of my major industrial collaborators.

Q: What are nanoscale materials and why study them?

A: At a very small, or "nano" scale, materials behave differently. The study of nanomaterials is much more than miniaturisation – we are discovering how changes in size change a material's properties. For instance, red stained glass actually contains gold nanoparticles that alter the wavelength of light as it passes through. Sunscreen contains nanoparticles of titanium oxide that interact with light and prevent UV reaching the skin. Research efforts over the past decade have enabled us to make single nanoparticles – current research efforts are focused on putting different nanoparticles together to make devices and turn nanoscience into nanotechnology.

Q: Nanoscience was recently identified as one of the "Eight Great Technologies" that Britain excels at – what challenges will nanoscale materials help solve?

A: When you look at the list of the 8 technologies, nanoscience really does cut through all of them, and will truly help solve grand challenge problems. Energy is a big one for us. By reducing the distance that electrons have to move, nanomaterials will produce batteries with greater storage capacity. It turns out that the smaller things get, the bigger instruments you have to use to look at them and the more data you produce – CNM is therefore generating truly "big data" and managing this is a huge priority. Nanoscience is also important outside the physical sciences – we are helping to develop a novel cancer treatment with nanoscale magnetic discs which attach to tumour cells and destroy them. So our scope of work at CNM is pretty vast!

Q: What makes the CNM unique and how does it compare to other research facilities?

A: CNM is one of the Department of Energy's scientific user facilities – we provide free expertise and access to our equipment to around 450 industry and academic users per year from all over the world. To gain access, users write a short peer-reviewed proposal. If approved, there is free access providing research is published in the scientific literature. What's unique about the CNM is that users gain not only access to equipment but also expertise of world-leading scientists who will add value and provide support to the projects.

Q: How international are the activities? What is the extent of the interaction with the UK?

A: We have a very international base of users and currently have 18 projects from 7 UK institutions – although we would like to encourage more, especially from industry. The challenge is in letting the international community know about our capabilities, and that it's free for researchers to use. Prof Greg Wurtz from King's College London was formerly chair of our users' executive committee and is currently working with a researcher here to set up a joint student programme between Argonne and King's College London. It would be great to see more UK researchers using the CNM as we have a concentration of facilities and expertise that is not available in universities. Perhaps this is something the Science and Innovation network will be able to help us achieve.

Q: How similar or different is the way science in done in the UK vs the US and how do they complement each other?

A: In the universities, there's a lot of similarity. There is a realisation in both countries that it is now difficult to work in isolation: the days of a single researcher bravely fighting alone are largely behind us. A key difference is the extensive network of National labs in the US, and I believe this is an excellent way to do research. Team science and establishing a critical mass of researchers in one place allows us to work together to solve grand challenge problems. The main commonalties in both countries are the desires to discover, learn and train the next generation of scientists.

Q: Physics can be a difficult subject to engage the public with. How important is outreach in your work?

A: We take outreach very seriously and are committed to engaging with the public. Argonne has held open days where the public can come on site and see firsthand what we do – these have attracted up to 20,000 visitors in a single day! At CNM we participate in "Introduce a Girl to Engineering Day" where young women are linked up with a mentor at CNM and given projects to work on – we hope to inspire young women to consider the physical sciences as a career choice. We also engage with politicians and dignitaries, which is an important part of our work – we recently gave a tour to the Chicago's British Consul-General and we hope to use opportunities like these to build our links outside the US.

Q: Some of the best outreach sometimes comes from more unusual activities – CNM recently helped to solve one of Art History's great debates – how did this come about?

A: We teamed up with the Art Institute in Chicago to figure out what kind of paints Picasso used –a longstanding debate amongst Art Historians. A tiny flake of paint was removed from one of Picasso's pieces and given to us for analysis. We used our unique X-ray nanoprobe to look at the composition of the paint in the flake which revealed that Picasso had used ordinary house paint rather than more expensive artists' paint and solved the mystery!