New frontiers in science diplomacy

Navigating the changing balance of power

January 2010

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The cover image is a figure of a dipping needle from 'Directions for observations and experiments to be made by masters of ships, pilots and other fit persons in their sea-voyages' by Sir Robert Moray FRS and Robert Hooke FRS, which appeared in *Philosophical Transactions of the Royal Society* in 1666. The world's oldest scientific journal in continuous publication, *Philosophical Transactions* was first published in 1665 to inform and connect the Fellows of the Society and other natural philosophers all over the world to new frontiers in scientific knowledge.

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New frontiers in science diplomacy

Contents

Summary

'Many of the challenges we face today are international and—whether it's tackling climate change or fighting disease—these global problems require global solutions . . . That is why it is important that we create a new role for science in international policy-making and diplomacy . . . to place science at the heart of the progressive international agenda.'

Rt Hon Gordon Brown MP, Prime Minister

Science diplomacy is not new, but it has never been more important. Many of the defining challenges of the 21st century—from climate change and food security, to poverty reduction and nuclear disarmament—have scientific dimensions. No one country will be able to solve these problems on its own. The tools, techniques and tactics of foreign policy need to adapt to a world of increasing scientific and technical complexity.

There are strong foundations on which to renew momentum for science diplomacy. Advances in science have long relied on international flows of people and ideas. To give an example close to home, the post of Foreign Secretary of the Royal Society was instituted in 1723, nearly 60 years before the British Government appointed its first Secretary of State for Foreign Affairs. Throughout the Cold War, scientific organisations were an important conduit for informal discussion of nuclear issues between the United States and the Soviet Union. Today, science offers alternative channels of engagement with countries such as Iran, Saudi Arabia and Pakistan.

The potential contribution of science to foreign policy is attracting more attention in several countries. In the UK, the Prime Minister Gordon Brown recently called for a 'new role for science in international policymaking and diplomacy' (Brown 2009). This report attempts to define this role, and to demonstrate how scientists, diplomats and other policymakers can make it work in practice.

The report is based on the evidence gathered at a two-day meeting on 'New frontiers in science diplomacy', which was hosted by the Royal Society from 1–2 June 2009, in partnership with the American Association for the Advancement of Science (AAAS). The meeting was attended by almost 200 delegates from twenty countries in Africa, Asia, Europe, the Middle East, North and South America. Attendees included government ministers, scientists, diplomats, policymakers, business leaders and journalists (see Appendix 1 for the meeting agenda).

Three dimensions of science diplomacy

Drawing on historical and contemporary examples, the meeting explored how science can contribute to foreign policy objectives. Key points to emerge from the discussion include:

- 'Science diplomacy' is still a fluid concept, but can usefully be applied to the role of science, technology and innovation in three dimensions of policy:

- informing foreign policy objectives with scientific advice (*science in diplomacy*);
- facilitating international science cooperation (*diplomacy for science*);
- using science cooperation to improve international relations between countries (*science for diplomacy*).

- Scientific values of rationality, transparency and universality are the same the world over. They can help to underpin good governance and build trust between nations. Science provides a non-ideological environment for the participation and free exchange of ideas between people, regardless of cultural, national or religious backgrounds.
- Science is a source of what Joseph Nye, the former dean of the Kennedy School of Government at Harvard University, terms 'soft power' (Nye 2004). The scientific community often works beyond national boundaries on problems of common interest, so is well placed to support emerging forms of diplomacy that require non-traditional alliances of nations, sectors and non-governmental organisations. If aligned with wider foreign policy goals, these channels of scientific exchange can contribute to coalition-building and conflict resolution. Cooperation on the scientific aspects of sensitive issues—such as nuclear non-proliferation—can sometimes provide an effective route to other forms of political dialogue.
- Science diplomacy seeks to strengthen the symbiosis between the interests and motivations of the scientific and foreign policy communities. For the former, international cooperation is often driven by a desire to access the best people, research facilities or new sources of funding. For the latter, science offers potentially useful networks and channels of communication that can be used to support wider policy goals. But it is important that scientific and diplomatic goals remain clearly defined, to avoid the undue politicisation of science.
- Foreign ministries should place greater emphasis on science within their strategies, and draw more extensively on scientific advice in the formation and delivery of policy objectives. In the UK, the appointment of Professor David Clary FRS as the Chief Scientific Adviser at the Foreign and Commonwealth Office creates an important opportunity to integrate science across FCO priorities, and develop stronger linkages with science-related policies in other government departments.
- Regulatory barriers, such as visa restrictions and security controls, can also be a practical constraint to science diplomacy. Immediately after September 11 2001, the imposition of stringent travel and visa regimes in countries like the US and the UK severely limited opportunities for visiting scientists and scholars, particularly from Islamic countries. Whilst the strictest controls have since been lifted, the value of scientific

partnerships means that further reforms may be needed.

- Scientific organisations, including national academies, also have an important role to play in science diplomacy, particularly when formal political relationships are weak or strained. The scientific community may be able to broker new or different types of partnerships. The range of actors involved in these efforts should expand to include non-governmental organisations, multilateral agencies and other informal networks.

- There need to be more effective mechanisms and spaces for dialogue between policymakers, academics and researchers working in the foreign policy and scientific communities, to identify projects and processes that can further the interests of both communities. Foreign policy institutions and think tanks can offer leadership here, by devoting intellectual resources to science as an important component of modern day diplomacy.

- Science diplomacy needs support and encouragement at all levels of the science community. Younger scientists need opportunities and career incentives to engage with policy debates from the earliest stage of their careers. There is much to learn from related debates over science communication and public engagement by scientists, where there has been a culture change within science over the past ten years.

- Three immediate areas of opportunity for science diplomacy were highlighted at the meeting:

  - *New scientific partnerships with the Middle East and wider Islamic world*
    A new initiative to support these efforts, 'The Atlas of Islamic-World Science and Innovation', was announced at the meeting, with partners including the Royal Society, Organisation of Islamic Conference, *Nature*, the British Council and the International Development Research Centre (see Case study 1).

  - *Confidence building and nuclear disarmament*
    With the Review Conference of the Nuclear Non-Proliferation Treaty (NPT) taking place in May 2010, it is timely to consider how cooperation on the scientific aspects of nuclear disarmament could support the wider diplomatic process.

  - *Governance of international spaces*
    International spaces beyond national jurisdictions – including Antarctica, the high seas, the deep sea and outer space – cannot be managed through conventional models of governance and diplomacy, and will require flexible approaches to international cooperation, informed by scientific evidence and underpinned by practical scientific partnerships (see Case study 2).

1 The changing role of science in foreign policy

1.1 A brief history of science diplomacy

Scientists and diplomats are not obvious bedfellows. While science is in the business of establishing truth, Sir Henry Wotton, the 17th century diplomat, famously defined an ambassador as 'an honest man sent to lie abroad for the good of his country'. But despite differing motivations, there is a long history of scientists supporting international cooperation. Philip Zollman became Foreign Secretary of the Royal Society in 1723. His role was to maintain regular correspondence with scientists overseas to ensure that the Society's Fellows remained up-to-date with the latest ideas and research findings.

'The Royal Society has a long history of using science to rise above military conflict and political and cultural differences. My post was instituted in 1723, nearly 60 years before the British Government appointed its first Secretary of State for Foreign Affairs'

Professor Lorna Casselton FRS, Foreign Secretary, The Royal Society

Prior to the Second World War, details of scientific developments abroad were conveyed to London by military, agricultural or commercial attachés. The UK's first accredited scientific representative abroad, Sir Charles Galton Darwin FRS (the grandson of Charles Darwin), was appointed Director of the Central Scientific Office in Washington in 1941. His role was to collaborate with US research bodies, and facilitate the exchange of scientific information.

Shortly afterwards, from 1942 to 1946, Joseph Needham FRS was appointed head of the British Scientific Mission in China, from where he started work on the monumental multi-volume 'Science and Civilisation in China', which occupied the remaining forty years of his life. He was active in promoting an 'International Science Co-operation Service', and his lobbying led to the incorporation of natural sciences within the mandate of the United Nations Educational, Scientific and Cultural Organisation (UNESCO).

However, it was only after World War II, and the devastating use of the atomic bomb, that scientists became increasingly proactive in efforts to reduce conflict. On 9 July 1955, Bertrand Russell FRS and Albert Einstein FRS published a manifesto calling on scientists of all political persuasions to address the threat posed by the advent of nuclear weapons. A few days later, the philanthropist Cyrus S. Eaton offered to sponsor a conference on this theme in Pugwash, Nova Scotia.

Through the efforts of a wider group of scientists, including Sir Joseph Rotblat FRS (the only physicist to leave the Manhattan Project on the grounds of conscience), this meeting eventually took place in July 1957, as the first Pugwash

Conference on Science and World Affairs. Today Pugwash forums remain an important strand of international discussions on issues of peace, nuclear non-proliferation and security. Participants at Pugwash meetings attend as individuals, rather than as representatives of institutions, so are able to 'explore alternative approaches to arms control and tension reduction with a combination of candor, continuity, and flexibility seldom attained in official East-West and North-South discussions and negotiations.'[1] The Pugwash movement was recognised with a Nobel Peace Prize in 1995.

Other organisations which have been instrumental in the history of science diplomacy include the North Atlantic Treaty Organisation (NATO), which in 1957 set up a science programme, and the US National Academy of Sciences (NAS) and the Soviet Academy of Science (ASUSSR), which throughout the 1980s ran parallel Committees on International Security and Arms Control (CISAC). Ongoing communication between scientists on these committees was credited with laying the groundwork for eventual dialogue between Presidents Reagan and Gorbachev.

1.2 A renewed interest in science diplomacy

After a perceptible lull at the end of the Cold War, recent years have seen a fresh surge of interest in science diplomacy, most noticeably in the United States, the UK and Japan. In Washington DC, the post of Science and Technology Adviser to the US Secretary of State was created in 2000. Dr Nina Federoff, who currently performs this role, sees her priorities as strengthening partnerships across international scientific communities; building science capacity within the Department of State; and horizon scanning for scientific developments that could impact on US national interests.

'Science diplomacy is the use of scientific interactions among nations to address the common problems facing humanity and to build constructive, knowledge based international partnerships.'

Dr Nina Federoff, Science and Technology Adviser to US Secretary of State

The UK government set up a Science and Innovation Network (SIN) in 2001, with the aim of linking science more directly to its foreign policy priorities. Over eight years, SIN has expanded to include around ninety staff (a mix of UK expatriates and locally engaged experts) in forty cities in twenty-five countries. These are typically located in UK embassies, high commissions or consulates, and work alongside other diplomats and representatives of bodies such as UK Trade and Investment. While the network does not provide its own research funding, it facilitates collaboration between UK and international research partners across a wide variety of policy and scientific agendas, including energy, climate change and innovation. SIN officers develop an in-depth understanding of the policies, people and priorities of their host countries, and

1 http://www.pugwash.org/about.htm

identify opportunities for UK scientists, universities and high-tech firms. The place of science in UK foreign policy was further strengthened in summer 2009 by the appointment of Professor David Clary FRS as the first Chief Scientific Adviser to the Foreign and Commonwealth Office—a direct counterpart to Dr Nina Federoff in the United States.

But science diplomacy is of more than purely transatlantic interest. In London, there are science attachés posted to the embassies of Brazil, Canada, China, Russia and several European countries. The same is true in Beijing, Washington and New Delhi. Another country active in this area is Japan, which has had a formal policy on science diplomacy since 2007. This identifies four objectives: negotiating the participation of Japanese scientists in international research programmes; providing scientific advice to international policymaking; helping to build science capacity in developing countries; and using science to project power on the international stage, in ways that increase Japan's prestige and attract inward investment. This last area is motivated, in part, by Japan's recognition that its scientific and technological strengths are a source of strategic and economic value (Japanese Council for Science and Technology Policy 2008). Jun Yanagi from Japan's Ministry of Foreign Affairs, who spoke at the Royal Society/AAAS meeting, suggested that by promoting Japanese science 'we could expect to see inward movement of R&D money, brains, human resources and ideas into Japan' (Royal Society/AAAS 2009).

Interest in science diplomacy is growing at a time when international relations are changing. Alongside national governments and multilateral institutions, a more complicated and disaggregated diplomatic system is taking shape, consisting of networks of regulators, lawyers, non-governmental organisations, the media and scientific bodies. To take one recent example, the Copenhagen COP-15 climate change conference, which ran from 7–18 December 2009, was primarily designed to enable negotiations between the national delegations from 192 countries, including 100 world leaders. But up to 18,000 delegates, drawn from a vast array of non-governmental, business, regulatory, scientific and media groups, attended all but the final stages of the summit, and contributed in numerous ways to its outcomes.

Foreign policy analysts, such as Anne-Marie Slaughter, have described this as a shift towards a 'disaggregated world order . . . latticed by countless government networks . . . for collecting and sharing information of all kinds, for policy coordination, for enforcement cooperation, for technical assistance and training, perhaps ultimately for rule making. They would be bilateral, plurilateral, regional, or global. Taken together, they would provide the skeleton or infrastructure for global governance' (Slaughter 2004). It seems likely that breakthroughs in global governance will increasingly occur through fora that support interaction between government and civil society actors, including the scientific community (UNCTAD 2003). But efforts to define and strengthen the role of scientists within this shifting architecture of governance and diplomacy are still at an early stage. Some initial efforts include:

- The UN Conference on Trade and Development (UNCTAD) agreed in 2001 to set up a science diplomacy initiative to improve 'the provision of science and technology advice to multilateral negotiations and the implementation of the results of such negotiations at the national level' (UNCTAD 2003). Its focus has been on building the capacity of scientists and diplomats from developing countries to participate in international negotiations.[2]
- In 2008, the AAAS established its Centre for Science Diplomacy to bring together science, foreign policy and public policy communities to identify areas where science cooperation can help build trust and foster intercultural understanding. Vaughan Turekian, the centre's director, describes how its work aims to strengthen the intellectual foundations for science diplomacy, while also providing practical demonstrations of 'the connecting power of science cooperation' (AAAS 2009).[3]
- The Royal Society has placed diplomacy at the core of its new Science Policy Centre. This centre supports the efforts of Royal Society Fellows and other experts to engage policymakers in each of the three dimensions of science diplomacy described in this report: strengthening the contribution of science to foreign policy objectives (*science in diplomacy*); facilitating international science cooperation (*diplomacy for science*); and using science cooperation to improve relations between countries (*science for diplomacy*).[4]

2 http://stdev.unctad.org/capacity/diplomacy.html

3 http://diplomacy.aaas.org/

4 http://royalsociety.org/policy/

2 Science in diplomacy

'Environmental threats are adding to the complexity of international relations in an already turbulent world. The anticipated bottlenecks and constraints—in food, water, energy and other critical natural resources and infrastructure—are bringing new geophysical, political and economic challenges, and creating new and hard-to-manage instabilities.'

Bernice Lee, Chatham House

Over the next thirty years, foreign policy will be increasingly shaped by the linked challenges of global sustainability (Lee 2009). Professor John Beddington FRS, the UK Government's Chief Scientific Adviser, has warned of a 'perfect storm' of food shortages, scarce water and insufficient energy resources, which threaten to unleash public unrest, cross-border conflicts and mass migration (Beddington 2009).

Science will be critical to addressing these challenges, and the priority of science *in* diplomacy should be to ensure the effective uptake of high quality scientific advice by policymakers (NAS 2002). The scientific community must inform policymakers with up-to-date information on the dynamics of the Earth's natural and socio-economic systems. Scientists must also identify where uncertainties exist, or where the evidence base is inadequate (Royal Society 2005).

Probably the best known example of a mechanism for informing policymaking with scientific advice is the Intergovernmental Panel on Climate Change (IPCC). This was established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), to provide the world with a clear scientific view on the current state of climate change and its potential environmental and socio-economic consequences. The IPCC does not carry out its own original research, but reviews and produces periodic assessments of recent scientific, technical and socio-economic research. Thousands of scientists from all over the world contribute to its work on a voluntary basis. Review is an essential part of the IPCC process, and differing viewpoints within the scientific community are reflected in the IPCC reports. In December 2007, the IPCC was awarded the Nobel Peace Prize (jointly with former U S Vice-President Al Gore) 'for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change'.[5]

National academies and learned societies are also an important source of independent scientific advice to international policymakers. For example, since 2005, the national academies of science of the G8 + 5 countries have met annually to produce joint statements relating to the themes of the G8 Presidency. Similarly, the InterAcademy Panel on International Issues (IAP), which represents over 100 of the world's national

5 http://nobelprize.org/nobel_prizes/peace/laureates/2007/

academies of science, has published statements in 2009 on ocean acidification and deforestation, as a contribution to the United Nations climate change negotiations.[6]

Even on sensitive issues of national security, collaboration between scientists can help to facilitate political negotiations. The Chinese Scientists Group on Arms Control and the US National Academy of Sciences Committee on International Security and Arms Control (CISAC) recently collaborated on the first Chinese-English glossary of nuclear security terms 'to remove barriers to progress in exchanges and diplomatic, cooperative, or other activities where unambiguous understandings is essential' (NAS 2008). And in the Arctic, a collaborative project led by the Geological Survey of Canada and involving researchers from Denmark, Norway, Sweden, Russia and the United States recently published the first comprehensive atlas of Arctic geology, which has implications for contentious sovereignty claims (Natural Resources Canada 2009).

2.1 Building capacity to give and receive scientific advice

The effective use of scientific advice in diplomacy requires international policymakers to have a minimum level of scientific literacy, or at least access to others who have it. It also requires scientists to communicate their work in an accessible and intelligible way, which is sensitive to its wider policy context. Scientific bodies can help to build this capacity: in the US, efforts to increase the number of scientists serving in the foreign policy community include the Jefferson Science Fellowships, administered by the National Academies of Science, and the Science Diplomacy Fellowships offered by the AAAS.

Establishing and nurturing links between the scientific and foreign policy communities informs scientists and policymakers alike: the former about the realities of policymaking; and the latter about the role and limits of science in policy. Improving the scientific capacity of delegations from developing countries is particularly important, especially for international negotiations on health and climate policy. For example, health campaigners argue that officials from developing countries may lack the necessary expertise to negotiate technical aspects of the international patent system. The same problem can apply in complex areas of climate change policy.

Scientific bodies can help to address these problems; a recent example being the partnership between the InterAcademy Panel and the European Climate Foundation, which convened workshops in Africa, Asia and Latin America to prepare officials from countries in these regions in the run up to the 2009 COP-15 Copenhagen climate change negotiations. In the UK, the Royal Society's MP-Scientist Pairing Scheme has been running since 2001. Scientists and policymakers in Uganda are now trialing a similar scheme (with the support of the Royal Society and the UK Parliamentary Office of Science and Technology) to try and improve the quality of scientific advice within Uganda's

6 http://www.interacademies.net/

parliament. And initiatives led by the US National Academy of Sciences, the Royal Society and the Network of African Science Academies (NASAC) are also working to improve the capacity of African science academies to provide independent, evidence-based scientific advice to their governments, as part of a growing recognition of the role of science in sustainable economic development.

3 Diplomacy for science

'International scientific and engineering collaboration is imperative to meet global challenges. Models of international scientific collaboration can lead the way for international diplomacy and policy.'

Professor John Beddington FRS, Chief Scientific Adviser to the UK Government

The second dimension of science diplomacy—*diplomacy for science*—seeks to facilitate international cooperation, whether in pursuit of top-down strategic priorities for research or bottom-up collaboration between individual scientists and researchers.

Flagship international projects, such as the International Thermonuclear Experimental Reactor (ITER) and the Large Hadron Collider (LHC) are one approach. These projects carry enormous costs and risks, but are increasingly vital in areas of science which require large upfront investments in infrastructure, beyond the budget of any one country. However, such projects are the visible tip of a large iceberg of everyday, bottom-up collaboration that takes place between individual scientists and institutions. The stereotype of the scientist as a lone genius no longer holds true. The scientific enterprise is now premised on the need to collaborate and connect. Globally there is 'an invisible college of researchers who collaborate not because they are told to but because they want to ... because they can offer each other complementary insight, knowledge or skills' (Wagner 2008).

Collaborations are no longer based purely on historical, institutional or cultural links. This creates an opportunity for the foreign policy community. Science can be a bridge to communities where political ties are weaker, but to develop relationships in these areas, scientists may require diplomatic assistance, whether in contract negotiations, intellectual property agreements or dealing with visa regulations.

Many countries conduct bilateral summits specifically on science issues, in order to establish government-level agreements on joint funding and facilitation of research. The UK, for example, has regular high-level meetings on science and innovation with Brazil, China, India, Russia, South Africa and South Korea. These are not only symbolic of cordial relations, but they provide an overarching framework within which scientists can work together. For the UK, these processes have resulted in a number of successful funding initiatives, including the UK-India Education and Research Initiative and the Science Bridges schemes with China, India and the US. Research Councils UK (RCUK) has also opened offices in Beijing, Brussels, New Delhi and Washington DC as part of the UK's efforts to drive bilateral research with strategic countries.

Global policy challenges must be addressed in a holistic way, drawing not only on science and technology, but also on economic, social, political and behavioural sciences. Interdisciplinary collaboration will be crucial, as illustrated by the recent consultation by the International Council on Science (ICSU) on the future of earth system research, which highlighted 'the complex inter-relationships between biological, geochemical, climate and social systems' and suggested that 'natural science should no longer dictate the Earth system research agenda; social science will be at least as important in its next phase' (Reid *et al*. 2009).

Competition hasn't gone away: the growing scientific capabilities of China, India, Brazil and others will challenge Europe and the US in some areas. But it is short sighted to view these developments primarily as a threat. As science and innovation capabilities grow worldwide, a central question is whether more defensive, national strategies gather momentum, or whether the countervailing impulse towards global collaboration will prove stronger. Efforts to strengthen national science and innovation systems remain vital, but must increasingly be accompanied by more creative and better-resourced mechanisms for orchestrating research across international networks in pursuit of shared goals—such as tackling climate change, food and energy security. The Large Hadron Collider is an excellent example of what countries can achieve by working together: a scale of scientific investment and ambition that no one country could manage alone.

4 Science for diplomacy

'Science diplomacy and science and technology cooperation . . . is one of our most effective ways of influencing and assisting other nations and creating real bridges between the United States and counterparts.'

Hillary Clinton, US Secretary of State

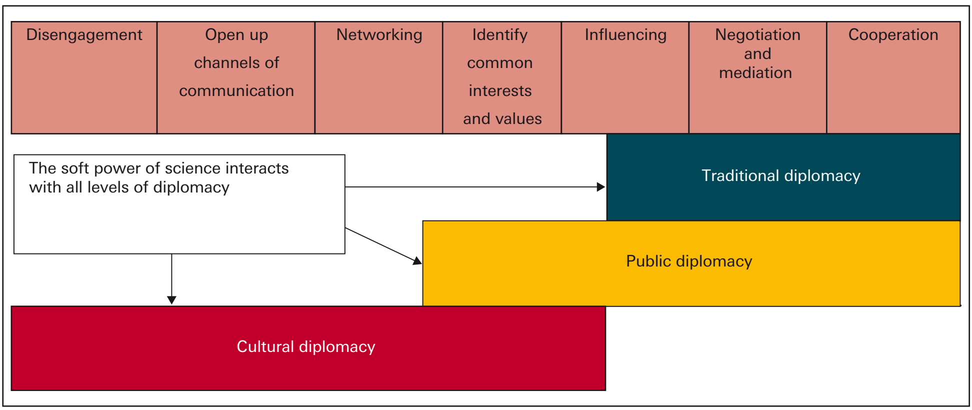
A third dimension of science diplomacy is *science for diplomacy*. Joseph Nye, former dean of the Kennedy School of Government at Harvard University famously distinguished between 'hard power', which uses military and economic means to coerce the behaviour of other nations, and 'soft power', which builds on common interests and values to attract, persuade and influence (Nye 2004). Science has always played a role in the development of hard power capabilities, such as military technologies. But science for diplomacy primarily draws on the 'soft power' of science: its attractiveness and influence both as a national asset, and as a universal activity that transcends national interests.

The soft power of science interacts with international relations in several ways, ranging from cultural diplomacy to more traditional forms of negotiation and mediation (see Figure 1).

Types of *science for diplomacy* include:

- *Science cooperation agreements*, which have long been used to symbolise improving political relations, for example between the US, USSR and China in the 1970s and 1980s. A scientific agreement was the first bilateral treaty to be agreed between the US and Libya in 2004, after Libya gave up its biological, chemical and nuclear weapons programmes.
- *New institutions* can be created to reflect the goals of science for diplomacy. Perhaps the best example is the European Organisation for Nuclear

Figure 1. The soft power of science.



Research (CERN), which was founded after World War II to help rebuild bridges between nations. CERN enabled some of the first post-war contacts between German and Israeli scientists, and kept open scientific relations with Russia and other Eastern bloc countries during the Cold War.

- *Educational scholarships* are a well-established mechanism for network-building and encouraging partnerships. For example, the Royal Society runs the Newton International Fellowships scheme, in partnership with the Royal Academy of Engineering and British Academy, to select the best early stage post-doctoral researchers from around the world, and offer them long-term support to sustain relations with institutions in the UK.[7]
- '*Track two' diplomacy* can be used to involve those working outside an official negotiation or mediation process, including scientists and other academics. To be effective, it requires outside participants who remain credible and influential. Official 'track one' processes must also recognise the role of track two efforts. For example, it was openly acknowledged during the Cold War meetings between national academies that both sides would report back to their political leaders.
- *Science festivals and exhibitions*, particularly linked to the history of science, can be an effective platform from which to emphasise the universality of science, and common cultural interests. China, India, Iran and other Islamic countries are particularly proud of their contributions to the history of science (see Case study 1).

4.1 New dimensions of international security

Cooperation on the scientific aspects of sensitive issues may sometimes be the only way to initiate a wider political dialogue. The soft power of science, and the universality of scientific methods, can be used to diffuse tensions even in 'hard power' scenarios, such as those relating to traditional military threats. For example, technologies to verify nuclear arms control agreements were a rare focus of joint working between the US and USSR during the Cold War.

Lessons from the Cold War are once again highly pertinent. In the run-up to the May 2010 Review Conference of the Nuclear Non-Proliferation Treaty (NPT), nuclear disarmament is firmly back on the international agenda. However, the timescale for disarmament is long, as illustrated by the history of negotiations over the Chemical Weapons Convention. After the Geneva Convention banned the use of chemical weapons in 1925, negotiations for a treaty banning their production and stockpiling did not start until the 1980s, and the convention entered into force only in 1997. Even now, stockpiles of chemical weapons in the US and Russia have yet to be destroyed.

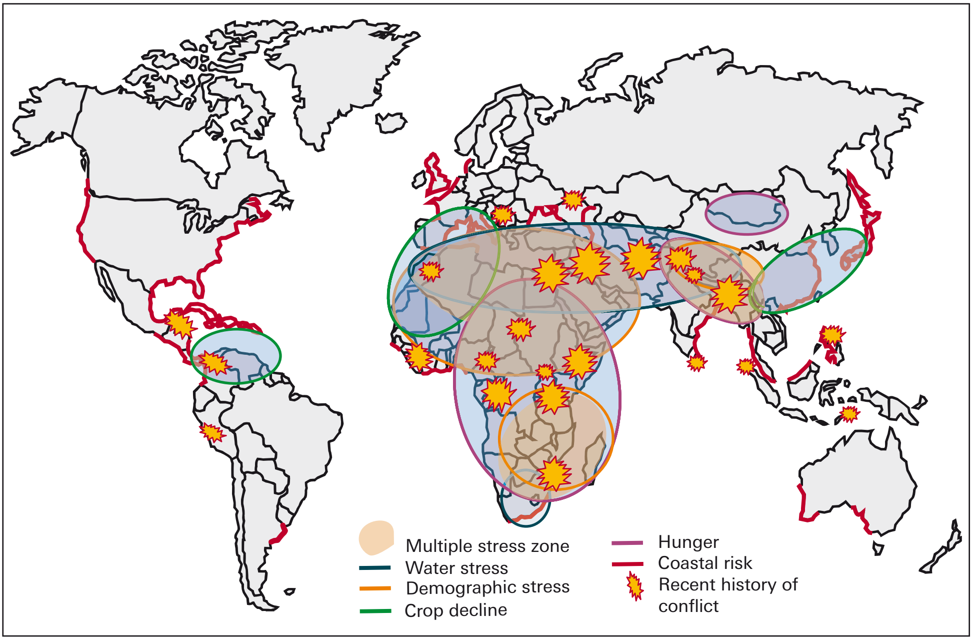
So focusing in 2010 on the challenges of the final stages of a nuclear disarmament

7 http://www.newtonfellowships.org/

process may be premature. A more practical next step could be to establish the scientific requirements for the verification regime necessary to support future stages of negotiation (Pregenzer 2008). In 2008, the Norwegian Minister of Foreign Affairs suggested that a high-level Intergovernmental Panel on Nuclear Disarmament could be established (based on the model of the Intergovernmental Panel on Climate Change). This panel could begin by identifying the scientific and technical aspects of disarmament, and then set out a research agenda necessary to achieve them. International cooperation would be essential, both between nuclear and non-nuclear weapon states, as all would need to have confidence that reductions are taking place. The recent initiative between the UK and Norwegian governments on disarmament verification sets a precedent here, and could be expanded to include additional States (VERTIC 2009).

However, security threats now extend beyond the military domain, with environmental security attracting particular attention (Abbott C, Rogers P & Sloboda S 2007). Essential resources, such as freshwater, cultivable land, crop yields and fish stocks, are likely to become scarcer in many parts of the world, increasing the risk of competition over resources within and between states (UNEP 2009). This could intensify as previously inaccessible

Figure 2. Multiple stress zones.



regions, such as the Arctic Ocean, open up as a consequence of climate change and ice melt. Substantial parts of the world also risk being left uninhabitable by rising sea levels, reduced freshwater availability or declining agricultural capacity. Many of the regions that are vulnerable to the impacts of these multiple stresses are already the locus of existing instability and conflict (see Figure 2).

5 Conclusions

The main conclusions to emerge from the discussions at the Royal Society/AAAS meeting were as follows:

5.1 The three dimensions of science diplomacy

The concept of science diplomacy is gaining increasing currency in the US, UK, Japan and elsewhere. It is still a fluid concept, but can usefully be applied to the role of science, technology and innovation in three related areas:

- informing foreign policy objectives with scientific advice (*science in diplomacy*);
- facilitating international science cooperation (*diplomacy for science*);
- using science cooperation to improve international relations between countries (*science for diplomacy*).

5.2 Science and universal values

Scientific values of rationality, transparency and universality are the same the world over. They can help to underpin good governance and build trust between nations. Science provides a non-ideological environment for the participation and free exchange of ideas between people, regardless of cultural, national or religious backgrounds.

5.3 The soft power of science

Science is a source of what Joseph Nye terms 'soft power' (Nye 2004). The scientific community often works beyond national boundaries on problems of common interest, so is well placed to support emerging forms of diplomacy that require non-traditional alliances of nations, sectors and non-governmental organisations. If aligned with wider foreign policy goals, these channels of scientific exchange can contribute to coalition-building and conflict resolution.

Cooperation on the scientific aspects of sensitive issues—such as nuclear nonproliferation—can sometimes provide an effective route to other forms of political dialogue. Similarly the potential of science as an arena for building trust and understanding between countries is gaining traction, particularly in the Middle East and wider Islamic world (see Case study 1).

5.4 Motivations for science diplomacy

Science diplomacy seeks to strengthen the symbiosis between the interests and motivations of the scientific and foreign policy communities. For the former, international cooperation is often driven by a desire to access the best people, research facilities or new sources of funding. For the latter, science offers useful networks and channels of communication that can be used to support wider policy goals. Foreign ministries should place greater emphasis on science within their strategies, and draw more extensively on scientific advice in the formation and delivery of policy objectives. In the UK, the appointment of

Professor David Clary FRS as the Chief Scientific Adviser at the Foreign and Commonwealth Office creates an important opportunity to integrate science across FCO priorities, and develop stronger linkages with science-related policies in other government departments.

Mechanisms to help achieve this could include:

- ensuring messages about the value of science are promulgated throughout foreign ministries and embassies, including to all Heads of Mission;
- incorporating science policy training into induction courses and training for foreign ministry staff, and specialist diplomatic training for dedicated science officers;
- involving more scientists in foreign ministries to advise at senior and strategic levels;
- encouraging the recruitment of science graduates as part of the general intake to the foreign service;
- encouraging secondments and pairing between diplomats and scientists;
- encouraging independent scientific bodies to provide science policy briefings for foreign ministry and embassy staff.

5.5 Avoiding politicisation

In all forms of science diplomacy, it is important to be clear when science ends and politics begins. At the Royal Society/AAAS meeting, Professor John Beddington FRS, the UK's Chief Scientific Adviser, agreed that scientific collaboration could provide a 'blueprint for international diplomacy', but warned of possible dangers for 'scientists who wish to engage in the diplomatic game' if this means that science ends up being used for political ends. Similarly, Chris Whitty, the Chief Scientific Adviser at the Department for International Development (DfID), endorsed scientific collaboration with developing countries if the goal is 'to transform the lives of the poor'. But he questioned whether using science to support social stability or deliver broader political goals would prove effective (Royal Society/AAAS 2009). Some governments have strict guidelines for how scientific advice is used in national policymaking, which can also be applied to the international arena (Government Office for Science 2005).

5.6 Practical barriers to scientific exchange

The constraints to science diplomacy include regulatory barriers, such as visa restrictions and security controls. Immediately after September 11 2001, more stringent travel and visa regimes in countries like the US and the UK severely limited the opportunities for visiting scientists and scholars, particularly from Islamic countries. Although efforts have been made to unpick some of these strict controls, there are still significant problems with the free mobility of scientists from certain countries. Such policies shut out talented scientists and hinder opportunities to build scientific relations between countries. Security controls can also prevent collaboration on certain scientific subjects, such as nuclear physics and microbiology. Although these policies are based on legitimate concerns over the dual use potential of some scientific knowledge, they should also take into consideration the diplomatic value of scientific partnerships in sensitive areas to help rebuild trust between nations.

5.7 Widening the circle of science diplomacy

Scientific organisations, including national academies, also have an important role to play in science diplomacy, particularly when formal political relationships are weak or strained. The scientific community may be able to broker new or different types of partnerships. The range of actors involved in these efforts should expand to include non-governmental organisations, multilateral agencies and other informal networks. A nation's scientific diaspora is also strategically important, as scientists based overseas are often keen to retain a close involvement with their country of birth.

There need to be more effective mechanisms and spaces for dialogue between policymakers, academics and researchers working in the foreign policy and scientific communities, to identify projects and processes that can further the interests of both communities. Foreign policy institutions and think tanks can offer leadership here, by devoting intellectual resources to science as an important component of modern day diplomacy.

5.8 Fostering science diplomats

Science diplomacy needs support and encouragement at all levels of the science community. Younger scientists need to have opportunities and career incentives to engage with policy processes from the earliest stage of their careers. How to achieve this is the subject of debate (see, for example, the recent consultation on the UK's Research Excellence Framework). But there is much that could be learnt and applied from related debates over science communication and public engagement by scientists, where there has been a culture change within science over the past ten years (DIUS 2008). Science diplomacy also provides scientists with an opportunity to become ambassadors on behalf of their national scientific community (Lord and Turekian 2007).

5.9 Priorities for science diplomacy

Three immediate areas of opportunity for science diplomacy were highlighted at the Royal Society/AAAS meeting:

- *New scientific partnerships with the Middle East and wider Islamic world* A new initiative to support these efforts, 'The Atlas of Islamic-World Science and Innovation', was announced at the meeting, with partners including the Royal Society, Organisation of Islamic Conference, *Nature*, the British Council and the

International Development Research Centre (see Case study 1).

- *Confidence building and nuclear disarmament*
  With the Review Conference of the Nuclear Non-Proliferation Treaty (NPT) taking place in May 2010, it is timely to consider how cooperation on the scientific aspects of nuclear disarmament could support the wider diplomatic process.
- *Governance of international spaces*
  International spaces beyond national jurisdictions—including Antarctica, the high seas, the deep sea and outer space—cannot be managed through conventional models of governance and diplomacy, and will require flexible approaches to international cooperation, informed by scientific evidence and underpinned by practical scientific partnerships (see Case study 2).

Case study 1 Using science to strengthen relations with the Islamic world

'On science and technology, we will launch a new fund to support technological development in Muslim-majority countries, and to help transfer ideas to the marketplace so they can create jobs. We will open centres of scientific excellence in Africa, the Middle East and south-east Asia, and appoint new science envoys to collaborate on programmes that develop new sources of energy, create green jobs, digitise records, clean water and grow new crops.'

President Barack Obama

President Obama's speech at Cairo's Al-Azhar University in June 2009 marked a fresh start in US relations with the Islamic world. It also highlighted science as a key tool with which to strengthen relationships. With announcements of educational exchanges, scholarships and investments in research collaboration, the speech reflected a growing recognition of the potential of science to help rebuild trust and foster understanding with the Islamic world at a time when this is urgently needed.

However, the desire of countries such as the UK and US to improve political relations is only half of the science diplomacy equation. It also requires partners in Islamic countries that are not only supportive of such collaborations, but are also scientifically qualified to engage meaningfully in joint research. While Islamic scholars and thinkers are rightly credited with influencing the direction of modern science in the 10th and 11th centuries, more recent history has revealed a steep and protracted decline in scientific excellence. In 2005, the 17 countries of the Arab world together produced 13,444 scientific publications, fewer than the 15,455 achieved by Harvard University alone.

Fortunately, there are now promising signs of renewed science ambition and investment. With gas-rich Qatar aiming to spend 2.8% of its GDP on research; the United Arab Emirates set to create the world's first sustainable city; and Nigeria pouring US$5 billion into research and education; the scientific potential of countries in the Middle East and wider Islamic-World merits closer analysis. And at a pan-Islamic world level, the 57 member-state Organisation of the Islamic Conference (OIC) has prioritised building science capacity and promoting exchange between its members.

In the autumn of 2009, the eyes of the world's scientific community turned to Saudi Arabia for the opening of the King Abdullah University of Science and Technology (KAUST). With an endowment of between US$10 and $20 billion, this graduate university aims to attract students and leading researchers from across the world, and eventually rival the California Institute of Technology for prestige. In a country where women's rights are restricted, the campus is uniquely co-educational. It has also been successful in wooing leading international universities in Europe and the US as partners. Saudi officials talk confidently of KAUST having the potential to usher in a fresh period of scientific leadership in the Middle East, not seen since the golden age of Islamic science centuries ago.

Such initiatives create a timely opportunity for Europe and the US to reach out to Islamic countries, using the soft power of science to facilitate cooperation, particularly around common interests, such as low carbon innovation. The hope is that research communities in Europe, the US and Islamic countries could help to repair fractious relationships, and inspire a next generation of leaders in research, government, academia and industry.

One promising initiative is the Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME), which is under construction in Jordan. Modelled on CERN in Europe, SESAME is a partnership between Bahrain, Cyprus, Egypt, Israel, Iran, Jordan, Pakistan, the Palestinian Authority and Turkey. Iraq is also considering joining. Synchrotrons are large and expensive facilities and are usually only found in wealthy countries. Few exist in developing countries and there are none in the Middle East. By pooling regional resources, SESAME has the potential to build scientific capacity within the region. Although it will not be fully operational until 2012, SESAME is already bringing together scientists from its partner countries for training and discussion meetings. It is hoped that SESAME will create research career opportunities that limit brain drain from the region, and serve as a model for other areas of scientific collaboration.

The Atlas of Islamic-World Science and Innovation

Alongside flagship projects like SESAME, more effort is required to strengthen partnerships by traditional means. Collaborative research between Islamic countries and the rest of the world is hindered by a lack of knowledge about potential partners for cooperation, limited support for fellowships and exchanges (compared to, for example, China), and regulatory barriers such as visa controls. Political tensions, or concerns over the potential dual use of certain technologies, can also restrict more innovative partnerships with Islamic countries.

How to map the changing landscape for science in the Islamic world, and identify practical opportunities for collaboration, is the focus of a new initiative—*The Atlas of Islamic-World Science and Innovation*—that the Royal Society has helped to set up, in partnership with the OIC, *Nature*, the British Council, Qatar Foundation and the International Development Research Centre. This project aims to monitor trends in science and innovation across the Islamic world, and support new policies and mechanisms for scientific partnerships.

Such platforms for ongoing dialogue and collaboration are vital, especially at moments of tension. For example, after Iran's elections in June 2009, Iranian scientists called on the international research community to 'do everything possible to promote continued contacts with colleagues in Iran, if only to promote détente between Iran and the West when relations are bellicose' (Nature 2009). Scientists, both within and outside of Iran, have a part to play in promoting a society that is more open to rational, critical thinking.

It would be naive, however, to exaggerate the contribution that science can play in overcoming the deep and long-term foreign policy challenges in this region. Tensions fuelled by the Israeli-Palestinian conflict, the politics of oil, and fundamentalist movements like the Taliban and al-Qaeda, mean that relations between Islamic countries, and with the wider world, remain fraught with complexities.

In isolation, there is little that science diplomacy can do to build peace and stability in the Middle East. But as one small piece in the jigsaw of geopolitical relations, science can make a contribution. President Obama's announcement in Cairo of scientific envoys to promote collaboration with Africa, the Middle East and South-East Asia is a symbolic step, and more must be done if science diplomacy is to realise its potential.

Case study 2 The governance of international spaces

'The [Antarctic] Treaty is a blueprint for the kind of international cooperation that will be needed more and more to address the challenges of the 21st century ... Governments coming together around a common interest and citizens, scientists, and institutions from different countries joined in scientific collaboration to advance peace and understanding.'

Hilary Clinton, US Secretary of State (Clinton 2009b)

2009 was the 50th anniversary of the Antarctic Treaty. So it is timely to revisit the governance of the global commons—the 'international spaces' that exist beyond national jurisdictions, including Antarctica, the high seas, the deep sea and outer space. The governance of Antarctica sets a precedent for how the soft power of science can help to strike a balance between national and common interests, and could offer lessons for the peaceful governance of other international spaces and transnational resources.

The Antarctic Treaty, which was signed in 1959 and came into force in 1961, represents a milestone in global environmental governance, and was underpinned by science cooperation. A key military threat after World War II was the potential use of rockets to deliver nuclear weapons. In 1955, President Eisenhower proposed that the US and USSR conduct surveillance flights over each other's territory for reassurance that neither was preparing to attack. The USSR rejected this proposal. But both nations and their allies agreed to participate in the International Geophysical Year (IGY), which ran from July 1957 to December 1958, as the joint activities that this enabled in pursuit of upper atmospheric science, using rockets and satellite launches, provided a public and non-confrontational demonstration of technological capabilities.

By 1958, following successful satellite launches by the US and USSR, the pressure grew for control of ballistic missiles and the testing of nuclear weapons in outer space. But these issues were too sensitive to tackle directly. Antarctica, as a neutral space, therefore assumed strategic importance, as it allowed nations to carry out a surrogate dialogue about military controls and the inspection regimes necessary to verify them. It was anticipated from the outset that the Antarctic Treaty could set an institutional precedent for the peaceful governance of other international spaces.

By 'not asserting, supporting or denying a claim to territorial sovereignty' signatories to the Antarctic Treaty transformed it into an international space, beyond national jurisdictions (Conference on Antarctica 1959). However, questions remained about how Antarctica should be governed. In the spirit of the International Geophysical Year, it was agreed that the answer was scientific cooperation. The most important common interest articulated in the Treaty was the freedom of scientific research, including the exchange of data and people. This was crucial to inform management strategies to protect the Antarctic environment and ensure the sustainable use of its resources. The Treaty also forbids military activities, and by prohibiting the testing of nuclear weapons and disposal of radioactive wastes in Antarctica, it became the first nuclear arms control agreement.

The future governance of the Arctic

The latest International Polar Year (IPY) ran from 2007–2009, and the hope is that this could have a similar legacy in the Arctic as IGY had in the Antarctic. The Arctic Ocean is currently crossing an environmental threshold, from a perpetually ice-covered region to a seasonally ice-free one. This is altering the geo-strategic dynamics of the Arctic, and awakening national interests in energy, fishing, shipping and tourism by Arctic States, China and the European Union. There are growing calls for a new, integrated governance regime for the Arctic Ocean, including proposals for an Arctic Treaty, similar to that in the Antarctic.

The existing patchwork of legal regimes for the region has the potential to fragment. Whereas Antarctica is an isolated continent surrounded by ocean, the Arctic consists of continental land masses semi-enclosing the Arctic Ocean. There is no single regulatory regime covering the entire region. Instead, the surrounding land masses of the five coastal states of Canada, Greenland (Denmark), Svalbard (Norway), Russia and the United States are sovereign territories. The Arctic Ocean is governed by national and international legal regimes, most notably the United Nations Convention on the Law of the Sea (UNCLOS). Common interests in the region are coordinated by the Arctic Council, but its membership is limited to the coastal Arctic States, which do not believe a new legal regime is required. Other countries with interests in the region are excluded from this body.

One option would be to focus on the centre of the Arctic Ocean, which is now covered by frozen ice. Whilst much of the sea floor may come under national jurisdictions, the overlying water column and sea surface at the centre of the Arctic Ocean is legally distinct, and the UNCLOS already recognises it as undisputed international space. The centre of the Arctic Ocean therefore provides a starting point for governance discussions, which do not threaten the national jurisdictions of the Arctic coastal states, or require an entirely new legal regime.

Science cooperation provides a useful basis for these discussions (Berkman and Young 2009). Ongoing research into Arctic Ocean systems will be essential to inform management strategies for when the ice thaws and makes this international space more accessible. More research is required into sea-level rises; loss of sea ice; melting permafrost and feedback mechanisms; the location and availability of resources; and the impacts of long-range pollutants. Much of this research will require international collaboration, especially when the harsh conditions of the Arctic necessitate the sharing of costs, logistics, facilities and other capabilities.

There is an even greater need to prevent conflict as the sea ice in the Arctic Ocean starts to disappear. The Arctic States have identified the socio-economic development of the region's natural resources and the protection of its ecosystems as their common interests. However peace is yet to be identified as an explicit common interest, so the Arctic Council is not mandated to discuss military and related security risks.

Again, a possible solution is provided by the centre of the Arctic Ocean. Environmental security discussions focused on this international space could provide a cooperative framework through which to address military risks. For example, energy development, fishing, shipping and tourism in the Arctic all require coordinated search and rescue missions for stranded vessels. The thawing of the Arctic Ocean also increases the risk of accidents and the need for emergency responses to ecological disasters. Given that militaries are trained in providing disaster relief and search and rescue, clarifying their role in this context could increase transparency and maintain a dialogue that could eventually allow more sensitive issues to be addressed.

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Further information

Information and resources on science diplomacy are available online at:

Royal Society Science Policy Centre
www.royalsociety.org/policy

AAAS Centre for Science Diplomacy
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Appendix 1 Discussion meeting programme

Day 1: Monday 1 June 2009

Welcome and opening remarks
Lord Martin Rees, President, The Royal Society

Session 1 Current and future directions for science diplomacy

Chair: Professor Lorna Casselton FRS, Foreign Secretary, The Royal Society

Security challenges in the 21st century
Professor John Beddington FRS, Chief Scientific Adviser to the UK Government, UK

Science diplomacy for the 21st century
Dr Nina Fedoroff, Science and Technology Adviser to the Secretary of State, US Department of State, USA

Session 2 Perspectives on science diplomacy I

Chair: Dr Alan Leshner, Chief Executive, American Association for the Advancement of Science, USA

China's international science and technology cooperation
Mr CHEN Futao, Minister Counsellor for Science and Technology, Chinese Embassy, UK

Science and technology diplomacy; Japanese perspectives and approaches
Mr Jun Yanagi, Director, International Science Cooperation Division, Ministry of Foreign Affairs, Japan

Europe's international science cooperation
Ms Sigi Gruber, Directorate for International Cooperation, Directorate General Science, Research and Development, European Commission, Belgium

Session 3 Perspectives on science diplomacy II

Chair: Professor Mohamed Hassan, Executive Director, Third World Academy of Sciences, Italy

Science diplomacy and ever changing India
Dr Raghunath Mashelkar FRS, President, Global Research Alliance, India

Brazil and science diplomacy
Professor Luis Davidovich, Director, Brazilian Academy of Sciences

Science diplomacy: a view from industry
Mr James Smith, Chairman, Shell UK

Session 4 New partnerships with the Islamic world

Chair: Mr Ehsan Masood, Chief Commissioning Editor, *Nature*, UK

The Atlas of Islamic-World science and innovation
Dr Razley Mohd Nordin, Director General of Science and Technology, Organisation of the Islamic Conference, Pakistan

Building Trust by Empowering Societies Through Knowledge
Mr Naser Faruqui, Director, Innovation, Policy and Science (IPS), International Development Research Centre, Canada

Synchrotron-light for Experimental Science and Applications in the Middle East (SESAME): fostering science, building bridges
Professor Chris Llewellyn Smith FRS, President, Synchrotron-light for Experimental Science and its Applications in the Middle East

Day 2: Tuesday 2 June 2009

Session 5 Science for development: humanitarian, ethical or political investment?

Chair: Dr Andree Carter, Director, UK Collaborative on Development Sciences, UK

Science and new approaches to international development
Professor Chris Whitty, Head (Research), Policy and Research Division, Department for International Development, UK

Science, technology and innovation capacity building partnerships for sustainable development
Mr Alfred Watkins, Coordinator for Science, Technology and Innovation, World Bank, USA

Session 6 Building capacity for science diplomacy

Chair: Dr Yusaf Samiullah, Deputy Director and Head of Profession and Infrastructure, Policy and Research Division, Department for International Development, UK

Engaging tomorrow's leaders
Mr Martin Davidson, Chief Executive, British Council, UK

Universities, skills and scientific exchange: beyond the ivory tower
Professor Stephen Hillier, Vice-Principal (International) and Director of Postgraduate Studies and International Relations, Edinburgh University, UK

Capacity building and networks
Professor Mohamed Hassan, Executive Director, Third World Academy of Sciences, Italy

Science, technology and innovation in State building
Professor Atta-ur Rahman FRS, Coordinator General, Committee on Scientific and Technology Cooperation, Organisation of the Islamic Conference, Pakistan

Session 7 Environmental security: poles apart?

Chair: Dr Jim McQuaid FREng, Former Chairman, Environmental Security Panel, Science for Peace and Security Committee, NATO

Arctic science: international science partnerships to nurture and reinforce diplomacy
Professor Howard Alper, Chair, Science, Technology and Innovation Council, Canada

Governing the Arctic: policymaking based on national or common interests?
Ms Diana Wallis MEP, Vice President, European Parliament, Belgium

Governing international spaces: negotiating the Antarctic Treaty and the future of the Arctic

Professor Paul Berkman, Head, Arctic Oceans Geopolitics Programme, Scott Polar Research Institute, Cambridge University, UK

Session 8 Back to the future: the role of science and scientists in nuclear diplomacy

Chair: Dr Anne Harrington, Director, Committee on International Security and Arms Control, National Academies of Science, USA

Ensuring the impact of technical cooperation

Dr Arian Pregenzer, Senior Scientist, Cooperative Monitoring Centre, Sandia National Laboratories, USA

The contribution of the science community in treaty implementation and verification

Ambassador Tibor Tóth, Executive Secretary, Preparatory Commission of the Comprehensive Nuclear Test Ban Treaty Organisation, Austria

Session 9 New frontiers in science diplomacy

Chair: Dr James Wilsdon, Director, Science Policy Centre, The Royal Society

Emerging countries as ambassadors for science diplomacy

Professor Romain Murenzi, Minister of State for Science and Technology, Rwanda

Panel

- Mr Gavin Costigan, Head, International Science and Innovation Unit, Department for Innovation, Universities and Skills, UK
- Professor David Kerr, Chief Research Advisor, Sidra Medical and Research Centre, Qatar
- Dr Norman Neureiter, Senior Adviser to Centre for Science Diplomacy, American Association for the Advancement of Science, USA

The Royal Society

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- **Increase** access to the best science internationally
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