

DEBATE SUMMARY

Making the most of UK/China research and innovation partnerships

Held at The Royal Society on 11th June, 2014

The Foundation is grateful to BP, the Catlin Group, Lloyd's of London,
and the Michael John Trust for supporting this debate.

The hash tag for this debate is #fstchina .

A round-table discussion on the same theme was held in the afternoon of 11th June.
The report of the round-table discussion is at the end of this report.

Chair: **The Earl of Selborne GBE FRS**
Chairman, The Foundation for Science and Technology

Speakers: **Professor Anthony Cheetham FRS**
Treasurer and Vice-President, The Royal Society
Michael Kwok
Main Board Director and Head, Shanghai Office, Arup
Professor Robin Grimes FREng
Chief Scientific Adviser, Foreign and Commonwealth Office
The Rt Hon David Willetts MP
Minister of State for Universities and Science
Department for Business, Innovation and Skills

PROFESSOR ANTHONY CHEETHAM said that developing links with the emerging economic powers, including China, was a strategic priority for the Royal Society. A recent visit to China, which had included Sir Paul Nurse, had been a resounding success. Academic collaboration with China was highly desirable because China was developing into one of the leading scientific nations in the world. The volume of scientific publications from China was now second only to the USA; and its quality, judged by publications in leading journals, was rapidly improving. It was stronger in some fields (e.g. chemistry) than others. But on current trends China would rapidly overtake the UK across the board. It was already ahead (and overwhelmingly so) in publication and citation data for chemistry.

A large proportion of the best science in China was carried out by the Chinese Academy of Sciences institutes; but a smaller number of universities had strengths in research. Fudan University was, for example, ranked at 96 in Physical Sciences in the 2014 'Leiden Ranking', slightly ahead of Edinburgh and Durham. (Bangalore was the top Indian university in the field, at 288).

Here again the evidence was that China is stronger in some fields than others.

Chinese science was unequivocally, therefore, in the 'Premier League' – and moving up the table. That was to be celebrated as good for global scientific endeavour. But the UK should not be complacent, either in relation to how well placed it was to respond to this development, or indeed about its future status as a major scientific nation.

Perceptions that intellectual property is not well protected in China and that plagiarism and duplication are widespread remained. There was clear evidence of improvement in the laws on intellectual property and their enforcement, but this remained an issue for some companies. This was not really a concern at the academic level. Plagiarism in scientific journals was an issue, because of the way scientists were incentivised in the Chinese system; and in this connection The Royal Society had supported the San Francisco Declaration¹ relating to not using

¹ <http://am.ascb.org/dora/>

impact factors in assessing the scientific achievements of individuals.

There was already a good deal of scientific collaboration between the UK and China, much of it financed from China. The UK had now overtaken Japan to become the second biggest collaborator with the Chinese in terms of joint publications (though still a long way behind the US). But there were warning signs. There was a high mismatch between the numbers of Chinese students studying in the UK and UK students studying in China. The UK was not in the top 15 countries sending students to China and was well behind France and Germany (8,400 a year and 6,300 respectively, compared to 4,000 from the UK). The mismatch was even greater at post-doctoral level.

Educating a workforce that was well informed about the strengths and weaknesses of China and familiar with Chinese culture was vital for the UK. The greatest single need was to provide more young British scientists with the opportunity to experience China. Face to face interactions were extremely important when dealing with the Chinese; and in addition to providing the platform for good research, the 'soft' power of scientific engagement should not be overlooked.

MICHAEL KWOK said that innovation supported by research was a vital factor in the business model of a company such as Arup, seeking to build its business in China. Research created value – and often over an extended period. Innovation was at a premium in China, driven by the scale of demand, the speed of change and the rapidly developing skills of the huge pool of talented people. China had already overtaken the US as the world's largest construction market. The scale and speed of urbanisation was breath-taking. In 1978, 17.9% of the population was urbanised; by 1990 it was 26%; by 2012 it was 52.6%. It was estimated that a population the size of Plymouth would move from rural environments to urban settings in China every week for the next 16 years.

As hundreds of millions of people moved into the middle class, consumption was set to become the main driver for the growth. These developments brought major environmental and technological problems in their wake, for which the Chinese were urgently seeking solutions through innovations in science and technology. Major

initiatives in carbon reduction and clean technology had been launched – with targets and planning conditions being incorporated into burgeoning new developments in areas such as urban metros, eco-cities, smart grids and green buildings.

The push for research and innovation, therefore, came from the expanding demand for solutions to engineering problems and technical challenges across a wide front. The pull came from the need to stay ahead of the game, keep at the cutting edge of science and innovation and maintain the highest standards of excellence. This required more and broader partnerships, with a greater emphasis on multi-disciplinary and cross-organisational collaboration. Arup had benefited from just such partnerships with Chinese universities and companies. The process of collaboration was often more important than the actual outcome; and Arup had found great benefits from supporting technical forums for knowledge sharing and student visits for knowledge dissemination. Collaboration had taken different forms – MOUs, and joint applications for funding, for example – and involved different parties, including both Chinese based and UK organisations.

Some invisible barriers to entering Chinese government-led research activity remained. The balance could be tipped further towards welcoming the global insight and sector knowledge and technical expertise that the UK and other international players could bring. But China provided a strong platform for research and innovation led business. The demand and the appetite were both there. The key was to work alongside the Chinese in setting common goals.

PROFESSOR ROBIN GRIMES pointed out that China now outstripped the rest of the world on funding research and development, with the exception of the US whose lead it was narrowing. A linear extrapolation of trends in total research publication showed China about to overtake the US and surge past it. The implications were clear. China would become the largest science nation both in economic terms and in terms of potential for long term collaboration in science, engineering and medicine. If we missed that opportunity we would lose influence commercially and intellectually; and there were obvious risks to the UK as well if China did not engage on our agenda – for example on environmental challenges and healthcare.

The opportunities were there. China had for example, made huge advances in space and aerospace, science and product development. But there may well be downstream opportunities for partnership with satellites and scope for Chinese aerospace companies to move to the UK. Life Sciences were a potentially large market, with opportunities for rapid commercialisation.

The key for the UK in seeking to collaborate with China in research and innovation was to bridge the 'valley of death' between the early stages of research development and implementation in the market place. There were also commercial and security risks in working in China. But patent, trade mark and copyright laws were being revised, driven by domestic Chinese stakeholders. There were different research paradigms which could be adapted for future collaborations with China on research and innovation. For example the new Catapult Centres - in which the Government was investing £200m - might become hubs for positive interaction with Chinese academics and corporations.

In the future there was likely to be a shift in where research was carried out, more effective transitions from the laboratory to the product line, more diverse teams of researchers and a more itinerant research population, new means of communications (though people to people links would always be important) higher aspirations and new and transformed markets. The main drivers of demand were still likely to come from environmental concerns, population changes, health provision, energy and resource management; but things could change quickly.

For the UK all this meant getting smarter at strategic collaboration: matching the best minds here with the best in China; more UK students spending time in China and Chinese students considering internships in the UK; joint degree opportunities with Chinese universities; developing new models for long-standing relationships, perhaps on the lines of the German Humboldt Foundation²; and above all, a long term, joined up approach to ensure the UK is the research partner of choice not just now but in 30 year's time.

Speaking after dinner, DAVID WILLETTS said that there was plenty of respect in China for our science and our scientists. He, too,

referred to the great reception given to Sir Paul Nurse on the recent visit to China. China was looking for a structured approach to preferred partnerships with other countries in science; and the UK was well placed to respond. Inevitably, given its stage of development, China had been an 'absorptive' state in respect of research and innovation.

But that was changing as the internal market for innovation in China developed and as the quality of Chinese research was being transformed. Moreover, real progress was being made on issues such as intellectual property and copyright where, again, China's own internal market was driving improvements.

There was clearly scope to work more closely together with China in a number of areas: partnerships and exchange programmes between universities (with proportionally more British students going to China); standard setting in areas such as synthetic biology, building design and standards, and 5G technology, where the Chinese appetite for foresight and future planning was immense and highly focussed; and the social sciences - the significance of which in coming to terms with social change in their country was understood by the Chinese.

The Newton Fund³, providing £75m investment a year for five years, should represent what he recognised was a much needed impetus to research collaboration with the emerging economic powers. Priorities had already been identified; and the Chinese - who were bringing a delegation to the UK in the following week - had been enthusiastic about the Fund and very flexible (for example in re-designing their 2014 science budget to accommodate it). He hoped the Fund would be a springboard to take the UK's engagement with China on research and innovation to a new level.

Arising from these contributions and the discussions before and after dinner it was clear that there was a strong consensus about the potential for increasing collaboration with China in research and innovation - and the boost which the Newton Fund was already providing to further action. A number of contributors welcomed the creation of the Newton Fund as a potential

² www.humboldt-foundation.de/web/programmes-by-target-group.html

³ www.gov.uk/government/publications/newton-fund-building-science-and-innovation-capacity-in-developing-countries/newton-fund-building-science-and-innovation-capacity-in-developing-countries

game-changer. It would of course need to be evaluated but the response to the initiative in China was already encouraging; and quite apart from the positive outcomes that could be expected from specific projects and programmes, the process of engagement would undoubtedly yield further benefits.

Another strong thread through the contributions was the need for a change in attitude in our education system, from schools through to universities. Universities needed to change their approach both to Chinese students studying in this country – who could form an important alumni base for the future – and to establishing a more effective UK academic presence in China. A longer term view was needed; and much more effort to develop a deeper and wider understanding of Chinese culture (and better language skills) on the part of students and researchers, for many of whom China remained a cultural ‘blind spot’. Existing UK expertise in these areas – as in the School of African and Oriental Studies – could be exploited more effectively.

The need to find ways of ‘working smarter’ was also strongly endorsed. There was, for example, a need for better co-ordination between UK agencies working on the ground in China, better continuity of funding (which the Newton Fund might provide), and better connectivity to facilitate face to face communications in China and knowledge exchange. There were also disincentives in

the way the current grant application system worked. It needed to be more broad-based.

The UK should put more emphasis on multi-disciplinary approaches – and through the research councils, academies and the learned societies should be well placed to do so. The UK also had a strong historical record on urbanisation on which to draw, including the fact that London – unusually in advanced Western countries – was still expanding. The strong emphasis within China on innovation with quick practical benefits was acknowledged. There was no single answer to this challenge. More plural, dynamic collaborations should flow in both directions, engaging partners in academia and in commerce and exploiting new paradigms such as the Catapult Centres. It was important not to see such collaboration as one way – what we could do for the Chinese market. We needed to learn from China and to encourage Chinese expertise and investment into the UK.

Concluding the discussion, the Chairman welcomed the positive responses it had generated and re-emphasised the importance of seeing this as a priority for the long term.

Sir Hugh Taylor KCB

At the end of this report is the report of the round-table discussion held on the same theme during the afternoon of 11th June, 2014.

Useful URLs – save the document (right click) and open with Adobe Reader outside the browser and click on the URL to go to the site.

Arup
www.arup.com

Asia House
<http://asiahouse.org>

BP
www.bp.com

Catlin Group
www.catlin.com/en

Department for Business Innovation & Skills
www.gov.uk/government/organisations/departments-for-business-innovation-skills

Engineering and Physical Sciences Research Council
www.epsrc.ac.uk

Foreign and Commonwealth Office
www.gov.uk/government/organisations/foreign-commonwealth-office

The Foundation for Science and Technology
www.foundation.org.uk

Government Office for Science
www.gov.uk/government/organisations/government-office-for-science

Lloyd's of London
www.lloyds.com

National Environment Research Council
www.nerc.ac.uk

Needham Research Institute
www.nri.org.uk

NESTA Report on the potential for UK/China collaboration in research and innovation
www.nesta.org.uk/sites/default/files/chinas_absorptive_state_0.pdf

Newton Fund
www.gov.uk/government/publications/china-david-willetts-hosts-uk-china-joint-commission-on-science-and-technology-april-2014/china-david-willetts-hosts-uk-china-joint-commission-on-science-and-technology-april-2014

Research Councils UK
www.rcuk.ac.uk

The Royal Society
www.royalsociety.org

SPRU - Science and Technology Policy Research, University of Sussex
www.sussex.ac.uk/spru

Technology Strategy Board
www.innovateuk.org

The Foundation for Science and Technology
A Company Limited by Guarantee,
Registered in England No: 1327814,
Registered Charity No: 274727

Move to the next page to read the report of the round-table discussion held in the afternoon.

ROUND-TABLE DISCUSSION SUMMARY

Making the most of UK/China research and innovation partnerships

Held at The British Academy on 11th June, 2014.

Chair: **The Earl of Selborne GBE FRS**
Chairman, The Foundation for Science and Technology

Speakers: **Sir John Boyd, KCMG**
Chairman, Asia House
Michael Kwok
Main Board Director and Head, Shanghai Office, Arup

SIR JOHN BOYD said that the resurgence of a stronger China was one of the most welcome developments in recent decades. China had a proud history of innovation and invention. It was a nation that took science seriously. Scientists had suffered during the Cultural Revolution. But following the reforms introduced by Deng Xiaoping, the change had been revolutionary. Science had become a national priority, with major public investment in science and research – resulting in a huge growth in the number of scientists and the volume of published research.

The development of closer links with China through increased collaboration on research and development was clearly in the national interest of the UK. China was an essential market. All the big issues requiring global resolution required scientific collaboration. And such collaboration could only be a stimulus to the UK to keep raising its standards in science and innovation. Going forward, for the UK this would mean increasing the skills of our young scientists, a concerted drive to persuade Ministers to prioritise and back collaboration with China in science and innovation, and a step change in our commitment to understanding and working with the Chinese at all levels.

Our education system needed to produce more fluent Mandarin speakers. More students, researchers and experts in all branches of science should be working in China and in Chinese laboratories. And we needed to welcome Chinese skills and investment into the UK, including the burgeoning number of Chinese corporations.

MICHAEL KWOK said that of Arup's 11,000 global workforce, 3,000 were working in

China: currently 2,200 in Hong Kong and 800 on the Chinese mainland. They would be looking to move progressively more of their development infrastructure to the mainland because of the obvious potential for growth, driven by the scale of demand and hunger for innovation, pace of change and the rapidly developing skills of the huge pool of talented people in China. As hundreds of millions of people moved into the middle class, consumption would become the main driver of economic growth. That would in itself create huge demand, but it would also produce environmental and other challenges requiring technical and institutional innovation in areas such as green technology (with applications in building, planning, the automotive industry etc.).

For a firm such as Arup this put research and innovation at the heart of their business model. The push came from the expanding demand for a solution to engineering problems and technical challenges across a wide front, the pull from the need to stay ahead of the game, keep at the cutting edge of science and innovation and maintain the highest standards of excellence. This required more and broader partnerships, with a greater emphasis on multi-disciplinary and cross organisational collaboration.

There were still some invisible barriers to entering Chinese government-led research activity for non-Chinese corporations. The picture was changing. Stronger international collaborations were now being encouraged. But it was to be hoped that the balance could be tipped further towards welcoming the global insight and sector knowledge and technical expertise that the UK and other international players could bring.

A number of contributors to the subsequent debate picked up on the role of education in further collaboration with China in research and innovation. The importance of continuing to attract high quality Chinese students and post graduates researchers to the UK was emphasised. UK education was undoubtedly seen as an asset by the Chinese.

But there was no room for complacency. The US attracted three or four times more Chinese students per year than the UK – and a higher percentage of top quality students and researchers (judged by comparative performance in terms of collaborative research publications in the most prestigious journals). Too often we were second choice to the US at PhD level, with our universities being too slow to get out offers. Delays in obtaining visas also remained a persistent problem: an issue on which Ministers should be pressed.

The need to increase the number of UK students in China was strongly endorsed. This should be accompanied by a UK wide drive to increase the number of Mandarin speakers and to broaden and deepen the understanding of Chinese history and culture. This was a national priority, given the increasing importance of China's economy and its influence and impact on a wide range of global issues. Further investment in area studies and language skills was needed. But it was also an urgent priority for institutions and organisations to seek to develop partnerships with counterparts in China (and with UK academic institutions with expertise in this area on which they could draw). There was also a strong consensus around the table that there was no substitute for presence in China. The scale of demand for research and innovation was such that the opportunities for expanding the number of PhD students and other researchers working in China was undoubtedly there.

But proximity and frequent visits were vital – not least because of the importance of building long term personal relationships (on which the Chinese placed more weight than on relationships between companies and institutions). The pace and scale of change in China also meant that it was only too easy to miss opportunities and to get out of date. This presented real difficulties for smaller UK based companies and institutions with no

presence on the ground in China. But, again, it reinforced the need for collaboration with partners in China; such interaction was increasingly welcome there. Examples were cited of schemes which linked Chinese companies with academic partners in the UK, others which matched expertise between Chinese and UK universities opening up opportunities for researchers from the UK to spend time in China and others which linked individual students or created student networks.

Another significant strand of discussion was the rich range of opportunities that were opening up for collaboration with China. The Chinese admired the UK's contribution to discovery science, where it was seen as punching above its weight. This has been emphasised during the recent visit of a Royal Society delegation to China and reflected in the rapturous reception given to Sir Paul Nurse when he lectured to over 1,000 students. The UK had overtaken Japan to become the second most significant partner in collaborative research with the Chinese.

The aim should be to establish this relationship on a long term basis: matching the best brains in science and engineering in the UK with the best in China. The impact of climate change and other environmental issues on China featured strongly in opportunities for collaboration in which participants were already engaged or had been identified. Examples given included the potential for partnerships in exploiting satellites to support developments in agriculture, pollution and water shortages; and research and innovation on air quality where London was seen (following the Olympics) as providing a template for improvement.

But the opportunities ranged wider, in areas where the UK was seen as a world leader. In marine technology, for example, a major UK/Chinese research collaboration had recently been launched with £25m of investment on the Chinese side. There were opportunities in the insurance market where there would be increasing demand for expertise on modelling risks associated with catastrophes such as earthquakes and flooding. There was great interest in our expertise in construction and building standards. The Meteorological Office was already talking to potential partners in China

– and engaged with UK partners in research collaboration in China.

Academic partnerships would be essential for UK organisations seeking to collaborate with the Chinese in these and other areas, supported by better co-ordination of partnerships within the UK.

There was some debate over whether the UK nationally, or the academic community itself, should have a single coherent strategy for prioritising areas for potential collaboration. Sustainable energy, improving public health, urbanisation, cell biology and genetics were all cited as potential candidates for prioritisation. However, cautionary notes were also sounded. We should not make assumptions about Chinese perceptions of our niche areas of expertise. There was also the issue of the huge mismatch of scales between the UK and China. Taking too narrow a perspective on prioritisation would mean missed opportunities for working at regional and city level – on developments in areas such as railway infrastructure for example.

The Newton Fund was seen as a most welcome and potentially game changing development. Too often collaboration with China on research and innovation had depended on investment from the Chinese side; and as China's own scientific and technological base had expanded and skills accelerated, the incentives for collaboration with the UK had inevitably reduced. There was already evidence that the Newton Fund had changed perceptions dramatically in China. UK institutions needed to be ready to respond.

A strong challenge was also mounted in the discussion about the importance of supporting applied, business centred innovation. This was deeply built into Chinese culture – and reflected in the engineering background of many of its leaders (in contrast to the UK). The UK's science base and its strengths in academic research were recognised in China and it should be possible to build on the already established links in this area. But matching effort was required in innovation which yielded quick, practical returns. The scale of opportunity in China and the huge pool of graduates there meant it was a fertile environment for testing and prototyping

innovation. There was a high appetite for risk and "accelerated" innovation of 'disposable' products. The Newton fund was certainly seen by the Chinese government as an opportunity for the UK to put a new emphasis on the promotion of partnerships for innovation – combining research and commercial expertise with financial banking. A number of contributors endorsed the view that a step change in the UK contribution to the innovation and applications agenda, alongside its input on education and academic research, would have a marked impact on Chinese perceptions of the UK. It was recognised that the issue of protecting intellectual property had been seen by some major companies – particularly in the pharmaceutical and biotech areas – as a barrier to research collaboration in China.

Tensions also persisted in other areas of innovation where there were commercial sensitivities and certain geo-political restrictions. But it was agreed that the picture was changing and improving all the time, driven not least by the development of China's own internal market. New laws protecting patents and intellectual property had been introduced; successful cases had been brought by international companies in the Chinese courts. Often the perception of risk was greater than the actuality.

Companies on the ground in China found their experience there to be comparable with their experience in other developing economies. The key was to practice due diligence, know where the lines were and build personal relations which created trust. There was a strong sense throughout the discussion of optimism about the scale of potential opportunities for further collaboration with China. This would be very much a two way process. We had much to learn from the Chinese: from their history but also from their present and future, as their economy and science base surged forward. Nor should the UK take anything for granted. Other developed nations were pressing for China's attention. To succeed we would have to stay at the cutting edge of academic research and innovation; and we would have to deepen our connections with China and our understanding of its culture, past and present.

Sir Hugh Taylor KCB

Useful URLs – save the document (right click) and open with Adobe Reader outside the browser and click on the URL to go to the site.

Arup

www.arup.com

Asia House

<http://asiahouse.org>

BP

www.bp.com

Catlin Group

www.catlin.com/en

Department for Business Innovation & Skills

www.gov.uk/government/organisations/department-for-business-innovation-skills

EPSRC

www.epsrc.ac.uk

Foreign and Commonwealth Office

www.gov.uk/government/organisations/foreign-commonwealth-office

The Foundation for Science and Technology

www.foundation.org.uk

Government Office for Science

www.gov.uk/government/organisations/government-office-for-science

Lloyd's of London

www.lloyds.com

National Environment Research Council

www.nerc.ac.uk

Needham Research Institute

www.nri.org.uk

NESTA Report on the potential for UK/China collaboration in research and innovation

www.nesta.org.uk/sites/default/files/chinas_absorptive_state_0.pdf

Newton Fund

www.gov.uk/government/publications/china-david-willetts-hosts-uk-china-joint-commission-on-science-and-technology-april-2014/china-david-willetts-hosts-uk-china-joint-commission-on-science-and-technology-april-2014

Research Councils UK
www.rcuk.ac.uk

The Royal Society
www.royalsociety.org

SPRU - Science and Technology Policy Research, University of Sussex
www.sussex.ac.uk/spru

Technology Strategy Board
www.innovateuk.org

The Foundation for Science and Technology
10 Carlton House Terrace
London
SW1Y 5AH

A Company Limited by Guarantee

Registered in England, No: 1327814
Registered Charity No: 274727