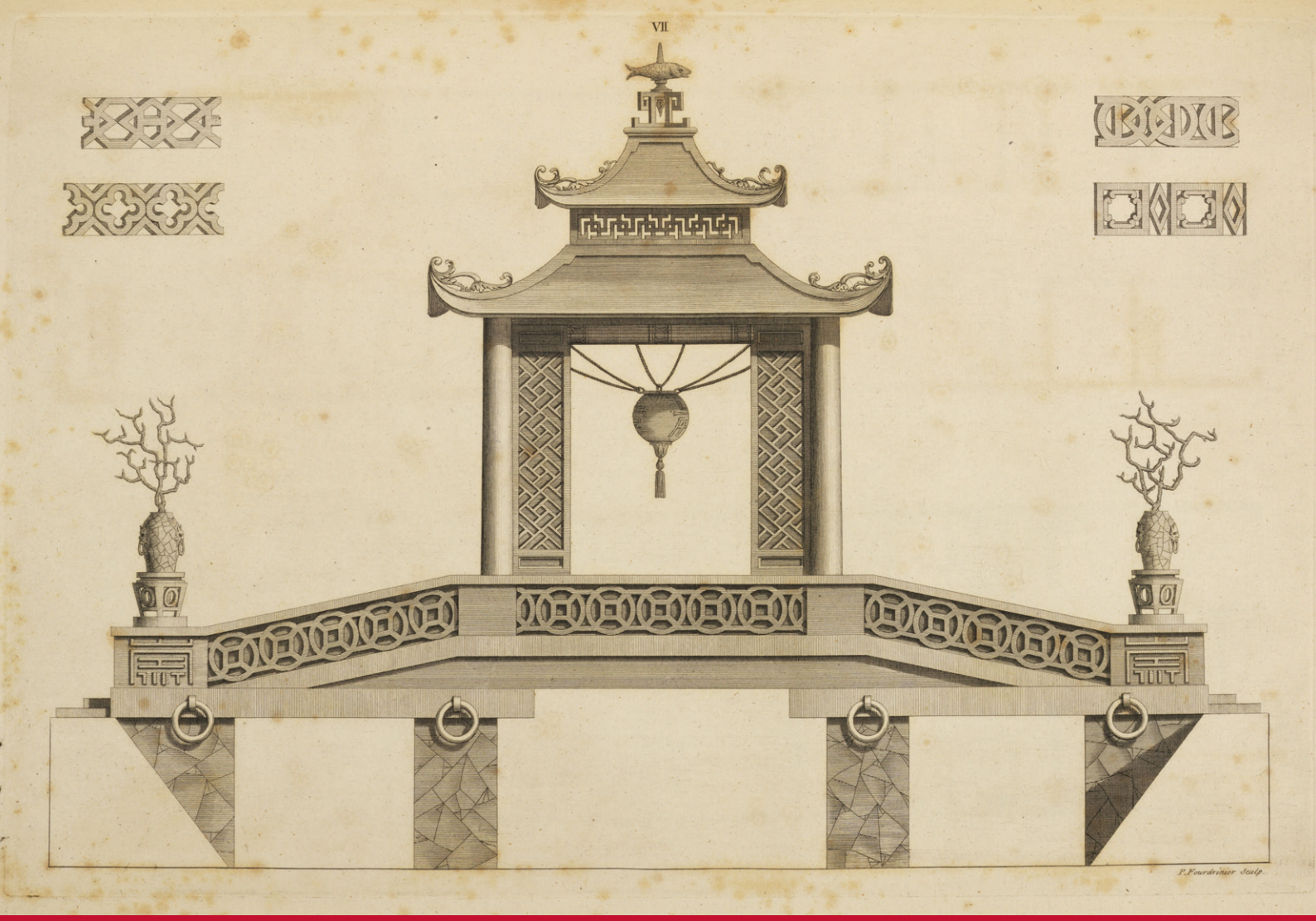

UK-China-Netherlands Frontiers of Science Meeting

Fragrant Hills, Beijing, 8-11 November 2009

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UK-China-Netherlands Frontiers of Science Meeting

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1 Introduction

From Sunday 8 November to Wednesday 11 November 2009, 75 of the best and brightest early-career scientists from the UK, China and the Netherlands met for a Frontiers of Science symposium in the Xiangshan (Fragrant Hills) area in the north-west of Beijing, to discuss the latest advances in research in their disciplines and others, and to highlight the big questions at the frontiers of their field.

The meeting was organised by a committee of 16 scientists from all three countries who identified and selected the topics for the eight sessions, recruited expert speakers in the field, nominated other outstanding scientists to participate, and chaired and moderated the sessions. The history, aims and objectives of the Frontiers of Science programme are discussed in more detail below.

This report summarises the key issues and findings discussed at the symposium. It is not necessarily an expression of the views of the Royal Society.

2 The Frontiers of Science programme

The Frontiers of Science programme is a prestigious series of international meetings for outstanding early career scientists, organised by the Royal Society, through its Science Policy Centre, and a number of other prestigious national academies and other scientific organisations around the world including the US National Academy of Science, the Alexander von Humboldt Foundation, the Chinese Academy of Sciences and the Japanese Society for the Promotion of Science.

Frontiers of Science meetings are designed to bring together future leaders in science in all disciplines in an environment which encourages informal networking and discussion, and to explore opportunities for international and cross-disciplinary collaboration. Participants are encouraged to think about the 'big questions' at the frontiers of their field, and to identify new and emerging scientific challenges on the horizon of current knowledge.

The meetings usually involve around eight sessions, spread over three or four days, in which scientists introduce a particular topic within their field to an informed, but non-specialist audience drawn from all areas of the natural sciences. The Royal Society has been running Frontiers of Science meetings since 2004, when it hosted the inaugural UK-US meeting. Since then, it has held meetings with Germany (2006), the Visegrad Four group of countries (2007), Hong Kong, India, Germany, and Japan (all 2008). Further meetings are planned in 2010 with Australia and Brazil.

The UK-China-Netherlands meeting was organised in conjunction with the Society's sister academies in China and the Netherlands, the Chinese Academy of Sciences (CAS), and the Royal Netherlands Academy of Arts and Sciences (KNAW). The Society has deep historical links with both countries, having celebrated the 30th anniversary of formal links with China in 2008, and which go even further back in the case of the Netherlands, through early Fellows such as Antonie van Leeuwenhoek and Christiaan Huygens who were key figures in the early years of the Society, and in European scientific history.

3 Key Points

- Our understanding of the effects of climate change on biodiversity is being greatly increased by collaboration between geneticists and ecologists in order to ascertain to what extent species are responding to a changing climate through genetic evolution, or by altering their phenotypic traits, and the interplay between the two strategies
- Recent advances in synthetic biology have enabled the design and construction of DNA-based nanomachines, which have resulted from increasing collaboration between physicists, biologists and engineers, and have a wide range of possible applications as well as the potential to deepen our understanding of biological systems
- China's rapid rise as one of the world's emerging scientific powers is underlined by the construction of the LAMOST telescope, a $40 million endeavour which will provide Chinese researchers with access to world-class astronomical and astrophysical data
- The distribution of mass, including dark matter, in our Milky Way galaxy, is becoming increasingly clearer as a result of detailed, sophisticated and novel astronomical observations and their associated theoretical modelling efforts, which make use of "stellar streams" – the remains of disrupted "dwarf" galaxies cannibalised by the Milky Way
- Modern neuroscience is significantly enhancing our understanding of language processing, arguably the most complex process in the brain, through applying techniques such as functional neuroimaging and event-related potentials to the brains of bilingual speakers, and illuminating major differences in cognition between first and second languages, which is also dependent on the nature of the languages themselves
- The development of strategies to quantify, categorise, and understand uncertainty is one of the central questions facing researchers in disciplines as varied as climate science and economics. An ever increasing number of sophisticated approaches are being proposed to deal with uncertainty, which have the potential to replace traditional approaches, which are resource-intensive in terms of time and computer power
- The exponential increase in computing technology in recent decades, as predicted by Moore's Law, is fast approaching fundamental physical limits, a problem which the emerging new field of spintronics is attempting to address, with the ultimate, albeit currently distant, goal being to create a workable spin transistor
- New technologies associated with GPS data are revolutionising geological science, enabling a greater understanding of plate tectonics and continental rifts, with the potential to dramatically improve our knowledge of the processes affecting the earth's surface
- Stem cell researchers are greatly expanding our understanding of the causes of cancer through a number of methods, including the use of biomarkers to track cancer stem cell development and differentiation, which have yielded new insights into the development of colinic and intestinal cancer as well as childhood leukaemia

4 The sessions

4.1 Adult stem cells and cancer: two sides of the same coin

Organised by Dr Marie-José Goumans, Leiden University Medical Centre, and Dr Stefan Hoppler, Institute of Medical Sciences, University of Aberdeen

Speakers: Dr Feng LIU, Institute of Zoology, CAS
Dr Marc Van De Wetering, Hubrecht Institute
Dr Marella de Bruijn, University of Oxford

Stem cells are the fundamental building blocks of the body, and are characterised by two important features: their ability to divide and self-renew indefinitely, and their potential to differentiate into different cell types (eg muscle, skin, bone etc). They can either be found in embryos or in adult tissue, and are crucial in tissue regeneration and repair.

The role of adult stem cells is a key area of research into the causes of cancer, and there are a number of parallels between stem cells and cancer cells. Tumours may often originate from the transformation of normal stem cells, or by the indefinite potential for self-renewal of rare 'cancer stem cells'.

In order to map the lifecycle and function of stem cells, and to examine when, how and why normal stem cells become cancerous, a number of methods have been developed. These include attaching biomarkers to cells in the form of marker proteins, which has led to a greater understanding of the development of colinic and intestinal cancer, and specifically where and how cell differentiation takes place in the process.

Similar research efforts into the role of hematopoietic (blood-forming) stem cells have yielded new insights into the development of childhood leukemia.

4.2 Beyond Moore's Law: what will Physics contribute to future electronics?

Organised by Professor Jie GAO, Institute of High Energy Physics, CAS and Dr Wilfred van der Wiel, Twente University

Speakers: Professor Honjun GAO,
Institute of Physics, CAS
Dr Tamalika Banerjee, University of Groningen
Professor Werner Hofer, University of Liverpool

Moore's Law is one of the guiding principles that has driven the development of the computer chip industry. It stems from a 1965 article by Intel co-founder Gordon Moore, in which he argued that the number of transistors on a chip would double every 24 months. This turned out to be an accurate prediction of the digital revolution which followed, and the extraordinary improvements in silicon technology which it entailed.

However, this exponential increase is approaching fundamental physical limits. At current rates of development, the steadily decreasing size of transistors will approach the atomic scale within the next couple of decades. In order to meet this challenge, new and alternative approaches at the cutting edge of contemporary physics are required.

One of the most promising areas of research in this field is in spintronics, which makes use of spin, a fundamental property of elementary particles, and has already found a number of practical applications in consumer electronics and biomedical equipment.

However, translating this ability to orchestrate these properties on a subatomic scale into a system with stable physical properties, and realise the 'holy grail' of research in this field, a spin transistor, ultimately remains elusive, despite interesting progress. Thus a technically viable molecular electronics industry is still beyond the horizon of current projections, although intense research efforts in this area will continue.

4.3 Climate change affects animal distribution

Organised by Dr Caroline Nichol, Institute of Atmospheric and Environmental Science, University of Edinburgh and Dr Runzhi ZHANG, Institute of Zoology, CAS

Speakers: Professor Simon Verhulst, University of Groningen
Dr Alastair Wilson, University of Edinburgh
Dr Chaodong ZHU, Institute of Zoology, CAS

Measuring and addressing the impact of climate change on the environment is one of the major scientific and policy challenges of the 21st century. There is overwhelming evidence that it is driving major ecological changes in animal populations, and putting some species at much greater risk of extinction.

One of the key questions in analysing these developments is to what extent animals are evolving genetically in response to the challenges posed by climate change, and whether this will be occurring at a fast enough rate to ensure long-term survival; and to what extent phenotypic plasticity, the response of certain species to environmental changes by altering their non-genetic traits, is a factor, particularly in alterations to the range of certain species; and to what extent this plasticity can itself evolve. A CAS experiment in 2005 highlighted this phenomenon by isolating a beetle/plant/aphid ecosystem in the lab and varied the levels of carbon dioxide, which resulted in an alteration in the beetles' feeding patterns and preferences.

Variation in individual species' responses to environmental factors can lead to ecological imbalances when some species in the food chain adapt faster than others, causing reproductive cycles to be out of sync with food peaks, a good example being the phenomenon of pied flycatchers breeding after the caterpillar population has peaked. The impacts of these and other related phenological changes (the effect of climate change on annually or periodically occurring natural events), have significant implications and severe negative consequences for ecosystems and public health (for example in the distribution of infectious diseases).

The need to address these and other related questions has led to compelling collaborations between geneticists and ecologists to apply molecular and quantitative genetic methods to long term ecological studies, in order to distinguish genetic from environmental influences on traits, to understand how they interact, and to explore ways of accurately measuring and predicting rates of genetic change. This has been a major growth area of research in the last decade, as genomic approaches become ever more applicable to organisms outside the laboratory.

4.4 Continental rifting: turning mountains into oceans

Organised by Dr James Wookey, Department of Earth Sciences, University of Bristol and Professor Wenjiao XIAO, Institute of Geology and Geophysics, CAS

Speakers: Professor Jan-Diederik Van Wees, Vrije Universiteit Amsterdam
Dr Carolina Pagli, University of Leeds
Dr Xianhua LI, Institute of Geology and Geophysics, CAS

Continental rifts are elongated depressions in the Earth's surface, often thousands of kilometres long and tens of kilometres wide and deep, filled with sediments and volcanic rocks. They mark zones where the outer solid part of the earth, the lithosphere, has thinned and heated in response to extension, and which may lead to future continental rupture. The study of these rifts, and their causes and effects, encompasses a wide range of related disciplines within the earth sciences, including geomechanics, geochemistry, geophysics, structural geology and petrology.

Case studies from research teams working on large scale plate tectonics in Iceland and Ethiopia, where rifting events are taking place, are providing valuable insights into these processes, and are making use of new technologies such as GPS data to track rifting in new and innovative ways, which in turn enable more sophisticated modelling. This is essential in order to understand the process, an effort currently hampered by the limitations of current models to take into account the influence of factors such as magma flow.

CAS researchers are currently investigating the cyclical pattern of the formation and disintegration of continents, combining age dating of rocks with research into directions of tectonic movement in order to provide insights into past plate tectonic routes, and the formation and breakup of prehistoric supercontinents such as Rodinia.

4.5 Dealing with uncertainty

Organised by Professor Hester Bijl, Technical University of Delft and Dr Yong ZHOU, Academy of Mathematics and Systems Science, CAS

Speakers: Professor Jinhong YOU,
Shanghai University of Finance and Economics
Dr Catherine Powell, University of Manchester
Dr Jeroen Witteveen, Delft University of Technology

One of the key questions facing contemporary scientists is how to quantify, categorise, understand, and work with uncertainty in science. As the growth in computing power in recent decades has permitted ever more sophisticated mathematical modelling, it remains imperative to incorporate uncertainty into these models in order to perform risk assessments in a number of disciplines. This wide-ranging session looked at different approaches to uncertainty in three major fields: engineering, computational fluid dynamics and statistics.

There is a need to distinguish between two types of uncertainty: aleatory uncertainty caused by natural variations in input data, and epistemic uncertainty, which results from a lack of knowledge about the input data. The latter often involves irreducible physical randomness, for example in the permeability coefficients of rocks, which limits predictive capability. A practical example of this problem was highlighted in a proposal to build a nuclear waste dump, before which the water flow through the rock bed on the proposed site had to be modelled. A second was demonstrated by the flow of air around the wings of aeroplanes and rockets which illustrates the uncertainty problems associated with turbulence and sonic shock.

Many approaches to uncertainty problems such as these involve Monte Carlo simulations, which derive their name from the casinos in the place of the same name. This technique uses random numbers to observe a fraction of those numbers obeying some property or properties, and are particularly useful in obtaining numerical solutions to problems which are too complicated to solve analytically. It has had a great impact in many fields of computational science, and works best when the process is one in which the underlying probabilities are known but the results are more difficult to determine.

However, a typical Monte Carlo simulation of a fluid flow problem could run for days, if not weeks, on a single processor computer. For this reason, a number of more sophisticated numerical methods have been proposed in recent years which entail their own computational challenges.

4.6 Galactic Archaeology: Streams as fossils of the formation history of galaxies

Organised by Professor Richard de Grijs, Department of Physics and Astronomy, University of Sheffield and Professor Amina Helmi, Kapteyn Astronomical Institute, University of Groningen

Speakers: Professor Elizabeth Tolstoy,
University of Groningen
Dr Mark Wilkinson, University of Leicester
Professor Martin Smith, Kavli Institute for Astronomy and Astrophysics, Peking University

The formation of our own Milky Way galaxy may have resulted from the merger of dwarf galaxies containing stars, gas and dark matter, the oldest of which are among its fundamental building blocks. As they merged, they gave rise to 'stellar streams' - disrupted stellar systems which leave longlived signatures in the positions, motions and chemistry of stars, and are the 'fossil tracers' of the galaxy formation process. Observations of these properties, and recent improvements in star cluster physics, enable scientists to address some of the most important questions in modern astrophysics research by piecing together the history, formation and evolution of our galaxy and others, and exploring the process of star formation. The results of this research will also help to elucidate the largescale distribution of dark matter in the Milky Way.

China has recently undertaken one of the largest, most ambitious and compelling research efforts to meet these challenges. The Large Sky Area Multi-Object Fiber Spectroscopic Telescope (LAMOST) project was completed in 2008 and cost over $40 million to build, and will provide Chinese researchers with access to world-class astronomical and astrophysical data. One of its many scientific goals includes a vast survey of the Milky Way focussing on stellar streams, distant tracers, its oldest stars and the evolution of its disc. The Gaia satellite, which will launched by the European Space Agency in 2012, will enable even greater use to be made of LAMOST's data by accurately pinpointing three dimensional positions and velocities of stars and stellar streams, and allow the construction of detailed mass models of our galaxy.

In addition, China has recently joined the Thirty Meter Telescope Project, an ambitious international partnership which aims to build the world's most advanced and capable astronomical observatory in 2018, with the preferred site being Mauna Kea in Hawaii. The National Astronomical Observatories of the Chinese Academy of Sciences (NAOC) will participate in planning its development and will eventually become a full partner in the project.

4.7 Molecular machine: DNA based nanodevices

Organised by Dr Xiaohong FANG, Institute of Chemistry, CAS and Dr Rachel O'Reilly, Department of

Chemistry, University of Warwick
Speakers: Dr Jonathan Bath, University of Oxford
Professor Gijs Wuite, Vrije Universiteit Amsterdam
Professor Dongsheng LIU, Tsinghua University

Recent advances in the rapidly developing field of synthetic biology have enabled scientists to achieve unprecedented levels of precision in their control of DNA. It is now possible to pick up a single DNA molecule and stretch it like a spring, and to design DNA machines that assemble themselves and operate without external intervention.

These innovations exploit DNA's capacity for information storage, and the simple rules that govern the interaction between the bases within it, to encode rules for self-assembly which can then be used to design linear motors which respond to an external trigger, such as a change in acidity, light, or a small molecule. In designing these nanomachines, scientists have made use of novel tools such as 'optical tweezers', which use light to manipulate microscopic objects down to the level of a single atom, and have proved particularly useful in the study of biological systems. Although the construction of DNA based nanodevices is already a reality in the laboratory, the conditions under which they work, particularly in terms of acidity (Ph value), currently make it impossible to run these machines in a living body.

The design, development and simulation of these methods has led to some fascinating collaborations between physicists, biologists and engineers in an attempt to quantify biological systems in order to generate predictive models, and to provide a comprehensive mathematical description of DNA. This highlights the potential of this research not only to produce novel devices with a wide range of possible applications in a number of disciplines, but also to broaden and deepen our understanding of the fundamental processes that govern life itself.

4.8 Two languages, one brain: the cognitive neuroscience of bilingualism

Organised by Dr Li LIU, Institute of Biophysics, CAS and Professor Niels Schiller, Leiden University

Speakers: Professor Guillaume Thierry, Bangor University
Professor Janet Van Hell, Radboud Universiteit Nijmegen
Dr Qingfang ZHANG, Institute of Psychology, CAS

The acquisition and development of complex language is one of the unique attributes that differentiate humans from their fellow animals, and language processing is arguably one of the most complex processes 10 implemented in the brain. Our understanding of these processes and the drivers behind them are being greatly enhanced by recent advances in cognitive neuroscience, and neuroimaging techniques such as functional magnetic resonance imaging and electroencephalography which allow the electric activity of the brain to be measured.

By examining this in response to a particular stimulus, such as a sound, picture or word, on a millisecond-bymillisecond basis, in what are known as event-related potentials (ERPs), scientists can determine specific responses to spoken or written words, phrases or sentences in the brains of bilingual speakers, and gain valuable insights into the timing and degree of neural activation as language processing unfolds in real time. Bilingualism has largely been ignored in many previous studies on language and cognition in the brain, but is now a major growth area of research.

Studies have demonstrated significant differences in the way first and second languages are processed in the brains of bilingual children and second language learners, with second language learners more reliant on word form than meaning in the early stages of language acquisition. Connections between form and concept in the brain appear to be more advanced in fluent bilingual speakers. However, patterns of brain activity vary depending on the learning context and in the languages spoken – so for example, bilinguals who speak languages using the same script (eg Dutch and German) display contrasting effects to those who speak languages with very different scripts (eg English and Chinese). This is forcing neuroscientists and linguists to revisit earlier language production theories, which were mainly developed from alphabetic languages such as English or Dutch.

Research in this area suggests that the most effective language learning takes place through total language immersion – ie where the learner is forced to use the new language to communicate.

5 Horizon scanning

Scientists who participated in the meeting were asked to identify what they perceived as the emerging scientific challenges in the next five to ten years in their field. These included:

- Sustainable chemistry which aims to replace polluting technologies by benign alternatives, to reduce dependence on fossilised carbon by obtaining reagants from renewable sources, and to develop renewable energy technologies.
- Threats to ecosystem services on which human civilisation is fundamentally dependent, such as air and water purification, detoxification of waste, climate regulation, soil regeneration, and biodiversity.
- The nature of dark energy which is the only solution that can account for the increasing acceleration of the universe's expansion, which the total amount of matter in it, both in the form of ordinary and dark matter, cannot explain. This crucial non-visible component of the universe is the focus of much theoretical and observational work in astronomy.
- The emerging field of nano-biotechnology involving DNA, peptides and other biomaterials, and improving the design of self-assembling biological systems.
- Mathematical modelling in medical applications such as tomography, brain imaging, and cancer studies.
- Controlling single quantum systems for applications ranging from precision measurements to building quantum communication systems and computers.
- 'Decoding' mental states from new techniques being developed which enable new ways of looking at neuroimaging data, and linking these neuroscientific results with formal psychological theories using computational modelling.
- Developing comprehensive systems-level approaches to the regulation of gene expression both experimentally and computationally, in order to better understand the development, differentiation, and transitions of stem cells, and their potential applications.
- Translational medicine which aims to apply new techniques in laboratory based biomedical research to a clinical environment.
- The role of quantum effects in the physics of the brain and biological systems along the lines of recent work on quantum effects in photosynthesis.

6 Feedback

Participants were also invited to provide their thoughts on the symposium after the event. Responses were largely positive, with participants welcoming the chance provided by the Frontiers format to think beyond disciplinary boundaries, and to forge new links with their counterparts in the other countries. A number of participants also indicated that they had established links with potential collaborators, and in some cases had already begun to discuss joint projects, seminars and other collaborations. A selection of quotations from their comments is provided below.

"I found [it] very interesting to meet researchers from very different disciplines and have fruitful discussions on all aspects of research. This is a very unique opportunity that we otherwise hardly ever have."

"I found the talks fascinating and really valued the opportunity to meet and interact with researchers in other fields (which almost never happens by chance)."

"It is always impressive to discover the core questions in another field and the strategies developed by others to tackle these questions. This makes us aware of generic principles underlying the scientific approach."

"The interaction with other participants makes you feel a real scientist in a broader sense, not just in your discipline."

"The interdisciplinary networking was the real highlight for me."

"All in all, I found this meeting very exciting, interesting and stimulating. I have met many new researchers in very different fields of research, and the discussions have fostered some further collaborations [...] I think it is very useful to think outside the box, and I have taken with me many ideas about future directions that I might look into. "

"Overall, I thoroughly enjoyed the meeting and it was a joy to share views with and ask questions to individuals who have a completely different theme in mind. Even though our objects are different, the principles governing our research are similar. Thank you for this wonderful invitation."

Appendix 1: List of participants

Name	Affiliation
Professor Sondipon Adhikari	School of Engineering, Swansea University
Dr Erika Andersson	School of Engineering and Physical Sciences, Heriot-Watt University
Dr Tamalika Banerjee Zernike	Institute of Advanced Materials, University of Groningen
Dr Jonathan Bath	Department of Physics, University of Oxford
Professor Hester Bijl	Aerodynamics Department, Delft University of Technology
Dr Sophia Bruggeman	Guy's Hospital Campus, King's College London
Professor Lorna Casselton FRS	Foreign Secretary, Royal Society
Dr Jane Chadwick	Faculty of Earth and Life Sciences, Vrije Universiteit Amsterdam
Dr Susana Chuva de Sousa Lopes	Department of Anatomy and Embryology, Leiden University Medical Centre
Dr Maria-Rosa Cioni	STRI/PAM, University of Hertfordshire
Luke Clarke	Science Policy Centre, Royal Society
Ruth Cooper	Science Policy Centre, Royal Society
Dr Marella de Bruijn	MRC Molecular Haematology Unit, Weatherall Institute for Molecular Medicine, University of Oxford
Dr Richard de Grijs	Department of Physics and Astronomy, University of Sheffield
Professor Zhaoxiang DENG	Department of Chemistry, University of Science and Technology of China
Dr Anne Donaldson	Institute of Medical Sciences, University of Aberdeen
Professor Xiaohong FANG	Institute of Chemistry, Chinese Academy of Sciences
Dr Annette Ferguson	Institute for Astronomy, University of Edinburgh
Dr Ana Ferreira	Environmental Sciences, University of East Anglia
Dr Jason Frank	Modelling, Analysis and Simulation, Centrum Wiskunde & Informatica (CWI)
Professor Hongjun GAO	Institute of Physics, Chinese Academy of Sciences
Professor Jie GAO	Accelerator Center, Institute of High Energy Physics
Dr Sam Gilbert	Institute of Cognitive Neuroscience, University College London
Dr Maria Goumans	Molecular Cell Biology Department, Leiden University Medical Centre
Dr Taomei GUO	State Key Laboratory of Cognitive Neuroscience and Learning, Beijing Normal University
Dr Chungming HAN	Institute of Geology and Geophysics, Chinese Academy of Sciences
Professor Amina Helmi	Department of Astronomy, Kapteyn Institute, University of Groningen
Dr Andreas Herrman	Department of Polymer Chemistry, Zernike Institute for Advanced Materials
Professor Werner Hofer	Surface Science Research Centre, Department of Chemistry and Department of Physics, University of Liverpool
Dr Dengli HONG	Shanghai Jiaotong University Medical School
Dr Stefan Hoppler	Institute of Medical Sciences, University of Aberdeen
Dr Marieke Jepma	Department of Psychology, Leiden University
Dr Peter Jonker	Netherlands Institute for Space Research
Dr Yulia Kovas	Institute of Psychiatry, King's College London
Dr Xianhua LI	Institute of Geology and Geophysics, Chinese Academy of Sciences
Professor Dongsheng LIU	Department of Chemistry, Tsinghua University
Dr Feng LIU	Institute of Zoology, Chinese Academy of Sciences
Professor Li LIU	Institute of Biophysics, Chinese Academy of Sciences
Professor Ming LIU	Institute of Microelectronics, Chinese Academy of Sciences
Professor Xiaowei LIU	Kavli Institute for Astronomy and Astrophysics, Peking University

Name	Affiliation
Professor Kofi Makinwa	Electronic Instrumentation Laboratory, Delft University of Technology
Dr Jie NA	Department of Biomedical Science, University of Sheffield
Dr Caroline Nichol	Institute of Atmospheric and Environmental Science, School of Geosciences, University of Edinburgh
Professor Edward Noort	Foreign Secretary, Royal Netherlands Academy of Arts and Sciences (KNAW)
Dr Rachel O'Reilly	Department of Chemistry, University of Warwick
Dr Carolina Pagli	School of Earth and Environment, University of Leeds
Professor Eric Peng	Astronomy Department, Peking University
Professor Simon Portegies Zwart	Leiden Observatory
Dr Catherine Powell	School of Mathematics, University of Manchester
Professor Dong REN	College of Life Science, Capital Normal University
Dr Casey Ryan	School of Geosciences, University of Edinburgh
Professor Weiguo SANG	Institute of Botany, Chinese Academy of Sciences
Professor Niels Schiller	Centre for Linguistics, Leiden University
Professor Martin Smith	Kavli Institute for Astronomy and Astrophysics, Peking University
Dr Eugen Stulz	School of Chemistry, University of Southampton
Professor Guillaume Thierry	School of Psychology, Bangor University
Dr Elizabeth Tolstoy	Kapteyn Institute, University of Groningen
Dr Marc van de Wetering	Clevers Group, Hubrecht Institute
Dr Wilfred van der Wiel	MESA+ Institute for Nanotechnology, University of Twente
Professor Janet van Hell	Social Sciences Department, Radboud University Nijmegen
Dr Matthias van Osch	Radiology Department, Leiden University Medical Centre
Professor Jan-Diederik van Wees	Department of Tectonics, Geoenergy and Geoinformation, Vrije University
Dr Elmar Veenendaal	Centre for Ecosystem Studies, Wagenigen University
Dr Gert Veenstra	Molecular Biology, Radboud University Nijmegen
Professor Simon Verhulst	Department of Behavioural Biology, University of Groningen
Dr Sikko Visscher	Royal Netherlands Academy of Arts and Sciences (KNAW)
Dr Shaoli WANG	School of Statistics and Management, Shanghai University of Finance and Economics
Dr Mark Wilkinson	Department of Physics and Astronomy, University of Leicester
Dr Alastair Wilson	Institute of Evolutionary Biology, University of Edinburgh
Dr James Wookey	Department of Earth Sciences, University of Bristol
Dr Jeroen Witteveen	Aerospace Engineering Department, Delft University of Technology
Professor Gijs Wuite	Exact Science Department, Vrije Universiteit Amsterdam
Professor Wenjiao XIAO	Institute of Geology and Geophysics, Chinese Academy of Sciences
Professor Jinhong YOU	School of Statistics and Management, Shanghai University of Finance and Economics
Dr Qingfang ZHANG	Institute of Psychology, Chinese Academy of Sciences
Professor Runzhi ZHANG	Institute of Zoology, Chinese Academy of Sciences
Dr Feng ZHOU	Lanzhou Institute of Chemical Physics
Professor Yong ZHOU	Academy of Mathematics and System Science, Chinese Academy of Sciences
Dr Chaodong ZHU	Institute of Zoology, Chinese Academy of Sciences

The Royal Society

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- **Invest** in future scientific leaders and in innovation
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- **Increase** access to the best science internationally
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Issued: June 2010 DES1863

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Cover image from 'Designs of Chinese buildings, furniture, dresses, machines, and utensils, engraved... from the originals drawn in China... to which is annexed a description of their temples, houses, gardens, &c.' 1757, by William Chambers FRS. From the Royal Society archives.