

Bow of Burning Gold

Faster than fairies, faster than witches

Gut Feelings

Out of the mouths of babes and sucklings

SCIENCE IN PARLIAMENT

sip

SUMMER 2012



The Journal of the
Parliamentary and
Scientific Committee

www.scienceinparliament.org.uk

The Materials Knowledge Transfer Network



New materials technologies are crucial to the revival of UK manufacturing and to sustaining innovation in sectors such as the modern built environment, transport, security, healthcare, sports, energy, electronics and retail. Materials are essential to underpin the technological advancement of most value-adding sectors in the UK economy and the drive for zero waste, low carbon emission and resource efficiency.

The UK has particular strengths in traditional materials such as metals, concrete, structural ceramics, wood, polymers, glass and industrial minerals. It also enjoys world-class levels of competence in designing with materials and in the newer areas of advanced composites, engineering ceramics, technical textiles, smart, multi-functional, electronic, natural and bio-compatible materials. Meanwhile UK research, standards and metrology institutions have a similarly high reputation for their success in the generation of knowledge and understanding across a wide range of materials.

As one of the Technology Strategy Board's Knowledge Transfer Networks (KTNs), the Materials KTN has been connecting materials scientists, technologists, producers, users and product designers to create and exploit the opportunities presented by new developments in materials, including those influenced by the major shift to deliver new products and services with lower environmental impact across their lifecycle and the need to meet consumer demands for smarter product functionalities.

For further information contact:

Dr Robert Quarshie
Director, Materials KTN
E: robert.quarshie@materialsktn.net

Prof Colin Seabrook
Chairman, Materials KTN
E: colin.seabrook@materialsktn.net

www.materialsktn.net



One of the earliest sporting events of Her Majesty's reign to make British hearts beat faster was Roger Bannister's iconic mile run.

Much has changed in the UK sporting scene since then, and several articles in this issue address the novelties which we will be seeing at this year's Olympics.

Photos of the Iffley Road track on which the 4 minute mile was run show a surface closer to a cross country course than to today's all weather track. His shoes would have been several grams heavier than today's new fabrics allow. His training was a few outings a week, of an hour or so at a time – he was a true amateur. His nutrition (and he was a qualified doctor) did not include high protein shakes. No one in the marathon will suffer dehydration as poor Jim Peters did in 1954.

Bannister was of course an Oxford graduate as were many of the UK track and field athletes at that time. In 2012, we have greatly increased our gene pool by taking advantage of many who are either immigrants themselves, or are the offspring of recent immigrants.

In the case of rowing, there have even been selective programmes to seek out strong, tall youngsters.

Britain's fantastic success in cycling has been helped by our meticulous attention to the technology of the bike itself – from producing materials of outstanding lightness and rigidity, to wind tunnel testing of bike plus athlete.

Sadly abuse of science has also led to performance enhancing drugs, whether synthetic like steroids, or natural like erythropoietin. Happily, drug testing keeps catching up, and this year will see the most sophisticated facilities ever.

It was therefore most fitting that the minister for Science, David Willetts, recently announced a huge £500m programme to support UK Bioscience over the next five years.



Andrew Miller MP
Chairman, Parliamentary
and Scientific
Committee

SCIENCE IN PARLIAMENT sip

The Journal of the Parliamentary and Scientific Committee.

The Committee is an Associate Parliamentary Group of members of both Houses of Parliament and British members of the European Parliament, representatives of scientific and technical institutions, industrial organisations and universities.



Science in Parliament has two main objectives:

1. to inform the scientific and industrial communities of activities within Parliament of a scientific nature and of the progress of relevant legislation;
2. to keep Members of Parliament abreast of scientific affairs.

CONTENTS

LONDON 2012

Hugh Robertson MP

BUILDING SCIENCE INTO LONDON 2012

Sir John Armitt

HEALTH AND SAFETY ON LONDON 2012

Lawrence Waterman

SCIENCE AND SPORT

Dr Mark Downs

THE SKILLS DEVELOPED THROUGH SPORT WILL BE A LEGACY

Professor David Lavallee

MAKING A DIFFERENCE WITH MATERIALS

Dr Robert Quarshie

INNOVATIONS FOR THE OLYMPIC ATHLETES AND SPECTATORS?

Brian J McCarthy

GEARING UP

PVC IS ONE OF MANY MATERIALS PLAYING A PART

2 CRITICAL COMMUNICATIONS AT THE OLYMPIC GAMES

Rupert Cazalet

3 RECENT DEVELOPMENTS IN SPORTS NUTRITION

Professor Ron Maughan

8 PROTECTING OLYMPIC RIDERS

Rachael Faulkner

10 WHY WOULD HS2 BE GOOD FOR BRITAIN?

Addresses to the P&SC by Bridget Rosewell, Professor Andrew McNaughton and Sir Richard Leese

12 VOICE OF THE FUTURE

STRENGTHENING THE TECHNICIAN WORKFORCE
Robert Neilson

14 FOOD AND GUT HEALTH

Addresses to the P&SC by Professor Glenn Gibson, Dr Linda Thomas and Professor Simon Carding

15 HARNESSING THE POWER OF GENOMICS FOR ANIMAL HEALTH

Dr Jim Huggett and Dr Jason Sawyer

18 TURKEY: ONE OF THE LATEST COUNTRIES TO JOIN UK SIN NETWORK 40

Dr Başak Candemir

20 ROCKET SCIENCE: UK AND RUSSIA IN SPACE 41

Dr Julia Knights

22 GETTING MORE PEOPLE TO DO PHYSICS 43

Duncan Chamberlain

24 SELECTED DEBATES 44

26 HOUSE OF COMMONS SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY 45

30 HOUSE OF LORDS SCIENCE AND TECHNOLOGY SELECT COMMITTEE 47

32 HOUSE OF COMMONS LIBRARY SCIENCE AND ENVIRONMENT SECTION 48

33 PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY 50

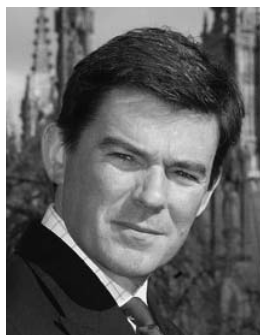
38 SCIENCE DIRECTORY 52

SCIENCE DIARY 61

The front cover is a montage from Parliamentary Links Day on 26th June, organised by the Society of Biology on behalf of the entire science and engineering community.



LONDON 2012



Hugh Robertson MP
Minister for Sport and the
Olympics

There are just a few days to go until the Opening Ceremony of the London 2012 Olympic Games, when our Capital – and our Country – welcomes the world to watch the greatest sporting event on Earth. We are ready. From infrastructure and planning to security and transport, I am as confident as I possibly can be that we will deliver a safe and successful

Games.

It is no secret that in the sporting world, science and medicine programmes play an invaluable role, from helping our athletes stay in peak condition, to fighting drugs in sport. In the run-up to 2012, I want to mention two specific organisations using science to help the athletes and sports governing bodies. The English Institute of Sport (EIS) are the 'team behind the team' supporting athletes in their training, physical fitness and psychological preparations. The UK Anti-Doping Agency has an excellent programme educating athletes about drugs as well as ensuring that cheats have no place to hide with its investigative and testing work.

The EIS delivers a range of science and sport medicine services to over 40 Olympic and Paralympic sports. It helps keep our athletes injury free and

prepared for competition. Our last four gold medals in Beijing were won by an aggregate time of 0.87 of a second, so the margin between getting on the medal podium and finishing fourth are slim. Sports science can often help make that little difference between a medal and going home with nothing.

UK Anti-Doping, working with its international partner, the World Anti-Doping Agency, is best placed to assess the threat of doping in this country. They do this by identifying changes and trends in doping activity and ensuring that there are strategies to deal with them. Work undertaken in this area includes

... The UK Anti-Doping Agency has an excellent programme. . .

Science and sports medicine is not only an incredibly important aspect of an athlete's preparation for world-class competition. It is also vital in helping us understand things like sudden death in sport, concussion in sport, genetics and sports performance.

the introduction of a blood profiling programme which helps to detect changes in the body which may be caused by the use of performance-enhancing drugs or methods.

In January this year, I helped the London Organising Committee open the Anti-Doping Laboratory for London 2012 with GlaxoSmithKline and King's College London. This lab is at the forefront of the fight against doping. It will be populated with scientists from King's at the top of their field during the Games who will carry out an exhaustive testing process.

They will analyze over 6,000 samples throughout the Games – up to 400 each day, more than at any other Games in history. Our message to any athlete thinking about doping is simple – we'll catch you. And, none of this would be possible without science in sport. From helping our elite athletes stay in top shape, to helping us combat the threat of doping, the Games would simply not be the greatest sporting event in the world without Science.

... we will deliver a safe and successful Games ...



BUILDING SCIENCE INTO LONDON 2012



Sir John Armitt CBE FREng
Chairman, Olympic Delivery
Authority

The first medals are yet to be won in London 2012, but the achievement of the construction and engineering industries, delivering this vast and challenging project on time and under budget, is surely worth a gold in anybody's book.

The Olympic Park has been transformed in six years from a neglected patch of east London – an underused industrial site that was part wasteland, part contaminated, and all in need of regeneration. Before we could even start building, the 2.5sq km site had to be cleared and the land remediated.

Our partners in “mission impossible” have been companies – and their employees – in every corner of the United Kingdom, sharing in more than 1,500 top-level contracts worth over £6.5bn. The UK has always been a leader in construction; London 2012 has helped capture the

public's imagination and build confidence, here and abroad, that we can still deliver. We are not only capable of delivering major projects but that we are up there with the very best.

London 2012 has provided a fantastic opportunity to showcase the quality and innovation of British companies. Science and technology have played a major part in this. To some on the outside, science may not always be spoken of in the same breath as construction, but the reality is that technology and innovative ways of working have been pivotal in getting the job done, whether through pioneering construction methods, the latest approaches to carbon reduction, or using new technology to create better buildings and infrastructure.

Structural engineers, who rely on technological advances, came into their own as they built the venues and

infrastructure that are now an established part of the London skyline. We have new world-class sports facilities, thousands of homes in the Olympic Village and the largest new urban park in the UK for over a century. We have new bridges and roads, together with a backbone of utility and energy infrastructure that will serve the area for decades to come.

Technology was vital in ensuring synergy in the Olympic Park. Computer-aided design (CAD) and Geographic Information Systems (GIS) were used extensively to manage the multi-disciplinary platform, to ensure a completely co-ordinated approach. 3D visualisation of the Olympic Park was an essential tool in ensuring the venues and parklands were integrated and interacted with the surrounding community. It also provided a cost effective and flexible means of producing



physical models, simulation, fly throughs, and video animation.

Modern soil drilling techniques allowed us to test the quality of the earth and helped us calculate what needed to be cleaned or removed. The investigation of 250 hectares of land was challenging in itself, with 3,000 exploratory holes being dug. However, this represented only the beginning as the chemical and geotechnical data generated by the investigation had to be transferred in a suitable format to the designers so that earthworks and remediation could be commissioned. After we had identified the material that needed cleaning, five “soil washing” machines were used to clean two million tonnes of earth, with 80 per cent being reused on site. Without the technology, we simply would not have been able to do this in the required time.

Science extended beyond the realm of construction. The wildflower meadows surrounding the 80,000-capacity Olympic Stadium have been artificially timed to flower in July for the Games, just one example of the painstakingly detailed and innovative work of the experts who have created the Olympic Park. And in the Olympic Village we have installed superfast broadband for the 2,818 apartments that will become a new community after the Games – East Village, the first development of this size to have fibre optic cables installed in every home.

It was never going to be easy, and there were significant challenges to overcome. Our shared success in delivering the project against a deadline and within budget is rooted in a culture of overcoming hurdles – from the earliest planning stages to the Big Build itself.



There have been so many notable aspects to this project. We have encouraged contractors to buy into our challenging targets from the outset. Their response was excellent and enabled us to achieve new benchmarks across a range of areas, including tough sustainability targets and industry-leading health and safety records. Hitting these valuable indicators has served to create a sense of achievement and of being a single team with the same goal.

We have met 90 per cent of our sustainability targets including those covering the recycling of waste, the reuse of steel for the structure of the Olympic Stadium and Velodrome, and achieving Level 4 in the Code for Sustainable Homes for the Olympic Village – a real stretch for the project. Many of these achievements are now recorded on the ODA's learning legacy website.

We have constructed venues that are built to last, not just for a few weeks this summer. The Aquatics Centre is designed so that the seating wings, which increase the capacity of the

building to 17,500 during the Games, can be removed, leaving a 2,500-seat venue for community use, elite athlete training and major events. The Olympic Stadium can be reduced to 25,000 seats, depending on the requirements of the London Legacy Development Corporation, which will take over responsibility for the Olympic Park after the Games.

Where there was not a need for a permanent venue, we built temporary ones. Engineers have met these challenges head-on, delivering the 12,000-seat Basketball Arena, which can be completely dismantled after the games to be reused elsewhere. We already have interest from Rio de Janeiro, host city for the 2016 Olympic and Paralympic Games.

British industry has shown that it has a wealth of talent and can deliver to the highest standards. With the eyes of the world on London this summer, people from across the world will be able to see for themselves, whether on television or in the flesh, what has been achieved.

The reputation of the British construction industry is as strong as it has been for a long time. The London 2012 project has helped promote UK expertise to a global audience, with companies proving that they can exceed expectations and deliver. The fact that it has all been done against a difficult economic backdrop – and to an immovable deadline – reinforces this.

In creating a completely new community – with sports venues, housing and infrastructure – the foundations have been built for the Olympic Park to become one of the best places in London to live. I believe the true test of the success and its legacy will not be this summer, or in five years time. It may take decades to be fully realised, but by 2030 I believe we will look back with satisfaction at what London – and the UK – gained from hosting the Games.

Learning Legacy website:
www.london2012.com/learning-legacy

HEALTH AND SAFETY ON LONDON 2012



Lawrence Waterman OBE
Head of Health and Safety,
Olympic Delivery Authority

INTRODUCTION

The UK construction industry contributes disproportionately to workplace accidents and injuries – if London 2012 had mirrored the sector in 2005, there would have been approximately 500 accidents reportable under the RIDDOR regulations, many causing major injuries and permanent disabilities for the workers involved, and three fatalities. The “health” part of health and safety in construction has not historically been addressed adequately, which, taken with the predominately male and ageing workforce, has left a considerable gap in health management.

With time constraints and huge public scrutiny in an industry recognised for a poor health and safety record, the London 2012 programme presented great challenges to defy the statistical averages. From its formation the Olympic Delivery Authority (ODA) identified its aspiration – that the process by which venues and infrastructure for London 2012 were to be constructed should reflect the Olympic and Paralympic ideals and ensure the safety, health and welfare of the workforce. Another aim was to create a positive, lasting legacy, not just in bricks and mortar but also in raising the bar in health and safety performance. This is now expressed in the Learning Legacy website with

independent research evaluations, case studies and tools.¹

COMMITMENT

The ODA placed health and safety considerations at the heart of management. The reasons for this focus were threefold:

- The ODA had a moral obligation to minimise harm to its workforce. There was a strong desire to prevent fatalities and ensure that everyone went home safely every day.
- Legally, the ODA had duties under the *Health and Safety at Work etc Act 1974*, and subsidiary legislation particularly the *Construction (Design and Management) Regulations*.
- Good management is responsible for managing risk – and the risks to the programme, including to the reputation of the ODA and its sponsoring Department DCMS, certainly encompassed the impact that serious accidents and/or work-related ill health could have.

It was unacceptable to work “business as usual” and suffer many accidents or ignore the health of workers on site. The ODA set its stretching benchmark as fewer than a RIDDOR-reportable accident for every one million hours worked and enhancing the well-being of the workers.

STRATEGY

The overall objective was to unlock the abilities of suppliers to deliver excellence, it was recognised that the major companies that had bid and had been appointed as Tier 1

contractors had done so because they wished for the high profile intrinsic to participating in the London 2012 works. Those companies installed some of their best people. This was a supply chain that at the top was truly committed to an excellent health and safety performance. The challenge was to realise that commitment in practice.

In summary, the programme operated so that:

1. The design brief and specifications, procurement and the wording of contracts all reflected the ODA's requirements. The adoption of a *Health and Safety Standard* developed through consultation with trades unions, industry bodies, HSE and professional institutions was an early achievement – for a client body to consult in order to confirm that what it was doing represented evidence-based best current practice was a major innovation.

2. Design management was used to drive the whole approach to “safe and healthy by design”.

3. On site there was a leadership programme, worker engagement and assurance through regular scrutiny.

LEADERSHIP FOR HIGH PERFORMANCE

The ODA Leadership Board was chaired by the CEO and attended by the ODA Chairman, the Chairman of the Board SHE Committee, executive directors and members of the senior team for the Delivery Partner. The Board reviewed the strategy

... ensure the safety, health and welfare of the workforce ...

and approved the initiatives being taken. Having made arrangements for this high level support, which was also evidenced by the senior staff participating in awards events on site and centrally, site tours and other engagements with each project, the focus moved to engaging the senior staff in the project teams.

A Safety, Health and Environment Leadership Team (SHELT) was formed with over 20 Tier 1 members each representing at the highest level the projects on the ground, together with senior staff from the Delivery Partner and three ODA representatives – Director of Construction and Heads of Health and Safety and of Environment. The leadership team was responsible for a wide range of very specific initiatives and innovations including:

- Banning unsafe equipment
- Establishing a mandatory supervisor course on leadership and behaviour
- Campaigns on electrical services timed for them going live

Agreeing Visual Standards and then using them to achieve good housekeeping

Ensuring that on every project there was a behavioural safety programme and really effective worker consultation

DESIGNING FOR SAFETY AND HEALTH

Falls from height remain a major cause of fatal accidents. An illustrative case of the value of seeking better design is the Velodrome. The architectural form was driven by the sightlines of the spectators and directly related to the geometry of the track and this in turn created the special shape of the roof affectionately described as looking like a 'Pringle' crisp.



Cablenet roof design at the Velodrome

The initial concept design of the Velodrome roof consisted of a steel truss roof design. Although constructable this would have led to a significant amount of work carried out at height with temporary support structures installed. This would in turn have created significant health and safety risks for the construction workers and introduced long term maintenance risks for the operator of the venue to manage. Exploring alternatives led to a safer and more cost effective roofing solution – a 'Cablenet' roof design, assembled at ground level, fixed to node points and hydraulically jacked into its final position. The Cablenet roof design solution reduced the need for construction workers to work at height, since the majority of the assembly work was carried out at ground level.

IMPLEMENTATION ON SITE

To achieve world class performance on health and safety, successful implementation at project level was critical. Each project's leadership, planning and workplace organisation, systems and procedures, and probably most importantly, behaviour and

culture programmes needed to be robust and fully effective from very early on.

On the Aquatics Centre project, for example, a significant amount of planning and organising took place in a relatively short space of time. What initially looked like a simple large work site soon

and safety management across all the projects. These standards, defining high level expectations in a wide range of technical areas, were collaboratively developed with Tier 1 representatives in order to set minimum expectations.

Implementing standards was enhanced by a set of supporting

... consistency in health and safety management ...

became a challenging work area with a number of concurrent activities taking place. All activities on the project were subject to thorough planning and review processes. The principal activities involved movement of heavy plant, significant lifting operations and placing large volumes of reinforcement and concrete in the early stages of construction. One of the key mechanisms for recording and communicating the changing workplace was a 'Weekly Overview' process that identified key areas of interface between people and machinery, and the associated risks.

A number of Olympic Park Common Standards were developed in order to drive a degree of consistency in health

documents that illustrated workplace conditions and personal behaviours in order to clearly communicate 'what good looks like'. These Visual Standards were used by the Aquatics Team in a number of ways: communicating health and safety expectations to teams; checking conditions on site inspections; and as leadership tool in management by eyesight tours. The nature of the documents also meant that workers for whom English was a second language, were still able to understand site requirements and participate in safety related activities. [An example of a visual standard is shown opposite.](#)

LEADERSHIP WITHIN A PROJECT

The team constructing the Olympic Stadium adopted and developed what became the Olympic Park approach to creating real, visible leadership around health and safety through a variety of means. A Project Leadership Team (PLT) was formed involving senior staff from the Tier 1 and a representative from each of the Tier 2s/3s (package sub-contractors). The PLT took the lead in promoting high standards of health and safety, and encouraging everyone to get involved and stay engaged. They actively encouraged near miss reporting – and by the end of the construction programme we had suffered 125 reportable accidents across the works, but received over 10,000 near miss reports which represent worker and supervisor identified opportunities for improvement, a sort of construction site suggestions box.

OCCUPATIONAL HEALTH

The health and well being of the site workforce was also central to the overall health and safety programme. There is good evidence that far more workers are harmed by exposure to hazards to their health – dusts, fumes, vibration, noise and many other factors – than are injured in accidents. The services of professional teams based on the Olympic Park and within the Athletes' Village ensured attention to these risks. The health initiatives covered:

- Pre-employment health checks, including medicals for safety critical workers
- Advice to identify safer substitute materials and methods
- Assistance with controls on exposures to chemical, physical and ergonomic hazards
- Health surveillance

- Drop-in Treatment Centres
- Campaigns on well-being (heart, obesity, diet, diabetes, sexual health, etc etc)
- Emergency Call-out with ambulance services operated by paramedics

The services were well respected, demonstrated by regular site worker surveys and the willingness of London Ambulance Service to sign a Memorandum with a private health provider as "First Responder" in the event of a health emergency.

REWARD AND RECOGNITION

One of the overriding impressions that health and safety programmes can convey is that of a focus on what is wrong, what can cause harm. Many workers will "see" health and safety when inspections are conducted, and all that is commented upon, noted and followed up are non-compliances with site rules. This wholly negative approach is not consistent with efforts to engage, involve and enthuse people to create exemplar projects and exemplar sites. Instead from the early stages of the works the ODA celebrated

LESSONS LEARNED - CONCLUSION

Through careful planning, the implementation of strategies which have a proven track record and, above all, clear leadership even the most complex construction programme can be safely managed. It is important that this is done systematically, which is why the ODA is the first Delivery Authority for a Games to have its health and safety management system certified against the internationally recognised Standard OHSAS 18001. The record is of a programme that has operated for over six years on site, with more than 80 million hours worked. During this time the accident experience has been comparable to the average for all GB employment rather than just for construction, and the health programme provides a degree of care and campaigning not previously experienced in the industry. The stretching benchmark of an accident rate better than 1 in a million has been reached and held for over a year and the health and safety performance has contributed to the projects hitting and beating their targets for delivery timetable and cost control.

... beating their targets for delivery timetable and cost control ...

health and safety performance, marking every achievement, creating an impression of winning, of protecting people by doing a great job. This was done locally at project level, and across the programme with everything from London 2012 badges and breakfast vouchers to competitions, award schemes and celebrations every time a million hours was worked without an accident or some other laudable achievement was made.

Healthy and safe projects are also efficient, and the time spent on health and safety represents a sound investment rather than an on-cost.

Footnote

- 1 There are many materials, including independent evaluation research reports on the London 2012 Learning Legacy website: <http://learninglegacy.london2012.com/themes/health-and-safety/index.php>

Olympic Park standard on: **Safe use of pulpit / platform steps**



Key points:

- A risk assessment and method statement should identify when pulpit steps should be used
- Only those who have received appropriate training should undertake any work at height
- Access equipment for any work at height must be erected on a firm, level base
- Individually numbered, inspected and maintained
- Outriggers must be used to increase stability

SCIENCE AND SPORT



Dr Mark Downs
Chief Executive, Society of Biology

... the best
nutritional
strategies to
improve athletes'
recovery and
endurance ...

British scientists work to improve the performance of athletes, protect them from injury, and improve recovery. Just as the impact of the Olympics on sport goes well beyond the athletes competing, the benefits of sport science can be felt by the wider population.

ELITE ATHLETE PERFORMANCE

Britain still holds some spectacular world records, including the women's marathon, with Paula Radcliffe claiming the title in 2 hours 15 minutes 25 seconds (2003). In men's athletics, Jonathan Edwards holds the triple jump world record (1995) with a distance of 18.29m, the equivalent length of a double decker bus!

Traditionally, coaches have relied on trial-and-error and gut reaction to improve performance. Science has revealed techniques, some of which seem counter-intuitive, with the potential to improve performance.

Researchers studying how athletes change their technique as they sprint round a bend, for example, have gained a deeper understanding of why sprint speeds are slower on bends than on the straight. Leaning inwards on the bend changes a sprinter's gait, for example the angle of the knee when the athlete puts down their foot, which is known to be associated with performance. They found that 'reduced touchdown distance' could be the key to improving performance on the bend.

Also emerging from research are genetic factors which affect performance. Our muscles contain two types of fibres; slow-twitch fibres are more efficient at continuous contractions, while fast-twitch

help generate a lot of force quickly. Most of us have a genetically determined mix of roughly 50% of each, and the ratio cannot be altered, whereas the fastest sprinters are born with up to 90% fast-twitch muscle fibres.

As athletes enter nerve-racking world competitions, psychology can have a major impact on who comes out on top. Interestingly, there has been a sudden improvement in performance of top sprinters over the past 4 years, ever since they had Usain Bolt to chase. Since Bolt came onto the blocks the top 25 sprinters have improved by nearly 1% – which is a lot when you consider how small the margins of victory can be in sprinting!

Nutrition during training and competition is an important factor in performance and overall health. Research teams

are working to determine what the best nutritional strategies are to improve athletes' recovery and endurance. Such findings will contribute to our general understanding of human nutrition and physiology – and will have lasting benefits after the Games are over.

PREVENTING AND TREATING INJURIES

Sport can have negative as well as positive outcomes; sporting injuries include damage to muscles and joints, repetitive motion injuries, and heat-related illnesses. Research is taking place in the UK to ensure that sport and physical education are safe, and maximise psychological, social and physical benefits.

Gymnastics is a demanding discipline which is known to put young people in particular at risk of injury. The bodies of gymnasts are subjected to frequent high-impact, weight-bearing activities, and scientists have studied ways to reduce injury risk. These include changes to landing technique and posture, medical screening, strength training, and an adequate warm up and cool down.

It is not only human athletes whose health must be guaranteed in international competition.

At the Olympic equestrian 3-day event, the horses will be subject to a veterinary inspection each day to ensure they are fit to compete in the demanding



events. Techniques are constantly being developed to judge a horse's gait to detect signs of injury before they are visible to the naked eye, and equine physiology and nutrition are being studied to improve horse performance and wellbeing.

Biology's members' magazine, covered a new threat to the integrity of competitive sport on the horizon: gene doping. Gene doping has been banned by the World Anti-Doping Agency since 2003, though there is currently no evidence that it has been attempted.



KEEPING COMPETITION FAIR

The anti-doping laboratory at the 2012 Olympics will work around the clock to test over half the estimated 18000 competitors taking part for drugs. By improving the speed of anti-doping tests, researchers have increased the chance of detecting athletes using banned performance-enhancers during the games.

At London 2012 a number of new technologies will be used to provide the most comprehensive data possible on the composition of the athletes' urine samples.

However, anti-doping tests may become more challenging. An article in the June edition of *The Biologist*, the Society of

Gene doping is the enhancement of athlete performance using cells, genes, or genetic material, or altering gene expression. There are huge technical challenges to gene doping, but current research suggests it has potential to enhance athlete performance.

Unlike drugs, which are chemical compounds that do not occur naturally in the body, gene doping would result in the production of biological molecules, making them very hard to detect without invasive tissue biopsies.

The kind of scientific advances which increase the potential for gene doping could also have positive outcomes for competitive sport. The time may not be far off when someone's genes could be used as an

additional tool to identify performance potential, or shape training, nutrition and drugging regimes.

SPORT FOR ALL

The benefits of sport and sport science are by no means limited to elite athletes. We are all aware of the overwhelming scientific evidence that sport has major health benefits and can improve general wellbeing. People who do regular activity have a lower risk of many chronic diseases, such as heart disease, type 2 diabetes, stroke and some cancers.

This knowledge has helped fuel campaigns to encourage more people to increase their level of exercise, and hopefully many lives can be improved and saved through exercise.

Many of the lessons elite athletes can learn from sport science are applicable to everyone, such as appropriate nutrition and hydration.

With approximately 70% of our body made up of water, optimal hydration is essential for health and maximum performance. Milk, for example, has gained scientific support for its role in promoting hydration, due to its high water and sodium content. About 20% of daily water intake comes from

food, and maintaining hydration can be helped by eating foods such as lettuce and watermelon.

THE IMPORTANCE OF SCIENCE

Behind every athlete at the London Olympics is a dedicated team of coaches, advisors and friends. Jenna Stevens-Smith, Public Engagement and Events Executive at the Society of Biology and a former international volleyball player, experienced the varied roles scientists have to play in supporting our athletes. She says: "Athletes from all sports, depending on the funding, have a whole team of scientists and experts around them: when I played volleyball for Great Britain, our support team included a physiotherapist, sports masseuse, nutritionist, sports psychologist, strength and conditioning coaches, lifestyle advisors, biomechanicists, technical coaches and even a sports optician!"

This summer's Olympic Games will not only be a testament to the strength of British sport, but also to the many and varied scientists who support it.

The benefits of science in sport will be one of the key legacies of the London Olympics.



... Science has revealed techniques with the potential to improve performance ...

The skills developed through sport will be a legacy of the 2012 Olympic and Paralympic Games



Professor David Lavalley
University of Stirling

... Research on retirement from sport can help us to understand retirement from other high performance and demanding domains such as business and politics. . .

... Individuals need to learn a broad range of diverse skills . . .

As the demands associated with high-performance sport have increased over the years, so has the interest in the skills developed by athletes during their sporting careers. Elite athletes are required to maintain a wide range of skills, but also have the ability to acquire new ones. A greater understanding of how they are able to do this will have implications for wider society, with elite sport serving as a model for the maintenance and enrichment of an individual's skill base.

The UK Skills for Sustainable Growth National Strategy¹ states that a prosperous economy depends on the development and adoption of new skills. Individuals need to learn and retain a broad range of diverse skills and also to acquire new ones in order to function successfully in a changing society. Otherwise innovation and new technologies will be threatened or we will fail to make the most of them.

Advancing knowledge in this area can identify the factors associated with the capacity to retrain, increase the effectiveness of reskilling for new work environments and accelerate skill-based learning through the development of training programmes. Such research is highly relevant to a workforce increasingly required

to be adaptable and to an ageing population who need to learn new skills associated with technological advances as well as to military veterans making the transition to civilian life.

I have studied the impact on athletes who make the move to other careers after they retire from sport.² The research aimed to help athletes plan for their lives after sport and found that high-level sporting competition plays an important role in developing transferable skills such as communication and time-management. However, I also found that athletes who focus exclusively on their sport can become role-restricted and find it difficult to change career. The athletes who were better prepared for life after sport managed to balance their education and career development alongside training and competition.

Due to the potential difficulties associated with

retirement from sport, several programmes have been developed by governing bodies and sport institutes around the world to assist athletes. Research² that my colleagues and I presented as part of the launch of the Academy of Social Sciences has changed the way athletes are supported through these programmes. (You can read more about it in *Making the Case for the social sciences: Sport and leisure*³ and in the report: *Supporting a UK success story: The impact of university research and sport development*⁴.)

The findings of this research have been used to train advisers to work with retiring athletes. It has also been used by programmes worldwide to assist active athletes to manage their lifestyle and enhance their ability to compete at the highest level while at the same time developing transferable skills that will benefit their future. The research underpinned an athlete



retirement support programme recently developed by the Irish Institute of Sport assisting over 200 athletes.

Because there is no doubt that athletes can face considerable problems at retirement. Michael Vaughan, the former England cricket captain, recently presented a documentary on the subject. He told BBC Sport's Marc Vesty:

"One of the big things that comes across in the documentary is that we all get addicted to the sport we play and there's not many who can do without it. I certainly couldn't do without the cricket.

... athletes can face considerable problems at retirement. . .

"Former Arsenal and England captain Tony Adams calls football a 'drug'. Open champion Darren Clarke says the same about golf and that's exactly what it is: a drug. It's what we do, what we know everything about and what, probably aside from our families, we wake up in the morning still thinking about."

Retirement from sport is just one of many transitions that athletes will face. This results in a change in assumptions about oneself and the world and requires a corresponding change in behaviour and relationships. Examples of other transitions in sport include injuries, relocation and changes in competition level. Athletes may also experience a number of transitions, including changes in employment, in relationships, and in recognition.

The intensity of training and commitment that athletes make to achieve success can have

negative consequences, and research suggests that as many as 20 per cent of athletes experience psychological difficulties following retirement.

Research on retirement from sport can help us to understand retirement from other high performance and demanding domains such as business and politics. Indeed, athletes and politicians have in common the possibility of a sudden, unexpected and very public retirement, whether through injury or electoral defeat.

The words of ancient philosophers appear as relevant today as they were more than

2000 years ago. In 400 BC Plato wrote that *"To be merely an athlete is to be nearly a savage"* while a few centuries later the philosopher Epictetus stated *"A person wishes to conquer at the Olympic games...I also wish indeed, for it is a fine thing...but observe both the things which come first, and the things which follow."* Elite athletes need to have a balanced life in order to perform at their best, rather than focus exclusively on being an athlete. Athletes should also consider their life after sport during their playing careers in order to make the transition out of sport a smooth one. If so, one of the legacies of the 2012 Olympic and Paralympic Games could be the skills developed by the competing athletes which will be transferred to new domains or wider activities after they retire from their sport.

David Lavallee is Professor and Head of the School of Sport at the University of Stirling

... we all get addicted to the sport we play ...

– Scotland's University for Sporting Excellence.

The research presented in the article is featured in the British Psychological Society's Public Engagement Project, entitled, 'Going for Gold: The Greatest Psychological Show on Earth'. <http://www.bps.org.uk/going-for-gold>

The Project was launched on 18 April 2012, 100 days before the opening of the Olympics, and is releasing 100 features (articles, videos and podcasts, an experiment where participants see the world through the eyes of a judo player preparing for a competition) associated with psychological phenomena that will be seen in the Olympics and Paralympics by spectators.

References

- 1 Department for Business, Innovation and Skills (2010). *Skills for sustainable growth*. <http://www.bis.gov.uk/assets/biscore/further-education-skills/docs/s/10-1274-skills-for-sustainable-growth-strategy.pdf>
- 2 Park, S., Lavallee, D., & Tod, D. (2012). Athletes' career transition out of sport: A systematic review. *International Review of Sport and Exercise Psychology*. DOI: 10.1080/1750984X.2012.687053
- 3 Academy of Social Sciences and British Psychological Society (2011). *Making the case for the social sciences 5: Sport and leisure*. <http://www.acss.org.uk/docs/Making%20the%20Case/MakingtheCase5-Sport%20and%20Leisure.pdf>
- 4 Research Councils UK, Universities UK and British Universities and Colleges Sport (2012). *Supporting a UK success story: The impact of university research and sport development*. <http://www.rcuk.ac.uk/documents/publications/SupportingAukSuccessStory.pdf>

Michael Vaughan quote: <http://www.bbc.co.uk/sport/0/17953358>



University of Stirling graduate Nick Hatchett completed an MSc in Sport Management and worked as the University Tennis Co-ordinator whilst ranked No 5 tennis player in Scotland.

MAKING A DIFFERENCE WITH MATERIALS



Dr Robert Quarshie
Director, Materials KTN

The UK is home to a number of world-class companies whose success depends on their development and use of advanced materials. Fortunately, the UK is recognised for its world-class understanding of materials and when this is combined with the country's excellent design capability, these world-class companies would agree that the UK is the best place to do business in materials. Examples of advances in materials technology include the use of advanced composites in aircraft and racing cars to reduce weight, reduce emissions and lower fuel bills. The UK has developed new ways of designing lighter power modules through smart choices of materials. The increasing use of smart materials for healthcare, sports applications and the fashion industry has catapulted the UK to become one of the top nations in the world for design and innovation.

A major challenge for the UK is to ensure that there is an ongoing investment in materials science and technology to support the much needed innovation and wealth creation by UK businesses. Making choices between different technologies is both challenging and complex. The Materials Knowledge Transfer Network (Materials KTN) and the Technology Strategy Board, through the implementation of its Advanced Materials Strategy, have been helping UK companies and researchers choose wisely.

RECYCLING AND URBAN MINING

Climate change, energy generation and efficient usage, materials security, waste reuse and recycling are all at the forefront of most nations' strategic plans – and, increasingly, consumers' minds. Materials advances are at the heart of solutions enabling, for example, the effective end-of-life deconstruction of structures and the recycling and reuse of product waste. Everyone is familiar with the environmental

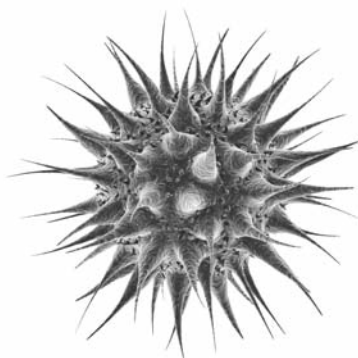
pressure to reduce waste by recycling, but another factor is the preservation of materials that may become scarce or expensive. Supply shortage is a good reason for recovering materials. Materials security means making sure you have the materials needed to build the item that has been designed. It means maximising recycling and recovery, improving anti-theft measures, substituting for more readily-available materials where possible, but more importantly ensuring supply. In an economy fuelled by materials, we need to be sure that we can get these and keep them for a very long time. This depends on where you source the material, what you do with it when it finishes one life, and how it comes back and has another life. Security is about materials flow. There are good processes available to segregate product waste, reuse and recovery of good materials from old landfill. The pressure is on to 'design out landfill'. A

House of Lords report suggested that up to 80% of a product's environmental impact could be eliminated through better design. A big factor is avoiding the waste of raw materials and the energy required for production and disassembly.

MATERIALS FOR ENERGY HARVESTING

Large-scale energy crises have often troubled modern society, but a huge amount of low-intensity energy is available throughout the environment if it can only be harvested and used. Many small-and-numerous sources go largely ignored. For example, advanced crystals in a road generate power when they are compressed by vehicles passing over them. Advanced materials are often key, and promise the availability of devices which may have maintenance-free lives of hundreds of years, deriving power from the environment in which they operate.

... The pressure is on to 'design out landfill'...



This source of energy includes photovoltaics (power from light), thermoelectrics (power from heat), piezoelectrics (power from pressure) and electrodynamics (power from movement). In many cases energy harvesting and storage depends on materials capability and cost. We have to make sure that the cost of the materials is low enough to do these things. That is where materials science comes in. The aim of development is to reduce costs, make installation easy and the result robust.

MATERIALS FOR HEALTHCARE AND PREVENTION OF MRSA

There are new materials available to meet the growing need for biomaterials and biomarkers to manage and monitor serious clinical conditions. In hospital environments where MRSA and C. difficile are particular problems, the application of new and old materials with innovative designs can reduce the risk of contracting hospital-borne infections, which can be fatal. Technical textiles with antimicrobials have been developed to control the spread of MRSA in hospitals.

In areas where cleaning alone cannot solve the problem such as in awkward corners and joints, advanced combinations of new and traditional materials

can, for example, rotational or injection moulding of polymers enables many hospital items, such as bedside cabinets, to have rounded inner corners and few joints to allow easy and effective cleaning. Silver-impregnated dressings used by the NHS cut wound infections and aid healing. Nanocrystalline silver is used in which the material is manipulated at the nano scale so that its surface area, and therefore effectiveness, is much increased. Copper is reported to kill 99.9% of bacteria within two hours of exposure. Trials in the UK and elsewhere with items such as taps, push blades and lavatory seats showed that they had over 90% fewer micro-organisms on them, compared with using chrome-plated brass, aluminium or soft plastic.

MATERIALS FOR SPORTS AND DANCE

How often when watching Wimbledon have we heard the umpire call, 'New balls, please'? This is because as the rubber warms up, it begins to leak air. Nanomaterials can be used to coat the balls to prevent the leakage, as the vast surface area of nanomaterial makes the air's route out of the ball much longer. The use of smart materials in tennis does not end here. Professional tennis players use rackets, which have carbon nanotubes to make them extremely light and durable.



Materials are also helping elite athletes tread the fine line between performance success and failure, by helping them get a better understanding of their own limitations and maximising their potential. Leading UK researchers in body sensor networks, biosensor design, sports performance monitoring and equipment design are working hard to position the UK at the forefront of sensing, both on- and off-body, in elite sports. This has become a reality with the advances in sensor design, integration of smart materials and ultra-low power micro-processor and wireless technologies.

Some advanced materials can be soft and flexible when treated gently, but become stiff and protective on impact. Such materials are ideal for impact protection clothing for sport and other uses, such as the ballet pointe shoe. The life of the professional ballerina has traditionally been a trade-off between grace on stage and excruciating foot pain. The points of traditional shoes are made from an inflexible papier-mâché mixture, which quickly goes from being too tough to disintegrating. With the help of the Materials KTN, a new high-technology shoe has been developed based on a shock-

absorbing polymer that hardens on impact to cushion the foot.

The demand for this special polymer came from Olympic athletes' need for flexibility and control, without compromising on protection.

CONNECTING WITH DESIGN, SKILLS AND ATTITUDES

The creative use of advanced materials by product designers is an important contribution to many of the innovations described above. Also, innovating with materials goes much further than supporting and strengthening scientific research and development, a fact demonstrated by the activities of the Materials KTN. Through its initiatives, designed to help accelerate the rate of industrial innovation, the KTN is also helping to equip young people with many vital skills and attitudes for innovation, including problem-solving, curiosity, interrogation skills and multidisciplinary teamwork. The KTN has shown, on many occasions, that when multidisciplinary teams from across materials science, technology, design and the arts tackle a problem together, the solutions they come up with are refreshing and very different to those that emerge from groups of experts in the same field.

... the UK is recognised for its world-class understanding of materials ...



Innovations for the Olympic Athletes – but what about Innovation for the Crowd and Spectators?



Brian J McCarthy
Materials KTN

During and after London 2012, technologists and the public will be exposed to many examples of technological innovations in sports apparel, footwear and equipment. Significant advances have been made in advanced performance materials which will legally enhance the achievements of the medal winners. However, such developments will be kept under wraps until the Games begin. It is estimated that the global sporting goods market will reach some \$303 billion by 2015 providing growth and employment – outperforming retail trends in both the US and the UK.

Prior to London 2012, Speedo (part of the Pentland Group) announced the Speed Fastskin 3 Racing System that claims to offer unrivalled benefits to swimmers. Similarly, Nike announced the Flyknit – a running shoe with an engineering knit to provide a light-weight, formfitted and virtually seamless upper shoe. They also launched Nike Pro TurboSpeed clothing and Nike Zoom Spikes – cutting edge spikes for running shoes. More examples will follow and such innovations will be seen in sports apparel in the High Street.

But what about innovation for the assembled audience – the crowds and spectators? How can technology improve the enjoyment of the assembled audience of sporting events?

Spectator experience is not merely an experience of receiving and consuming. It requires the active participation of the spectator in creating the atmosphere of the entire event. Sporting events provide much experience that cannot be delivered through broadcasts.

To date, most technology innovations have focused on providing a detailed view of the game/event/activity. Now things are changing.

A recent example in New York involved tagging marathon runners. Friends and family could then use a smart-phone app to track their loved one's progress, placing and time. Such interaction provides greater enjoyment, engagement and sharing of the experience.

What about innovations to help families to get to the stadium venue? A Manchester-based start-up company called Ruk-Bug Limited have developed a safe and reliable children's buggy that folds into a rucksack for ease of storage and carrying. It includes a child-changing kit.

Perhaps now is the time to get rid of queuing. Imagine a smart ticket that limits entry to

the stadium to a pre-determined time slot – allowing efficient people management – again improving the overall experience and crowd safety. The US Department of Defense are developing low-cost tracking systems which will help to prevent crowd crush situations. Each year over three million people descend on Mecca for the Hajj. In future, those pilgrims could be tracked by RFID technology in their passports or wristbands. Sporting events in Europe are prime targets for protestors. Visual tracking could deter muggings and pickpockets. It would also be an invaluable help for rescuing children lost in large crowds.

Scan the ticket barcode into your smart-phone and the ticket will remind you of the time and then use GPS to take you straight to your seat. The seat



may contain a disposable or re-usable tablet – rather like opera glasses – but is likely to contain an embedded mini-speaker

... improve the enjoyment of the assembled audience ...

from Singapore or Korea. No more booming announcements echoing around the stadium. The seat may also contain a microphone – scanning for terms of racial abuse – to direct Stewards to areas in the crowd of developing unrest.

Inventors in the US have developed directional sound which uses an ultrasonic emitter to shoot a laser-like beam of audible sound so focused that only people within a narrow path can hear it. Imagine telling the Umpire, Judge or Referee exactly what you thought of their decision directly and immediately! Or, perhaps talking about the 100 metres result in real-time with your friends who are at the opposite end of the stadium.

Bone conducting technology being developed by Kyocera uses bone in the face to

transmit sound to the ear – allowing you to listen to your phone commentary in the noisiest crowd.

Imagine the future uses of augmented reality. Point your phone (or tablet) to an athlete on the track and read through the results of his past performance, personal best times and likely chances of winning. The latest smart-phones can be unlocked using facial recognition.

Chevrolet rolled out the first Super Bowl smartphone app in 2012 that allows Big Game American Football watchers to enter a contest to win everything from pizza to a new Camaro. Coca Cola set up a Facebook page and website so viewers could see its animated polar bears – one cheering for the New England Patriots and the other for the New York Giants –

reacting to the game in real time.

The day's sporting programme would not be printed in hard copy – unless as a souvenir. Rather the programme timings – which may involve various sporting activities in the same stadium – would be updated in real-time allowing the spectators to move position to watch their selected events. Imagine the historical record – with millions of crowd photographs uploaded to the Internet.

No longer are the crowds and spectators merely passive. Perhaps the crowd itself could be consulted to judge the most sporting athlete – the man of the match or game rather than just the first past the post.

Here is one I would love to see in reality. The large display screen shows replays of the

sporting events. It then shows a worthy cause – for example, anti-malaria mosquito nets – and a large graph showing a target for charitable donations during the course of the sporting event – on the day or during the whole of the Games – from the crowd and the watching world TV audience. The crowd is encouraged – let's hit that target before the game ends. We watch in the background as the display grows towards a worthy target. In 2016, the target could be 100 million nets!

For a greater experience, for a truly memorable life-enhancing occasion – for the crowd itself – we need novel technology and innovation.

Let the Games begin! And let us all truly participate!

GEARING UP

This feature first appeared in the January 2011 issue of the IOM3 publication, *Materials World*

One of the most eye catching and technically challenging arenas built for the London 2012 Olympics is the cycling velodrome, **Ruth Hopgood-Oates**, Senior Engineer at Expedition Engineering, outlines the construction process.

Cycling has inspired the concept for the 2012 London Velodrome. The bike is an ergonomic object, honed for efficiency, and the team behind the Velodrome wanted the same application of design creativity and engineering rigour that goes into the design and manufacture of the bike to be present in the building. Not as a mimicry of the bicycle but as a 3D response to the functional requirements of the stadium. By applying the same thought processes and form finding approach, the aesthetics and

shape of the stadium have emerged. Tight budget constraints with stringent Olympic Delivery Authority (ODA) targets were set out in the Olympic Park materials strategy. The aim is to reduce waste through design – 90% of demolition material and site waste has to be reused or recycled, and at least 20% of this reused in permanent venues and associated works. The Velodrome is beating these targets with 95% of waste being recycled and 33% of materials made with recycled or partly



recycled content. The team's design strategy has focused on creating efficient elements that perform several functions.

RAISING THE ROOF

A doubly curved roof shape evolved as the form that would best meet the stadium's needs. The saddle-shaped roof form 'shrink wraps' the building

around the track, minimising the venue's volume and reducing heating and cooling requirements. Following cross-checks against traditional schemes using arches and trusses, a cable net was found to be suitable for the form and 140m span, while providing programme and construction safety advantages.



Typical cable nets support lightweight fabric and work like a tennis racquet using a grid of cables in tension with a large compression ring at the perimeter to isolate the net's tension forces. The Velodrome cable net, however, is not typical. The indoor venue needed a weather-tight, heavily insulated roof build up, and the graceful lines of the building form, combined with the desire to reduce steel usage, necessitated a roof design without a large perimeter ring beam. This presented the biggest structural engineering hurdle on the project. The first challenge involved designing structural timber panels that infill the gaps between the cables and form the roof surface. These panels had to adapt to the movement and tolerance required for the cable net roof, whose movements are significantly larger and more complex than a standard long span roof structure. In response, clever, rational panels with an articulated connection system were developed. The second test involved transferring out high cable tension forces while avoiding a large ring beam structure. In response, the building's steel upper seating bowl and entire structure below were designed to be used to

transfer out cable forces, meaning only a small ring beam structure was required. As a result of this design, the team made a large materials saving compared with traditional roof systems. The roof weight including cables, ring beam and finishes, is only 30kg/m². The delicate cable net roof employs pairs of 36mm diameter cables arranged in a 3.6m grid spacing with the prefabricated structural timber panels, known as cassettes, filling the gaps. The 1,050 cassettes are interspersed by rows of roof lights to provide natural light. A vapour barrier, followed by insulation, overlay the hollow cassettes with a final layer of standing seam metal cladding containing 95% recyclable aluminium. A further benefit of the standing seam is channelling rain falling on the 1.4Ha roof, delivering it to specially modelled hoppers and gutters in a manageable way. Much of the rainwater is then collected for greywater use.

AGAINST THE CLOCK

To keep to the two-year construction programme, all elements were designed with constructability in mind. Sheet pile walls, which were initially proposed as temporary works in the basement, became permanent structures.

Approximately 600 of the 1,000 piles were precast, used instead of open-bored piles in lightly loaded areas to improve installation speed and eliminate the need to dispose of contaminated spoil. Sensible sequencing was used in the placing of concrete, to allow early age thermal movement to occur and enabling the next phases of construction to begin at one end of the building, while concrete works were completed at the other.

commence. The 16km of cables used for this project were cut to length and fabricated in Germany. Once on site, the cables were laid out at ground level and the 1,000 or so nodes at cable crossover points clamped to form the net. The net was then jacked into place on top of the steel upper seating bowl in a carefully designed sequence, before being locked into position. This sequence eliminated the need for temporary works. The entire on-site cable net construction process took eight weeks. With the cable net in place, the prefabricated timber roof panels were craned into place and the remainder of the roof added.

THE FINISHING LINE

Efficiency in all aspects of design together with the careful selection of materials led to low levels of embodied carbon in the building. It is estimated that the total embodied CO₂ for structural elements, including concrete, steel and roof timber, is approximately 7,400t. This is less than 1,250kg per spectator



Above the concrete floor slabs, the use of prefabricated structural elements improved speed, minimised requirements for working at height, cut down on waste and improved quality. The roof design enabled early weather tightness, enabling internal dry works to

seat, which Expedition believes sets a new benchmark for best practice. The venue is naturally ventilated with humidity and temperature being carefully maintained to create exactly the right conditions for track cycling.

Polyvinyl chloride (PVC) is one of many materials playing a part in the Olympics.

Eoin Redahan reports.

There is something in the water, and it is feminising boys. Is this what the world is coming to: multi-tasking, emotionally intelligent males?

Apparently, according to popular media and some campaigners, this is what could happen if the phthalates from PVC enter the water table and seep into the blood stream – that, cancer and fertility problems.

So, when the Olympic Development Authority (ODA) conceived various structures for the 2012 Olympics, it decided to be careful about material selection. Not only was there pressure to use sustainable, reusable materials, the ODA also had to be aware of potential health risks.

Despite the debate surrounding PVC, when cost and intended use were analysed, it was found to be the best material in several areas, due to its strength, malleability and light weight. It was also cheaper than alternatives such as ethylene tetrafluoroethylene (ETFE). At a recent talk given to the South East Plastics and Rubber Group in London, UK, the ODA's Noah Bold explained, "We decided we'd use PVC, but to a strict environmental specification". The intention was to source PVC with non-phthalate plasticisers.

This proved more difficult than expected. A French company called Serge Ferrari produced a phthalate-free version, but it failed the fire safety test in the first trial run,



© London 2012

noted Bold. As such, the PVC used in the Olympic Stadium and the temporary Basketball Arena contain phthalates.

When the time came to build temporary wings to extend the capacity of the aquatic centre, Serge Ferrari produced a phthalate-free membrane that passed the fire tests. Similarly, for the Shooting venue, a phthalate-free perfect PVC was stretched over the frame to create a temporary arena. The Water Polo arena also employed a similar fabric in its roof.

In total, 142,638m² of PVC fabric wrap was used, 98,038m² of which was phthalate-free. According to the organisers, suppliers or manufacturers are requested to provide takeback schemes to ensure materials will be re-used or recycled after the Games. By the time the Olympic torch has moved on, much of the material could be on a boat bound for a second life in South America.

Other plastics have been used in Olympic construction. Polypropylene seats with reinforced nylon parts, for example, will be used to catch thousands of backsides in the Olympic Stadium. The Olympic track is also made using natural rubber.

According to Bold, shorter distance athletes prefer the surface to long-distance runners due to its hardness. So, if Usain Bolt whizzes over the line in world record time, as well as thanking years of dedication and his mother,

he should also thank the materials that made it all happen.

MORE ABOUT PHTHALATES

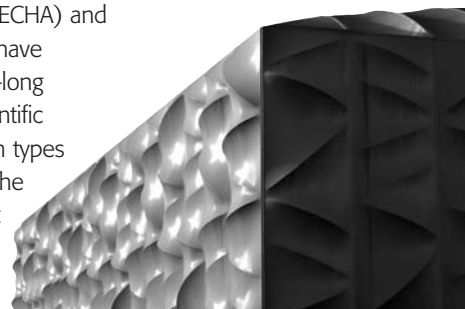
Stuart Patrick
Chair Polymer Society Board
and PVC Committee IOM3

Phthalate PVC plasticisers are a generic group covering a number of chemicals made by reacting phthalic anhydride with alcohols. They are divided into two distinct groups, with very different applications, toxicological properties and classification.

In Europe, the European Commission, the European Chemicals Agency (ECHA) and EU Member States have undertaken 10-year-long comprehensive scientific assessments of both types of phthalate under the EU Risk Assessment Regulation.

High molecular weight phthalates represent more than 80% of all the phthalates being produced in Europe. Risk assessments have shown positive results regarding the safe use of this group of substances. They all have been registered for REACH and do not require any classification for health and environmental effects, nor are they on the Candidate List for Authorisation. Consequently, under the Classification, Labelling and Packaging (CLP) Directive, there are no specific requirements.

Low molecular weight phthalates represent about 10% of the European market. Risk assessments have led to their classification and labelling as Category 1B Reproductive agents. They have been registered under REACH but are included in the EU Candidate List based on their hazard classification and will therefore have to go through the REACH Authorisation process. These plasticisers will be phased out by the EU by February 2015 unless an application for authorisation is made before July 2013 and an authorisation granted. As a result of the classification, these materials must now carry a label with the appropriate CLP Pictogram and Hazard and Precautionary Statements.



© London 2012

CRITICAL COMMUNICATIONS AT THE OLYMPIC GAMES



Rupert Cazalet
Head of Public Affairs, Airwave

AIRWAVE AT THE OLYMPICS

Around 42,000 people¹ – police officers, security staff, volunteers and the military – will keep London safe during the Olympic Games. Airwave, the company behind the emergency services' communications network, will be making sure that they can all stay in contact by upgrading the main Network used by the police fire and ambulance services, and having built a brand new network (known as Apollo) which will be used by LOCOG staff and volunteers.

Both networks use Airwave's technology and expertise developed by delivering high quality communications for more than a decade:

- **Working together** – The main Network is used by all the emergency services, and 300 other organisations which help to keep the public safe. Because they communicate on the same system, they can work together during major events. The separate Apollo Network will be used by LOCOG staff in all Olympic venues.

- **Security** – Communications on the Airwave and Apollo Networks are encrypted, and cannot be scanned.

- **Reliability** – Public safety requirements mean that the Airwave Services must be exceptionally reliable. Designed to withstand major incidents, the

Service remains operational when other networks fail.

- **Clarity** – Digital networks mean that communications on the Airwave and Apollo Networks are crystal clear.

- **Coverage** – The main Network covers 99% of Great Britain, including the Highlands and islands. The Apollo Network covers every single Olympic venue, from sailing in Weymouth to football in Glasgow.

It is estimated that around 200,000 people will be working to ensure that events commence on time, athletes find their way to the venues and that the public have a safe and enjoyable experience. Co-ordinating such a large workforce over 34 competition venues across the country presents a monumental logistical challenge for LOCOG as well as the police, fire and ambulance services charged with keeping the public safe.

CRITICAL RADIO

Both for the day-to-day co-ordination of the Games and planning for emergencies, effective, secure and clear



Airwave network supports police as they assist the general public

private mobile radio communication is going to be vital. It is here that Airwave is playing its part to help ensure that the London 2012 Games are safely delivered.

We deliver critical communications to organisations which provide vital public services. This includes the police, fire and ambulance services as well as local authorities, utilities and transport providers. In addition, the new network that will unite the tens of thousands of London 2012 staff and volunteers needed to guarantee that the Games progress smoothly, on time and with the flair that will see the London Games ranked as one of the best ever.

APOLLO – COMMUNICATIONS WORTHY OF THE GAMES

LOCOG was quick to realise the importance of having effective, reliable and modern private digital communications in place for the Games. The 200,000 members of staff and volunteers working in events organisation and logistics, security, transport and technology support need to be able to communicate immediately and clearly.

LOCOG chose Airwave to provide its critical communication for the Games because of its expertise in designing, building and now operating the public safety network. As well as allowing the emergency services to communicate on a day-to-day basis, our service has also facilitated communications across large planned events, and unanticipated major incidents.

... keep London safe during the Olympic Games...

... Digital networks mean that communications are crystal clear...

To meet the radio communications requirements of the Games, Airwave used expertise built by helping the emergency services to communicate to design a reliable, secure and clear network. The Apollo network has been live since May 2011. During the Games it will include: 10,000 radio handsets, 2,000 vehicle-based radios and 350 desktop radios (primarily for use in control rooms). These all use the proven technology developed with the emergency services in mind.



Airwave supports the police mobile data requirement

Derek Graham, Senior Manager for Telecoms at LOCOG commented: "We were impressed with the ability of Airwave to prepare for and cope with large scale events that present similar communications challenges to those we anticipate during London 2012. We were also attracted by the fact they already worked with the emergency services, as we knew we would need to work closely with the police, fire and ambulance services throughout the event. Airwave seemed a natural choice to be our partner."

UPGRADING THE AIRWAVE NETWORK

East London will benefit in particular, as new base stations have been built around the Olympic Park. This work has been carried out with assistance from the Olympic Security Directorate, the Metropolitan Police and the National Police Improvement Agency, to make sure that the technology meets

... work closely with the police, fire and ambulance services ...



Airwave Emergency Response vehicle

the high standards required by the emergency services.

The Network will even cover the English Channel, as new base stations have been deployed to provide offshore coverage for emergency responders involved in any incidents surrounding the sailing events in Weymouth.

The project has come in on time and on budget and a number of the key milestones were met early. Deputy Chief Constable, Paul Minton, police lead for the Airwave service Olympic and Paralympic Games Project, said: "The solid working relationship between Airwave,

NPIA and forces demonstrates that there is a joint commitment to ensure that a secure and reliable communications network is delivered for the emergency services for the London 2012 Games. As a project, we are working hard to deliver a resilient service and are on target to meet the needs of the world's largest sporting event."

TESTING TIMES

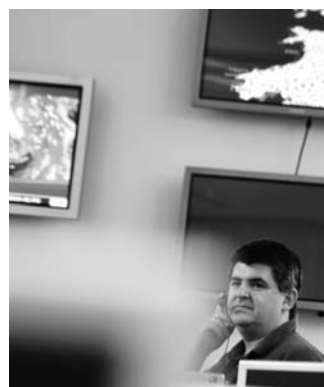
Apollo has already been used at the Olympic Test Events – the competitions held in Olympic

venues to make sure they are ready for the Games.

This gave us the chance to refine the service, and to practise procedures for training and equipping those who will use the radios.

This also gave LOCOG a chance to test the service. Gerry Pennell, Chief Information Officer for LOCOG said: "Now that we have a private mobile radio service using the Apollo network, our staff are using it in the run up and during test events. This will ensure they have sufficient time to understand the system and get the best out of the equipment and network".

Richard Bobbett, CEO of Airwave, said: "The value of our work with LOCOG lies in the association with the world's largest sporting event. We can already see the nation rallying behind the Games and the levels of excitement are growing to a fever pitch. This really is a once in a lifetime opportunity – one that is making everyone at Airwave incredibly excited."



Airwave network management centre operates 24 hours a day, 365 days of the year, ensuring support and technical solutions to the over 300 users of the network.

¹ <http://blogs.telegraph.co.uk/sport/jmagnay1/100025082/london-2012-olympics-weather-wont-dampen-british-spirits-but-locog-could-learn-from-jubilee-success/>

TRIAL RUN – THE DIAMOND JUBILEE

The Diamond Jubilee weekend was a chance to test Olympic security systems, as central London was even busier than it will be during the Games.

Three times the usual number of police officers were on duty in the capital, from forces as far afield as Fife and Mid Wales. In addition, organisations including the Army, the Port of London Authority and the RNLI kept the River Pageant safe and secure.

These organisations could co-ordinate their activity because they all use the Airwave Network.

... the world's largest sporting event ...

RECENT DEVELOPMENTS IN SPORTS NUTRITION



Ron Maughan
Emeritus Professor at
Loughborough University, and Chair
of the Nutrition Working Group of
the Medical Commission of the
International Olympic Committee

The standard of performance at the 2012 London Olympic and Paralympic Games will be higher than ever and those who stand on the podium will be truly exceptional human beings. In every event, the margin between victory and defeat will be small: the bitter taste of defeat is separated from the joy of victory by only a tiny fraction. Every athlete will be genetically gifted and highly motivated and will have trained over many years in pursuit of success. Success may be determined by other factors that, in themselves, have only a small effect on performance. Nutrition is one of those factors. A good diet will not turn a mediocre athlete into a champion, but inappropriate food choices will prevent the potential champion from performing at their best. This recognition of the importance of the athlete's diet has led to a search for nutritional strategies that may provide an advantage.

At the London Games of 1908, nutritional science was in its infancy, and the food choices of athletes were often dictated by a combination of the food preferences of the most successful athletes and of the blandishments of the snake-oil salesmen. In some respects, little has changed, but we now have a much better, though still imperfect, understanding of the

nutritional basis of successful performance.

The quantity of food that an athlete eats is driven by the energy demands of training and competition and by the physique that the athlete seeks to achieve. Endurance athletes may consume 6-8,000 calories per day, or even more, and yet have body fat levels that are as low as is consistent with good health. In some cases, body fat may even be so low as to pose a risk to health. At the other extreme, in some highly

The main fuel used by muscles during exercise is carbohydrate, especially during high intensity exercise. Athletes are therefore encouraged to eat a high carbohydrate diet with a relatively low fat intake. This is consistent with the public health message that reducing fat intake and increasing intake of carbohydrates is consistent with good health, and the successful athlete can be a good role model for public health campaigns.

... primary aim of training is to remodel the muscle tissue ...

technical sports where extreme leanness is considered desirable, such as gymnastics, the energy demand may be very low: in spite of long hours in training, the exercise expenditure is low, so energy intake is correspondingly low. Treading the thin line between too much and too little food intake requires careful monitoring.

Traditionally, athletes, especially those in strength and power events, have been concerned to achieve a high protein intake, as protein is associated with the growth and repair of muscle. Recent evidence shows that this belief is to some extent true, though the body accommodates over time: a high protein intake may

... inappropriate food choices will prevent the potential champion from performing ...



High levels of lactic acid cause pain! Buffering the acidity can improve performance in events where acidosis in muscle may be a limiting factor.

... strategies for the Olympic athlete may lead to clinical applications. ...

therefore be beneficial, and even necessary, in the early stages of an intense training program, but the body adapts and after a period of months or years, a high protein intake may be less necessary. The primary aim of training is to remodel the muscle tissue: the strength athlete wants more of the proteins that generate force within the muscle but the

after each training session. Some proteins seem to be more effective than others, and whey protein, which is derived from milk, seems to be particularly effective. These findings are now being applied to the rehabilitation of patients after muscle injury and to the reversal of the decline in muscle function that accompanies the ageing process.

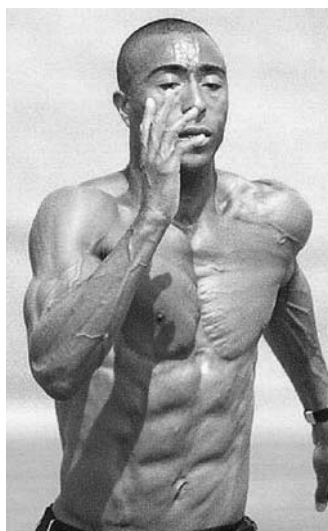
In extreme heat, which is possible, albeit unlikely, in London, maintaining hydration can be a challenge when sweat losses are high. Athletes are encouraged to develop a hydration strategy that meets their individual needs, as sweating rates vary greatly between individuals. The coincidence of the London Games with the Muslim holy month of Ramadan, where Muslim athletes would normally abstain from food and fluid intake during daily hours has thrown into sharp focus the issue of nutrition, and more especially of hydration, and performance. Those Muslim athletes who fast while competing in London will be very aware of this issue.

The use of dietary supplements is widespread in sport, as it is in the general population. Athletes use a wide variety of supplements in the pursuit of success and this raises a number of issues. Of the many thousands of different supplements on sale, only a handful are supported by good

evidence of efficacy and of safety. Athletes, of course, are often more concerned with the former than the latter, but those who have responsibility for the wellbeing of the athletes must be concerned that supplements pose no risk. A few supplements will be in common use among athletes in London. Creatine is popular with strength and power athletes as it can help increase speed and strength and can also help gain muscle mass. Caffeine is also widely used: it can help delay fatigue and increase both mental and physical performance. Buffering agents that can resist the negative effects of lactic acid formation

pressure in hypertension. There are other examples where the development of strategies for the Olympic athlete may lead to clinical applications.

Elite sport has been blighted in recent years by the use of drugs, and the promise is that the London Games will be the cleanest ever due to improved testing methodologies. Improved sensitivity of testing brings some issues, though, and there is evidence of the widespread contamination of the human food chain with doping agents that are used illegally to promote growth in animals. These drugs have the same effect in humans and are



The elite athlete is genetically gifted, highly motivated and trains to the limit of what is humanly possible. When all these factors are equal, the food choices that an athlete makes can make the difference between success and failure.

marathon runner has a different aim – the production of more of the proteins that are involved in energy generation in the muscle. This is achieved by the different training stimulus that is applied. The application of more invasive techniques that require sampling of muscle tissue has now shown that the intake of small amounts of protein just before, during or just after a training session may help stimulate the process of adaptation taking place in the muscle in the hours and days

... those who stand on the podium will be truly exceptional ...

are used in high intensity sports such as middle distance running, track cycling and rowing, all events where the United Kingdom has a strong tradition of success. Nitrate is a relative newcomer to this arena, but remarkable evidence is emerging to show nitrate supplements, which are often taken by athletes in the form of beetroot juice (beetroot is naturally high in nitrate), can reduce the oxygen cost of exercise and thus improve performance in events where oxygen supply is limiting. This applies particularly to events lasting a few minutes or more. This clearly also has implications for patients with a range of cardiac, pulmonary or vascular conditions where oxygen supply to tissues is compromised. Remarkably too, there is evidence of a reduction in blood

therefore prohibited by the anti-doping rules. At a recent international football tournament in Mexico, traces of clenbuterol were found in 109 of the 208 urine samples tested. Some dietary supplements also contain doping agents that are not declared on the label. These may arise from cross-contamination during manufacture or from deliberate adulteration intended to transform otherwise ineffective products into something that the consumer will see to be effective. This extends to the presence in weight-loss supplements of anorectic drugs, such as sibutramine, that have been withdrawn from sale because of safety concerns. While we must prosecute the guilty athletes, we must also protect the innocent.

... rehabilitation of patients after muscle injury ...

PROTECTING OLYMPIC RIDERS

New Technology from Hit Air will be protecting Olympic Riders this summer

This summer Great Britain will be represented by William Fox-Pitt, Zara Phillips, Mary King, Piggy French and Tina Cook in 3 day Eventing. Great Britain is one of the most successful eventing nations and all eyes will be on us at the end of July. 3 day Eventing comprises three disciplines Dressage, Cross country and Show Jumping with its roots in a comprehensive cavalry test requiring mastery of several types of riding.



... The professional riders of today cannot afford to be sidelined ...

Over the past two decades the FEI (Fédération Equestre Internationale) have been working with national federations around the world to make this sport safer. Everything from frangible pins to create collapsible cross country fences, to technical course design changes made after years of

Riders who use the Hit-Air vest include the Olympic Eventing Gold Medalist Phillip Dutton, "I am really excited about the new technology. I feel confident that I will be better protected if I fall. This is the way of the future."

... hacking down the road is where most accidents happen. ...

data collection at International competitions. The area which has made huge strides in the past two decades is rider body protection. Until the mid 80's riders wore only a helmet to protect themselves. It wasn't until the early 90's it became mandatory to wear a static foam based body protector.

Hit-Air vests are a culmination of over fifteen years of research and development by the Japanese company, Mugen Denko, the award winning designers of the original worn air bag. The technology was originally developed to protect motorcyclists hitting tarmac at over 70 mph – but the design has been refined over the last few years to suit the unique ergonomics of the rider.

Sam Watson, 4* event rider recently stated, "Until I saw the Hit Air I had no desire to ride in an air jacket. However, it is so light and unobtrusive that I don't realise that I'm wearing it. I was shocked by the extra protection from the Hit-air and how much it cushioned my fall. I never want to fall without it again...there's too much at stake!"

HOW DOES AIR TECHNOLOGY WORK?

The vest is worn over a body static body protector. The lanyard attaches to the saddle once the rider is mounted. In the event of a fall and the rider becoming separated from his horse, the lanyard pulls a key ball out of the vest releasing a

mechanism inside which pierces the compressed CO₂ cartridge. This is what triggers the inflation.

These vests provide leading-edge, shock buffering and stabilizing protection to the neck, spine, rib cage, lower back and vital organs when inflated.

NECK

Once inflated the vest provides a large neck air bag which inflates around the base of the helmet. This decelerates the head and neck protecting from hyper extension which causes whip lash, concussion and other neck injuries.

LOWER BACK AND SPINE

Upon inflation a flap un-pops and releases an air bag which covers the lower back along with two more which cover the length of the spine. When the rider hits the ground or an obstacle the inflated vest will absorb the impact and stabilize the body.

RIB CAGE AND CHEST

Hit Air provides unique ribcage protection and two air bags down the front of the chest. Broken ribs and collar bones are common amongst

event riders and have lengthy recovery times. The professional riders of today cannot afford to be sidelined.

PATENTED TECHNOLOGY

There is a patent on the design to fold the airbags away within a harness style vest. This allows the vest to inflate outwards, which has several major benefits.

There is no possibility of winding the rider on inflation, although the vest still provides a stabilizing effect to the upper torso. This is very important to our riders and also to medical teams.

The vest can be worn neatly over the body or body protector as the vest does not need to accommodate the inward inflation. The vest is discrete and it limits the interference with riding.

The vests are light-weight and flexible. Riders do not feel that they are wearing any additional protection at all. Any interference or restriction caused by extra garments will interfere with the rider's effectiveness and therefore cause a safety issue in itself.

It isn't just Olympic level event riders who are choosing Hit Air to protect themselves. Although 3 day eventing is classed as one of the most dangerous sports, hacking down the road is where most equestrian accidents happen. In 2011 there were 225 incidents on roads reported to the BHS through horseaccidents.org.uk, a dedicated incident reporting site. These included: eight rider fatalities and 52 serious rider injuries. Many accidents remain unreported. Leisure riders have seen International event riders embracing this technology and can see how it can help make them safer on the roads, commons and bridleways of Britain.

Senior safety officer at the BHS, Sheila Hardy recently stated, "This is something that is beneficial to riders whether they compete or not"

For more information on Hit Air Vests please visit www.hitairuk.co.uk.



Hit-Air deflated



Hit-Air inflated



WHY WOULD HS2 BE GOOD FOR BRITAIN?

Meeting of the Parliamentary and Scientific Committee on Tuesday 24th April

WHAT ARE THE LIKELY ECONOMIC AND SOCIETAL IMPACTS OF HS2?



Bridget Rosewell
Economist, Volterra Consulting

Without a transport system an economy cannot function. Accessibility increases both the density of employment and of population. The Eddington report¹ for the UK government supported this proposition and it has been the basis for the decision to invest in Crossrail.

Success in a globalised economy relies on cities and their infrastructure. Cities are by far the most important source of economic activity and growth in the UK economy. Nearly 80% of people in the UK live in an urban area and cities, even though urban areas only cover 9% of the UK's land mass².

Successful city economies require high volumes and densities of face-to-face contacts between firms, and access to wide pools of skilled labour. Good transport links, particularly rail, are essential in supporting this agglomeration. Additionally, high levels of physical accessibility nationally and internationally are needed for cities to be economically competitive.

Cities generate economic growth by creating business opportunities. Agglomeration (or clustering) is the process by

which this density of economic activity raises productivity. It does this by facilitating knowledge transfer and fostering innovation between firms and other knowledge producers such as universities and high-level government functions.

Considerable research has been conducted to back this up both in theory and practice. Paul Krugman, the Nobel laureate economist, has been central to this work³. This manifests itself in high densities of employment in advanced sectors such as financial and business services, design, science and creative industries, which also support advanced manufacturing sectors across city regions. Skilled labour is vital in supporting this economic activity. Workers need to be able to access main city employment locations from across a wide area.

The UK lags behind its competitors in infrastructure investment: the globalising economy is characterised by innovation and new opportunities. The agglomeration offered by cities is one of the main reasons why they have become a key delivery mechanism for growth. The UK

ranks only 34th in the world for its infrastructure, sixth in the G8 countries⁴, and only spends 1.5% of GDP on infrastructure compared with 6% in Japan and 3% in France⁵.

Better transport results in stronger local economies and jobs growth: history shows a compelling link between transport and economic prosperity, and analysis has shown that a location with 10% higher rail connectivity has an employment density that is 14% higher. An additional 400,000 jobs in Core Cities and a total 1 million in their wider urban areas will be underpinned by HSR.

Investment in a full HSR network and electrification will allow the creation of 35,000 jobs in Core Cities, and 1 million jobs in total across their wider urban areas (specifically the geography covered by their Local Economic Partnerships).

To support these jobs, weekly rail volumes into the Core Cities stations (and therefore the infrastructure required) will need to increase by around 70% over the next 20 years, supporting 150,000 new arrivals per day. This represents around 80,000

... The UK lags behind its competitors in infrastructure investment ...

additional trips per day on a High Speed line. This is likely to be an underestimate. This represents an increase over twenty years of 17 per cent in employment. The relationship illustrated here suggests that as much as a doubling of rail passenger growth will take place.

The UK's cities drive economic growth and can help invigorate the economy. The Core Cities urban areas already deliver 27% of GDP. Economic growth outside London and the South East is dependent on improved transport capacity and infrastructure between the Core Cities and London, and between

80 minutes. International evidence shows that such schemes create significant economic benefits, achieve some direct financial returns, more demand than was forecast, and reduce demand for road and air trips. Such benefits are based on trip generation rather than the value of time savings.

The need for HSR is fundamentally centred on the need for additional capacity on the rail network and better connectivity between Core Cities; the West Coast Main Line (WCML), Midland Main Line (MML) and East Coast Main Line (ECML) are forecast to be at or

... Better transport results in stronger local economies ...

the Core Cities themselves to create more coherent and powerful economic zones. There will be wider positive regeneration and economic benefits from HS2 and a full HSR network, contributing to reshaping and rebalancing the economy.

More rail capacity will benefit wider economic areas: the agglomeration potential of cities and their surrounding areas requires better transport networks. Improving connectivity makes labour markets more effective, facilitates competition, and fosters innovation.

The economic benefits of HSR and HS2 are likely to exceed the DfT estimates, although DfT has made a strong economic case for investment in HSR and HS2. Based on analysis of previous HSR schemes this estimate of jobs created is likely to be exceeded significantly. The new services bring Birmingham within one hour of London, and the full scheme reduces times for Manchester, Leeds, Sheffield and Newcastle to between 73 and

... More rail capacity will benefit wider economic areas ...

creating a new classic line represents poorer value for money than does a high speed line.

A new approach is needed to assessing the economic benefits of long distance rail projects in the UK. The real benefits of this investment for the economy are not captured by the current analytical approaches used for evaluating transport projects. They do not capture the transformational and regeneration impacts that it can have, or the additional benefits of releasing capacity on existing lines for commuter and freight uses.

Maximising the benefits of HSR will also require investment in existing lines, this is not an 'either or' investment case. Investment in city region transport networks, and strategic inter-urban rail improvements on

existing lines (including electrification) between some cities, and with London are vital to support economic growth and the rebalancing of the UK economy. It is essential therefore that plans for HSR are part of a wider, integrated, national strategy for rail or transport.

Plans for high speed and other transport investments need to be more closely aligned with economic development and land use planning strategies. Transport is only a means to an end and creating a vibrant economy will require other policies. However, without connectivity, economic expansion will not take place.

References

- 1 Eddington Transport Study 1 December 2006 to support 2006 pre-Budget report
- 2 ONS The UK's Major Urban Areas
- 3 Fujita, Krugman and Venables, (2001) The Spatial Economy, Cities, Regions and International Trade, MIT
- 4 World Economic Forum's Global Competitiveness Report
- 5 Association for Consultancy and Engineering, Avoiding the Infrastructure Crunch

... A new approach is needed to assessing the economic benefits of long distance rail projects ...



HSR FOR BRITAIN – SOME ROUTE AND ENGINEERING ASPECTS



Professor Andrew McNaughton
FREng
Technical Director, High Speed Two
Ltd

Andrew McNaughton has been engaged in railway construction, operation and management since 1973. He is Special Professor of Rail Engineering at Nottingham University and a Visiting Professor of Engineering at both Imperial College London and Southampton University. Since 2009 Andrew has been Chief Engineer and Technical Director of High Speed Two Ltd, developing the principles, network and specific route design for high speed rail in Great Britain. Prior to that, from 2001 he was Chief Engineer of the Special Rail Responsible for the specification and development of the GB rail network, investment authorisation and overall system safety management. Andrew is Vice Chair of the EU Transport Advisory Group, Chair of the European Rail Research Advisory Council and Special Advisor on rail to the Australian Government. He has lectured on the transport, land use and economic planning effects of regional, freight and long distance rail development in North America, Asia and Australia as well as Europe.

Getting the green light from Transport Secretary Justine Greening in January to develop plans for a high speed rail network that will connect London and the West Midlands in Phase 1 and then the North West through the East Midlands and Yorkshire – plus a link to Heathrow – in Phase 2 by the early 2030s was a significant political achievement.

The idea of such an ambitious project was far from the conventional thinking back in 2009 when HS2 Ltd was set up to examine the case for high speed rail by Andrew Adonis. At that time a third runway at Heathrow was being hotly debated but, unlike now, there was relatively little public discussion on the case for and against a new railway. So why do we want to build a complete new line rather than just improving what we already have?

Britain's rail system is becoming increasingly stretched, particularly in the South East, and between London and our great cities of the Midlands and North. Our population is growing – in England alone it is forecast to be around 60m by 2033 and 70m by 2050 – and passengers numbers continue to rise. Figures show that the number of long distance rail journeys has grown by an average of five per cent a year since 1995. Long distance rail travel has grown strongest of all, even during the

recent economic downturn.

Rail industry projections show that the West Coast Main Line will be full by the mid-2020s so it is vital that we bring on extra capacity.

Upgrading the existing line cannot provide the level we need in the long term. An attempt to do this was made a few years ago and it cost billions of pounds without really addressing the looming capacity crunch. So the choice is between new conventional lines or new high speed lines. The far higher benefits and only marginally higher cost of a high speed line make a compelling case for high speed rail, just as in other countries around the world.

High speed rail as a transport system is not new. The world's first, the Tokaido Shinkansen line, opened in Japan in 1964 and demonstrated the capacity, connectivity, reliability and safety breakthrough possible with a modern, well engineered, dedicated new line between today's major cities of population.

The technology has developed greatly in the last half century, and continues to do so. Quieter and more energy efficient trains capable of 225mph are now entering service in Europe and designs for yet higher speed are under development.

Developing a new high speed network that can connect

up our biggest cities will also stimulate and rebalance our economy, generate jobs as well as developing our skills set.

HS2 is supported by all the major conurbations that it will serve as they recognise the key economic benefits that it will bring. The network is expected to deliver up to £45 billion of business benefits alone.

Detailed assessments of jobs expectations have been undertaken for Phase 1 and we estimate around 40,000 will be generated. We expect that Phase 2 of the Y will also lead to a further substantial number of jobs being created in the major northern conurbations that it serves.

The Phase 2 'Y' network line is due to open in 2032 and it will be the core of the national long distance passenger network. While the route will join Birmingham, Manchester and Leeds new trains will be designed to continue onto the current network, providing direct services to and from Newcastle, Liverpool and Glasgow and Edinburgh. By moving a significant proportion of our current inter-city services from the existing railway onto new HS2 lines, there will be space for additional commuter, regional and freight services, benefiting many others across Britain.

Stretching for roughly 140 miles (225km), the first phase will reduce the travel time



between London and Birmingham to 49 minutes from the current 1h 24mins. The journey between London and Manchester comes down from 2h 8mins to 1h 40mins. The trip to Glasgow will take 4hrs rather than the 4h 20mins it takes now. There will be similar savings to Liverpool. Those living around Birmingham who want to take a trip to Paris will find they can get there in 3hrs compared to roughly 4.5hrs on the current timetable.

With Phase 2 in operation, not only would there be further time savings to the North West and Scotland, but also transformational challenges to the East Midlands, South Yorkshire and Leeds. Direct services from the North and Mainland Europe will be possible into Heathrow.

There will eventually be 18 trains an hour in each direction once the 'Y' network to Leeds and Manchester is up and running. For the Phase 1 route running between London and the West Midlands there would be up to 14 trains per hour running each way on the high-speed line and then on to the

classic network. The dedicated high speed trains could carry up to 1100 passengers each.

The route between London and the West Midlands, which was published when Justine Greening made her announcement in January this year, was one of several that HS2 Ltd has explored over the last three years.

Refining the various route options to one that we were confident to take to public consultation was achieved by balancing the benefits of better connectivity and journey time savings against the environmental impacts and costs. We divided each route into shorter sections and compared them in pairs. The

route that was eventually consulted on between February and July last year was the best – in terms of journey times and cost, whilst being comparable to any of the others in its environmental impact.

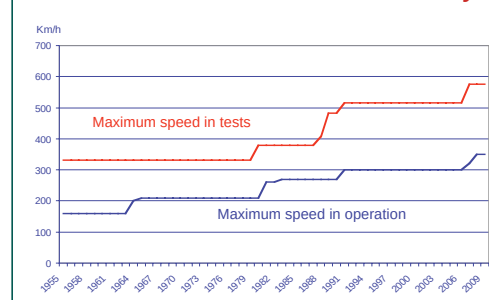
The public consultation was one of the largest ever held. We visited 31 cities, towns and villages along the line of the route from London to the West Midlands over 40 days. Almost 55,000 responses from organisations and individuals were received and a series of mitigation treatments and route refinements, such as increased tunnelling in North West London and the Chilterns, were agreed by the Secretary of State based on careful consideration of the views expressed.

Great care has been taken to use best practice developed on other high speed lines, especially HS1, to design the proposed route into the landscape and use natural cuttings, and tunnels, to reduce the visual and noise effects.

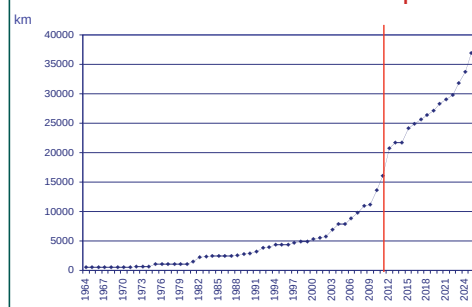
The route we have today has been extensively consulted on, as well as being reviewed and refined by three successive Transport Secretaries – Andrew Adonis, Philip Hammond, and Justine Greening.

The biggest challenge we face now is to set out in the hybrid bill, which will be laid before Parliament at the end of 2013, how we are going to build the new line on time and within the £16.3bn budget.

It continues to evolve technically



Planned World HSR Development



It is a challenging timetable that has been set and to help us with the engineering and environmental assessment work we have brought in considerable expertise in the shape of our development partner CH2M Hill, as well as a range of professional service contractors such as Arup, Atkins and Parsons Brinkerhoff to work on stations and systems designs.

To inform this process we are also running an extensive engagement programme with key stakeholders, local authority planners and the local communities along the route. In the summer we will run the second round of our 25 community forums, which will see HS2 Ltd engineering and environmental staff meeting with representatives of those directly

affected by our proposals to hear their views and to explain our thinking and plans.

There will also be a series of formal consultations on property compensation, the parcels of land that need to be safeguarded along the proposed line between London and the West Midlands, as well as the environmental impact assessment.

All this work will take place in tandem with the development of proposals for the Phase 2 Y' network – which will spread the benefits of high speed rail further across the country.

At the end of March this year HS2 Ltd submitted a report with route and station advice to the Secretary of State. She is considering this advice while

taking soundings from potential delivery partners in the cities where new stations could be located. The Government has announced that it will publish its response setting out initial preferred route and station options in the autumn.

There is much to be done in the weeks and months ahead.

Doing nothing is not an option and the mooted alternatives can not bring the necessary long term capacity and connectivity benefits HS2 offers. The rail network needs more space and HS2 when built will be the backbone of a new transport system for the 21st century.



WHY WOULD HS2 BE GOOD FOR BRITAIN?

WHY THE UK NEEDS HSR TO MANCHESTER?



Sir Richard Leese
Leader of Manchester City Council

Manchester has always been at the centre of Britain's Rail network; in 1830 Manchester witnessed the inauguration of the world's first inter-city passenger railway, creating the foundations of a comprehensive national network which has since spread to over 150 countries, encompassing almost a million miles of track.

On the back of the connectivity and new found opportunities which the railway created, Manchester became the world's original modern city, with an economy encompassing the textile and engineering trades and key scientific breakthroughs. Today's Manchester is just as pioneering. Over the past two decades Greater Manchester has reinvented itself, with an

economic base that has diversified into new knowledge intensive and hi-tech industries. Manchester is home to 65 of the FTSE 100 companies and is a focus for businesses which serve local, regional and

international markets in areas such as legal and financial services as well as e-commerce.

Cities like Manchester are the drivers of our future economy. With over 92,000 businesses

. . . Manchester became the world's original modern city . . .

generating nearly £47billion of GVA per annum, the Manchester city region is the fastest-growing economy outside London, and the economic powerhouse of Northern England.

In response to these changes rail has seen its popularity grow as Greater Manchester's Journey to Work Area (already the largest in the country after London and the south east) has continued to expand. As a result peak-time patronage into the centre of Manchester has increased by 30% over the last decade. Furthermore, forecasts as well as experience suggest that this is not a temporary blip, and that as a result of structural changes in

continue to rely on incremental improvements to our existing rail infrastructure to provide this.

Despite £9bn of upgrades, the West Coast Mainline is set again to exceed capacity by mid-2020. The West Coast is the only direct link between Manchester and London, and will see passenger demand grow by as much as 61% by 2025 according to the West Coast Rail Utilisation Strategy. Further upgrades to the line would be short sighted when set against the option to develop a new dedicated high-speed inter-urban network, which will provide unparalleled economic benefits.

the Government recognises that Manchester has the most potential in the UK to establish itself as a major economic centre to complement London and the South East.

However, the introduction of HS2 would bring significant economic benefits which spread far beyond the Greater Manchester area. Analysis suggests that almost 10,000 jobs would be generated across the Northern Way region, boosting productivity and growing the output across the area by £967 million per year. This demonstrates the substantial benefits HS2 will offer the whole of the North of

At the same time, the HSR programme should not be viewed as an alternate to more pressing investment needs in the existing network, but as an addition, in order to future-proof the national rail network. The effectiveness of the HSR programme is reliant upon the efficient running of the conventional network. It is critical that HSR stations and infrastructure are well integrated into existing local rail and tram networks, as the immediate area surrounding the HSR station is unlikely to be the ultimate origin or destination of any journey. Investment must be made to existing facilities or new connections created to allow passengers to transfer quickly to and from their ultimate origin and destination.

Just as the original railway boom in Manchester helped to revolutionise Britain into the economic capital of the world, it is essential for current national economic growth that a new HSR line links Manchester and the other major cities of the UK to address the imbalances in our economy. The Northern and Midland regions contributed £415bn, or 34% of total GVA to the UK economy in 2009. Failing to provide extra capacity on the already congested classic rail network will not only constrain economic growth and limit job creation in Manchester, but across the whole of the UK.

... the introduction of HS2 would bring significant economic benefits ...

the local economy, growth is expected to continue, despite the recent economic downturn.

Despite this success story, our local economy, and that of the nation, is not as productive as it should be, and poor connectivity to wider markets is partly responsible for this. Journey times of over two hours to London and over one and a half hours to Birmingham are unimpressive when compared with our European competitors. The expansion of knowledge intensive industries is dependent on fast inter-city transport links, and while Manchester is a city fit for the 21st Century, its rail network, which still includes that original 1830 line linking Manchester and Liverpool, is out-dated and not fit for purpose.

There is little spare capacity on the network around Greater Manchester, and we cannot

Just as in 1830 when the railways were originally planned, we now need strong, focused planning to bring our railways up to the best modern standards. A new high-speed line will deliver a quantum gain in connectivity and capacity, while also freeing up space on the existing network for important local travel, freight services, and increased services to intermediate cities.

Manchester is uniquely placed to attract further investment from the extra capacity HS2 would deliver. According to the European Cities Monitor 2010, Manchester was ranked the second-best city in the UK in which to locate a business, and the twelfth-best placed city in Europe. Similarly

England, rebalancing the national economy, and help to reduce the £38bn annual North/South productivity gap which is preventing the UK from reaching its full potential.

The alternatives to HS2 generate much lower cost benefits and crucially do not provide the long term capacity increases needed, while further upgrades and investment would suffer from the law of diminishing returns. Similarly investing in a new conventional rail line will only cost nine per cent less than a high-speed line, yet would not provide the required capacity improvements, and, significantly, none of the journey time savings which deliver huge economic benefits.

... It is critical that HSR stations are well integrated into existing local networks ...

VOICE OF THE FUTURE MARCH 2012

Something unprecedented occurred on 14th March in the House of Commons.

For the first time – **ever** – a Select Committee meeting was held which completely reversed the normal pattern.

Young scientists and engineers came to the House and sat in the Boothroyd Room in Portcullis House in the seats normally reserved for MPs.

The MPs – and the Minister and Shadow Minister – appeared as witnesses. The BBC Parliament Channel was there to record it.

Voice of the Future 2012 gave young scientists and engineers a unique chance to visit the House of Commons to take part in a science question time, organised by the Society of Biology. The Rt Hon David Willetts MP, Chi Onwurah MP, Andrew Miller MP and Members of the Science and Technology Select Committee were quizzed by young people in the first event of its kind.

The Speaker of the House of Commons, the Rt Hon John Bercow MP, inaugurated the event and praised the Society of Biology for organising it.



Pre-prepared questions were then invited from young people, who included school pupils, school teachers, university students and scientists.

The first witnesses to take questions were the Minister of Science, the Rt Hon David Willetts MP, and the new Chief Scientific Adviser for BIS, Professor John Perkins. The Minister openly discussed the challenges he has faced as Science Minister, focusing on

persuading colleagues that science funding was important in a tough economic climate. He was also keen to stress the importance of the Haldane Principle.

The pair were then asked about how they dealt with a situation where scientific advice differs from the political. They were keen to stress that science advice is not seen in isolation; it is one of many considerations in policy development. Willetts caused controversy by giving the example of homeopathy, and



justifying NHS funding because people want it despite the scientific evidence being stacked against it.

The Society of Biology's Chief Executive, Dr Mark Downs, said: "Both Willetts and Perkins were keen to stress the importance of Learned Societies, such as the Society of Biology, in forging links with business, and as a key source of advice and talent. The

... British science can hold its own ...

opportunity to run events such as this enables us to nurture the talents of young people so they can make a valuable contribution to politics and society. Bringing young people into contact with MPs was a valuable opportunity for them to get involved with science policy."

The next group to field questions were Andrew Miller MP and no less than seven members of the Science and

Mosley, MP for the City of Chester, saw a role for MPs to lead the discussion on GM.

Sixth form students were amongst those asking questions, and many took the opportunity to bring up education issues. Ideas suggested by the Select Committee for improving science in schools included encouraging more scientists to become teachers, particularly at primary level, diversifying

computer science education by using open-source software, and greater practical work facilitated by links with universities.

The UK's broad expertise in all the sciences and the collaborations this enables was put forward by MPs as a key way British science can hold its own. Inspiring the brightest young people to become scientists was agreed to be essential to our success.

The final witness was Chi Onwurah MP, Shadow Minister for Science and Innovation. She expressed her concern over reduced investment in science, and stressed the need for a science and innovation strategy that supports growth. She was keen to create a flow of people with the skills science needs, and would therefore not cap immigration.

Onwurah pointed out that the small numbers of women and ethnic minorities in science don't reflect the diversity of the population. She felt it was the responsibility of every scientist to ensure that women are supported in their careers. She also discussed general issues surrounding careers in science and was keen that academia shouldn't be seen as the only career path. Industry is a major employer of scientists.

Dr Downs said: "Voice of the Future was a unique opportunity for young people to visit Parliament and hear MPs' views on issues that are important to them. There were some very insightful questions which displayed young people's passion for science and their engagement with political issues."



Technology Select Committee – including one whose first meeting it was.

A question about the future of genetic engineering triggered interesting answers, with members of the Committee keen to re-open the debate of the pros and cons. Followers of the event on Twitter voiced their support for a reconsideration of the current position. Stephen

... "Both Willetts and Perkins were keen to stress the importance of Learned Societies, such as the Society of Biology, in forging links with business, and as a key source of advice and talent." ...



... small numbers of women and ethnic minorities in science don't reflect the diversity of the population ...

STRENGTHENING THE TECHNICIAN WORKFORCE

A personal perspective on a one-day programme organised by the Gatsby Foundation

Robert Neilson

CEO, Institute of Physics and Engineering in Medicine

In the Whitsun 2012 issue of Science in Parliament, Jon Poole wrote about “Recognising the role of Technicians” and the Technician Council, which was formed with support from Lord Sainsbury and his family’s Gatsby Foundation, to address the underlying issues behind the skills shortage in the UK to fill technician roles, and to look into how a common framework for professional recognition could be provided across science, engineering, IT and health.

Shortly after publication of Jon’s article, a further milestone was reached in recognising the role of technicians at an event organised by the Gatsby Charitable Foundation, held on 29th May, when Lord Sainsbury was the Introductory Speaker and the Rt Hon Vince Cable MP was the Keynote Speaker. As usual the subject of improving the UK’s scientific, engineering and technical workforce was one to which both speakers enthused, as did later Lord Adonis when he spoke of the progress that was being made with the University Technical Colleges initiative, born out of the vision of Lords Baker and Dearing and the eponymous Baker Dearing Educational Trust.

However, the real milestone of the day was the presentation

event that took place between the speeches from Lord Sainsbury and the Secretary of State for Business, Innovation and Skills. It marked the first awards of RSciTech (Registered Science Technician) to members of three of the seven organisations given pilot licences by the Science Council to make these new awards, which are the equivalent in science to the well-established EngTech awards in engineering. Representative awards of certificates were made to seven science technicians by Vince Cable, two to members of the Royal Society of Chemistry (RSC), two to members of the Association for Science Education (ASE), and three to members of the Institute of Physics and Engineering in Medicine (IPEM), my own organisation.

I was pleased to see the achievements of three IPEM members, Elizabeth St Clair, Francis Pillai, and Hemaltha Ganeshamurthy recognised by the award of RSciTech certificates on this public occasion, but I was also conscious that they were only three of 32 IPEM members whose applications for RSciTech have been accepted, so far, since applications were first invited in March 2012. We estimate that these 32 are less than 20% of existing IPEM

members who should already be eligible to be awarded RSciTech.

However, apart from existing IPEM members eligible for RSciTech, we know that there are many more science technicians (and also engineering technicians) working in physical sciences applied to medicine or biology, in healthcare, or academe, or healthcare industries who have never joined a professional body. We see RSciTech for science technicians (and EngTech for engineering technicians), under the umbrella of the Technician Council’s “Professional Technician” branding, as important awards to attract a group of staff who have traditionally eschewed professional membership. They will benefit from professional recognition that registration brings, especially having an award that recognises the generic standards of competence they have achieved. It also gives an assurance to their employers that they are keeping their competences up to date through continuing professional development, and are working within the framework of a professional body’s code of professional and ethical conduct.

It has been argued that technician roles are essentially

engineering roles and EngTech and Professional Technician are synonymous. This is manifestly not the case, as the Technician Council itself recognises. Colleagues such as Jon Poole (see Whitsun issue of Science in Parliament), working in organisations in the biosciences, eloquently put the case for the recognition of professional science technicians, to which the Science Council has responded with RSciTech.

My own organisation, IPEM, is one of a number amongst STEM professional bodies that hold licences from the Engineering Council as well as the Science Council. We are already seeing an upsurge of interest in RSciTech from technicians whose roles are not synonymous with engineering, giving technical support in areas such as brachytherapy dosimetry, radiation protection and physiological measurement. They would never have been candidates for EngTech, but they are Professional Technicians, and they can now have their professionalism recognised as Registered Science Technicians.

The afternoon was devoted to parallel sessions for Registered Engineering Technicians and Registered Science Technicians. With divided loyalties, I opted for the session aimed at strengthening

vocational pathways in science. Engineering apprenticeships are well established and well recognised, but science apprenticeships less so. The afternoon provided a useful interchange of ideas that reinforced my belief that, in addition to focusing its support for professional development on graduate-level outcomes (leading to RSci and IEng) or postgraduate-level outcomes (leading to CSci or CEng), IPeM should do more to set standards in its own subject areas for science and engineering technicians working in healthcare, in universities and in healthcare industries. I hope that we can work with the Gatsby Foundation and others to mill one small cog in the wider Professional Technician project.

IPeM's first three RSciTech registrants receive their certificates from the Rt Hon Vince Cable and Lord Sainsbury of Turville



Elizabeth Anne St Clair, St James' University Hospital, Leeds



Francis Pillai, Addenbrookes Hospital, Cambridge



Hemalatha Ganeshamurthy, East & North Hertfordshire NHS Trust



All seven RSciTech registrants with Krishnan Guru-Murthy (chair for the event), Lord Sainsbury and the Rt Hon Vince Cable

FOOD AND GUT HEALTH

Meeting of the Parliamentary and Scientific Committee on Tuesday 15th May

FRIENDS IN LOW PLACES AND HOW TO HELP THEM: Gut microbiology and health



Professor Glenn Gibson
The University of Reading

Chronic diseases, including cardiovascular complaints, Type II diabetes, many cancers, some dementias, acute and chronic gut disorders are a major and growing societal and financial concern for humankind (Gibson and Williams, 2000). Moreover, an increasingly obese and ageing population means there is greater prevalence of chronic disease. Increasingly there is a recognition that the 21st century health model will comprise both preventative life style and therapeutic entities, including dietary intervention. For example

the "functional foods" concept suggests that dietary ingredients can be used for purposes over and above their normal nutritional value. The Global Market Review of Functional Foods estimates that by 2013 the worldwide functional food market will reach a value of at least US\$90.5bn. Currently around 60% of functional foods in use in Europe are targeted at gastrointestinal health.

The biological and clinical importance of resident gastrointestinal microflora in

humans is becoming increasingly recognised by consumers and healthcare workers. Although it is known that many disease states involve bacterial metabolism, the human gut microflora may also be considered as extremely relevant for improvements in host health (Gibson and Roberfroid, 2008). For instance, bifidobacteria and lactobacilli are seen as positive components of the human gut microflora that can improve host health. They are thought to help resistance to gut infections by directly

inhibiting the growth of harmful bacteria, reduce cholesterol levels, sustain the immune response and synthesise vitamins (Steer *et al.*, 2000).

Scientific concepts underpinning directed modulation of the human gut microflora towards a more beneficial composition have had *probiotics* as a principal focus. While probiotics have been ingested by humans for several hundred years, their development has progressed markedly over the last 2 decades. Probiotics are defined as 'live microorganisms that, when administered in adequate amounts, confer a health benefit on the host' (United Nations Food and Agriculture Organisation of the United Nations 2002). Probiotics must be safe (ie the USA Food and Drug Administration standard of Generally Regarded As Safe), should be amenable to industrial processes necessary for commercial production, they must remain viable in the food product and during storage, need to persist in the gastrointestinal tract long enough to elicit an effect and they must improve host health (Kolida *et al.*, 2006). The use of live bacteria in the diet has been successful scientifically and economically. The best products need to maintain strain integrity and consistency, have survivability in the product and following ingestion.

In contrast, *prebiotics* are a far more recent concept than probiotics, being first developed in the mid 1990's. They are dietary ingredients that can selectively enhance beneficial components of the indigenous gut microbiota, such as lactobacilli or bifidobacteria, and are finding much increased application in the food sector. In contrast to probiotics, they can be added to many ingredients including heated products. Prebiotics were therefore originally developed to

selectively enhance beneficial components of the gut microbiota, such as lactobacilli or bifidobacteria, and are finding increased application. In the future, it is likely that this may be expanded towards other genera, eg *Eubacterium*, *Faecalibacterium* and *Roseburia*. Prebiotics were first defined as 'non digestible food ingredients that are selectively metabolised by colonic bacteria which have the capacity to improve health' (Gibson and Roberfroid, 1995). As such, their use is directed towards favouring beneficial changes within the indigenous gut microbial milieu itself. They are distinct from most dietary fibres like pectin, celluloses, xylan, which are not selectively metabolised in the gut. Criteria for classification as a prebiotic are (Gibson *et al.*, 2011):

- resists gastric acidity, hydrolysis by mammalian enzymes and gastrointestinal absorption
- is fermented by intestinal microflora
- selectively stimulates the growth and/or activity of

intestinal bacteria associated with health and well-being.

Any dietary component which reaches the colon intact is a potential prebiotic, however it is the third criteria which is the most difficult to fulfil. Much of the interest in the development of prebiotics is aimed at non-digestible oligosaccharides such as fructooligosaccharides (FOS), *trans*-galactooligosaccharides (GOS), lactulose, isomaltooligosaccharides (IMO), xylooligosaccharides (XOS), soyoligosaccharides (SOS), and lactosucrose. In Europe, FOS, GOS and lactulose have been shown to be prebiotics, through numerous volunteer trials, as evidenced by their ability to change the gut flora composition after a short feeding period (Gibson and Roberfroid, 2008).

At the University of Reading, we have generated and tested a new prebiotic galactooligosaccharide (GOS). This has powerful effects upon beneficial gut bacteria (bifidobacteria). The ingredient was manufactured from 'gut model' fermentation studies (Fig 1) and is made

through the enzymatic activities of a probiotic. The prebiotic and its biomass were scaled up to pilot plant production level in our Food Processing Hall (Fig 2). We have characterised and cloned the microbial enzymes responsible for production. This research has led to a new health food product (BiMuno). It was given the Frost and Sullivan Award for European Innovation in 2009.

The GOS is a synthetic lactose based oligosaccharide that, following ingestion, passes unchanged to the colon, where it serves as an energy source for saccharolytic colonic bacteria. It specifically increases populations of beneficial colonic bifidobacteria and is therefore a recognised prebiotic. The following summarises our research and impact of the product:

- The GOS is synthesised from enzymes in *B. bifidum* 41171. Traditionally, GOS is made from yeasts or bacilli. However, use of a known probiotic is relevant as the bifidobacteria are the target genera for GOS metabolism. This strain has



Figure 1. Human colonic model used to simulate the large intestine (and identify mechanisms of prebiotic effects). The model gives a close reflection to in vivo events and is used to plan subsequent human trials. Its use obviates the need for animal experimentation in prebiotic testing.



Figure 2. "Pilot plant" food processing hall at the University of Reading. This was used to develop a new galactan based prebiotic which is now commercially available. The pilot plant is used to test the prototypes of a range of new food ingredients, including novel functional foods.
(<http://www.reading.ac.uk/food/businessdevelopment/foodnut-processresearchcentre.aspx>)

now been fully genome sequenced and was one of the first non-USA probiotics to be included in the NIH's Human Microbiome Project:

(http://www.broad.mit.edu/annotation/genome/Bifidobacterium_group/MultiHome.html)

- BiMuno has been tested *in vitro*, in pigs and in humans for its prebiotic effect (Tzortzis et al. 2005a,b; Depeint et al. 2008)
- Human studies in IBS (Silk et al. 2009), elderly persons (Vulevic et al. 2008) and traveller's diarrhoea (Drakoularakou et al. 2010) are complete
- The synbiotic (probiotic and prebiotic combination) effects are now being researched with appropriate probiotics
- Its influence as an adjunct to the influenza vaccine is being researched at Reading
- The prebiotic has been trialled in 80 high level sports persons
- The Welsh team competing at the Commonwealth Games in Delhi in October 2010 took the supplement – to reduce risk of gastroenteritis. The English badminton and bowls sides also did so. Feedback has been extremely positive: <http://www.bimuno.com/bimuno-avoids-'dehli-belly'-at-the-commonwealth-games/>
- Recent research has shown that the gut microflora of both obese humans and mouse models of obesity is altered compared to lean counterparts. This raises the possibility of modulating the gut microflora as a novel strategy in tackling the epidemic of obesity and diabetes sweeping the developed world. A human study in markers of metabolic syndrome and dietary based

microbiota modulation by the GOS is almost complete.

Both probiotics and prebiotics have been researched for their abilities to alter the microbiome in a manner that improves health. Reduced risk of gastroenteritis, inflammatory conditions, atopic reactions and digestive cancers are among the conditions targeted. For the next generation of gut microbiome based interventions, microbial and metabolic profiling strategies should be applied in parallel to assess both the compositional and functional status of the microbiome and its interaction with the host. Such functional assessments of pro/prebiotic interventions and the identification of specific microbial-metabolic connectivities will facilitate the rational design of dietary interventions that are finely targeted in terms of their health attributes and underpinned by mechanisms of effect.

References

- F. Depeint et al., *Am. J. Clin. Nutr.* 87, 785 (2008).
- A. Drakoularakou et al., *Eur. J. Clin. Nutr.* 64, 146 (2010).
- G.R. Gibson and M.B. Roberfroid, *J. Nutr.* 125, 1401 (1995)
- G.R. Gibson and M.B. Roberfroid, (eds.) *A Handbook of Prebiotics*. Taylor & Francis, Boca Raton (2008)
- G.R. Gibson and C.M. Williams, (eds.) *Functional Foods: Concept to Product*. Woodhead Publishing Limited, Cambridge (2000)
- G.R. Gibson et al., *IFIS Functional Foods Bull.* 7, 1 (2011)
- S. Kolida et al., *Eur. J. Clin. Nutr.* 61, 1189 (2007)
- T.E. Steer et al., *Nutr. Res. Rev.* 13, 229 (2000)
- D.B. Silk et al., *Al. Pharm. Ther.* 29, 508 (2009)
- G. Tzortzis et al., *Appl. Microbiol. Biotech.* 68, 412 (2005a)
- G. Tzortzis et al., *J. Nutr.* 135, 1726 (2005b)
- J. Vulevic, et al. *Am. J. Clin. Nutr.* 88, 1438 (2008).
- United Nations Food and Agriculture Organization of the United Nations <http://ftp.fao.org/es/esn/food/wgreport2.pdf>. (2002)

FOOD AND GUT HEALTH

A PROBIOTIC INSIGHT: PAST, PRESENT AND FUTURE



Linda Thomas
Science Director, Yakult UK Ltd

THE ORIGINS OF A NEW MICROBIAL CONCEPT

A key figure in probiotic history was the Nobel prize-winner Professor Metchnikoff, who believed ageing was related to toxic metabolites produced by putrefactive bacteria in the large intestine. In his 1907 thesis, 'The Prolongation of Life', he argued that this could be suppressed by eating foods fermented with lactic-acid producing bacteria. Two decades later a scientist in Japan, Dr Shirota, believed that this strategy might help prevent infectious disease but realised

that, to be effective, the bacteria needed to remain alive through the gut. After screening many strains, he selected one (see Figure p37) to develop a simple fermented milk drink, eventually sold as a probiotic product. This reached the UK in 1996, starting the rapid expansion and popularity of the category with products now available as fermented milk drinks, yoghurt drinks, yoghurts, capsules, tablets or powders – from supermarkets, pharmacies, health food shops and the internet. In 2008, it was estimated that the retail value of

probiotic supplements in the EU was €380m (26% of the global total) and €5 billion for probiotic yoghurts (32% of the global total)¹.

WHAT ARE PROBIOTICS?

Back in the 1990s, it was a real challenge to persuade people that it was beneficial to eat live bacteria. Remember ads featuring a 'geeky guy' pontificating about 'friendly bacteria' and the importance of digestive health? By 2001, two United Nations bodies (the World Health Organisation and the Food and Agriculture



Organisation) recognised the need for guidelines for this category, and agreed the probiotic definition as: 'Live microorganisms which when administered in adequate amounts confer a health benefit on the host'².

Thus probiotics should have evidence of health benefit from human intervention studies conducted either with the product or the strain given at an equivalent level. They must be safe for their intended use: most strains are lactobacilli or bifidobacteria, types of bacteria associated with food for centuries and normally found in the gut of humans. Further advice can be found on the International Association for Probiotics and Prebiotics website (www.isapp.net), which emphasises that products should show the probiotic strain name and number of live microorganisms.

HOW DO PROBIOTICS WORK?

To understand this, one must appreciate the importance of the mutually beneficial relationship between humans and their personal collection of 100 trillion (10^{14}) gut bacteria, key to many of the body's developmental, immunological and nutritional functions. Disruption of this microbial community, perhaps because of antibiotic use, infection, stress, poor diet or ageing, can increase risk of infection or other disease.

Several mechanisms of probiotic activity are based on their ability to reach the lower colon alive and persist in the gut for a short period of time. Here, they can help strengthen different aspects of the gut defences by competing with pathogens for nutrients and adhesion sites in the gut, strengthening the gut barrier and suppressing harmful products of other microbes. Their generally carbohydrate-fermenting metabolism helps maintain a low gut pH, producing

metabolites such as short chain fatty acids, some of which are antimicrobial and important for the regulation of the gut cells. One reason why probiotics effects can go beyond the gut and become systemic, is their ability to modulate the immune response. Over 70% of immune cells are located in the gut; our gut bacteria can 'talk' to the immune system through specialised cells and receptors, starting a chain of instructions to the rest of the body via various cells and chemical messengers.

WHAT HEALTH BENEFITS HAVE BEEN SHOWN FOR PROBIOTICS?

An indication of the their strength of scientific evidence

and range of benefit can be gauged by searching the medical database PubMed³, which will find about 9,000 probiotic papers, about 10% of which describe human trials (see Table). Systematic reviews have also reached positive conclusions for probiotic use in a range of areas, recently for example to prevent antibiotic-associated diarrhoea⁴; to treat acute infectious diarrhoea⁵; to prevent upper respiratory tract infections⁶; and to prevent necrotizing colitis⁷.

Many people rely on a daily probiotic for relief of irritable bowel syndrome symptoms. Current guidelines from NICE and the British Dietetic Association⁸ advise that in these

cases, people should take the probiotic daily for at least one month at the recommended dose and monitor if this helps. If it does not, they suggest trying another.

THE REGULATORY SITUATION

Commercial health and nutrition claims now come under EC Regulation 1924/2006, requiring assessment of evidence by the European Food Safety Authority NDA panel. By 2008, approximately 350 probiotic claims were submitted via the Article 13.1 route for 'generally accepted scientific evidence', with the majority relating to the gut flora, digestive health or

The main areas of human study research where positive effects have been demonstrated*.

Investigation area	Outcomes
Intestinal microbiota	• Survival of the probiotic through the gut • Increase in 'beneficial' species (eg lactobacilli, bifidobacteria) • Reduction in pathogens • Reduction in harmful microbial metabolites
Infections (Gut-related)	• Reduction in diarrhoea (rotavirus, travellers', children) • Reduction in antibiotic-associated diarrhoea and <i>Clostridium difficile</i> infection • Reduction in necrotising enterocolitis in preterm babies • Reduction in post-operative infections
Gut function	• Improvement of irritable bowel syndrome symptoms • Improvement of constipation symptoms • Benefit for inflammatory bowel disease
Immune function	• Reduction of allergic and atopic disease incidence • Enhancing antibody response to vaccination • Reduction of common infectious diseases (eg colds) • Downregulation of inflammation in the gut
Other areas of research	• Cancer; children's colic; gut-brain axis (mood, anxiety); obesity-related disease (metabolic syndrome, etc.) ; urogenital health

*Probiotic effects are considered strain specific; not all effects have been demonstrated for all strains.

In our Olympic year: an example probiotic trial with athletes⁹

Athletes' heavy schedules of training and competition can affect their immune response and gut function, increasing their risk of infection and gastrointestinal problems. A double-blind, placebo-controlled randomised trial conducted at Loughborough University by Professor Mike Gleeson investigated the effects of a probiotic (*Lactobacillus casei* Shirota) who recruited 84 people engaged in endurance-based physical activity during four months' winter training. At the end of the trial, the average number of colds was 50% lower in the probiotic group, a benefit associated with better maintenance of levels of salivary IgA. The probiotic group also experienced significantly fewer days with digestive discomfort symptoms.

function, or immune system. Further claims have been submitted via other routes.

At the time of writing, however, no probiotic claims have been approved. So we have a situation where products that fit the WHO definition cannot be called probiotic – this is a health claim. This has come as a surprise to industry and scientists alike. Whilst some strains may well have insufficient



An electron micrograph of a probiotic strain (*Lactobacillus casei* Shirota)

evidence, others were considered to have good evidence of health benefit, with well-designed human studies published in peer-reviewed journals.

So what are the problems? Many claims (260) were rejected for lack of strain characterisation data, a requirement not realised at the time of submission. Evidence from even major studies was rejected for a variety of reasons, including use of disease endpoints or unvalidated biomarkers (there are few validated biomarkers that measure health maintenance). There was also a lack of acceptance that certain gut bacteria, such as lactobacilli or bifidobacteria, are beneficial to health.

Concern has been expressed by scientific and medical experts about the appropriateness of the current assessment

procedure for probiotics^{10, 11}. In April 2011, guidance for scientific requirements for claims relating to gut and immune health was published. A lack of clarity still remains, making it difficult for companies to invest in large, costly studies that could still be rejected as evidence even with positive results and peer approval. Rejection of claims also incurs negative media attention.

A scientific platform is needed to agree the criteria for probiotic claims that will satisfy the requirements of all stakeholders: regulators, manufacturers and researchers. This would enable this innovative functional food sector to demonstrate and communicate substantiated health benefits that are relevant to the general public, and for the EU to remain active in probiotic research.

References:

1. Data from Global Alliance for Probiotics.
2. <http://ftp.fao.org/es/esn/food/wgreport2.pdf>
3. <http://gopubmed.com/web/gopubmed/1?WEB10000h00100090000>
4. Hempel S et al (2012) Probiotics for the prevention and treatment of antibiotic-associated diarrhea: a systematic review and meta-analysis. *JAMA* 307(18):1959-1969.
5. Allen SJ et al (2010) Probiotics for treating acute infectious diarrhoea. *Cochrane Database Syst Rev* Nov 10;(11):CD003048.
6. Hao Q et al (2011) Probiotics for preventing acute upper respiratory tract infections. *Cochrane Database Syst Rev* Sep 7;(9):CD006895.
7. Alfaleh K et al (2011) Probiotics for prevention of necrotizing enterocolitis in preterm infants. *Cochrane Database Syst Rev* Mar 16;(3):CD005496.
8. http://www.bda.uk.com/publications/IBSdietary_resource.pdf
9. Gleeson M et al (2011) Daily probiotic's (*Lactobacillus casei* Shirota) reduction of infection incidence in athletes. *Int J Sport Nutr Exercise Metab* 21:55-64.
10. <http://www.gut-health.eu/>
11. Guarner F et al (2011) Probiotic and prebiotic claims in Europe: seeking a clear roadmap. *Brit J Nutr*. DOI:10.1017/S0007114511002248.

FOOD AND GUT HEALTH

MANIPULATING THE MICROBIOME FOR LIFELONG HEALTH

The third speaker on 15th May was Professor Simon Carding, from the Institute of Food Research in Norwich.

Here are some of the key points he raised :

Manipulating the microbiota composition and/or function has enormous potential for improving gut health.

There are several strategies

1. Pharmaceutical, involving antimicrobial therapy
2. Biotics, involving both probiotics and prebiotics
3. Altering the activity and behaviour of the microbiota and the response to it in patients using modified commensal bacteria and food

This last requires the

production of smart bacteria able to deliver, in a controlled manner, biologically active therapeutic agents to the gastro intestinal tract.

There are many benefits to this approach

- a. Increased safety
- b. Delivery is targeted to inductive mucosal sites
- c. Protection is afforded against both disease and infection
- d. Systemic and mucosal responses are stimulated
- e. There is usually high acceptance, and increased compliance

f. Administration is easy

g. It is cheaper than conventional therapies

Tests have shown that genetically modified probiotic organisms (*Lactococcus lactis*) can cure Inflammatory Bowel Disease – a chronic lifelong autoimmune disease.

Another organism, *bacteroides ovatus*, has been altered to enable it to treat ulcerative colitis.

The second half of his talk described work by his colleagues, Richard Mithen and Cathie Martin, to produce new varieties of broccoli with

enhanced levels of glucoraphanin, and tomatoes with elevated levels of several antioxidants. The tomatoes are purple and have the added advantage that they look pretty in salads. This increases the likelihood of consumer acceptance. This is no small matter when introducing novel foods, although it should be emphasised that both these are the products of conventional plant breeding.

Alan Malcolm
Editor, Science in Parliament



HARNESSING THE POWER OF GENOMICS FOR ANIMAL HEALTH AND FOOD SECURITY



Dr Jim Huggett
Science Leader for Nucleic Acid
Metrology and Diagnostics, LGC



Dr Jason Sawyer
Head of Technology Transfer Unit,
Animal Health and Veterinary
Laboratories Agency (AHVLA)

The field of genomics, that is the study of DNA sequences that make up the genetic code of living organisms, has advanced at a breathtaking pace over the last twenty years. At the beginning of the 90s an international project was launched that took over twelve years to sequence the human genome. Today the same exercise to read the 3 billion letters of the human genetic code can be achieved in less than a week. This relentless advance of the field of genomics, which has revolutionised genetics and offered considerable medical advances, is not limited to investigating human DNA. DNA analysis methods have been used to study many groups of plants, animals and bacteria and these methods are increasingly being applied to test for species identity or the presence of a genetically modified organism. This technology has important applications in the domain of animal health and food security, as exemplified by the use of advanced genomic techniques to identify and understand last year's E. coli outbreak in Germany. Yet it is fair to say, when compared to human disease, direct application of genomics or the knowledge generated from genomics to

food security and animal health is still in its infancy. However, we are now in a situation where advances in genomics show tremendous potential to assist in monitoring diseases and rapidly identifying and tracking disease outbreaks.

Two examples of meetings which bring experts together to consider genomics in animal health are the International Symposium on Animal Functional Genomics (ISAFG) and the International Symposium on Animal Genomics for Animal Health (AGAH). The conference websites show that there is a huge amount of research being performed using advanced genomics methods, however the challenge remains in translating this to everyday applications. The last AGAH meeting identified four priority areas for genomics and the associated challenges that need to be overcome to ensure they

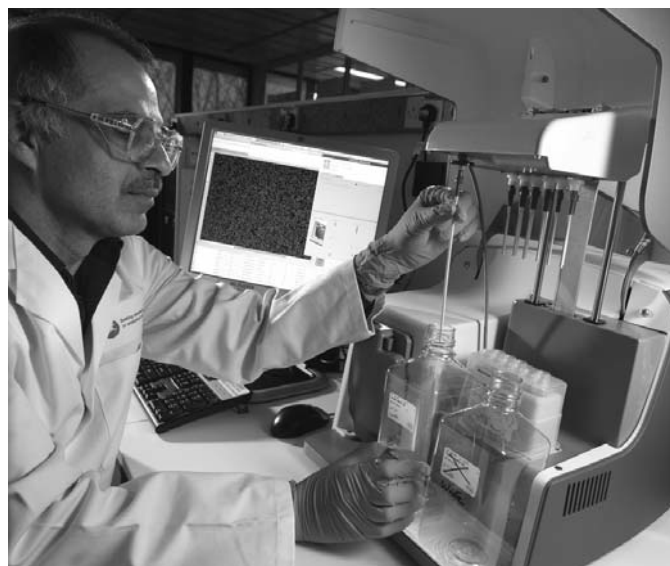
have maximum impact¹. These were:

1. Marker-assisted selection of animals with desirable health traits
2. Functional genomics of host-pathogen interactions
3. Translating genomic information to tools for controlling diseases
4. Integrating stakeholder support to advance animal genomics in animal health

This final priority reflects the inherent difficulties associated with introducing "disruptive" albeit highly beneficial transformative innovations into existing well established markets.

There are a few more technical hurdles that need to be overcome before genomics can make a full transition from its current predominant use in research fields to widespread application as a routine screening tool for animal health

... UK science has an opportunity to lead the world in this area ...



Courtesy of Andrew Brookes, www.andrewbrookes.co.uk

protection. It requires the analysis of the whole or large parts of a genome and necessarily depends on the power of computing to interrogate the resulting very large data sets. Direct application of genomic techniques to complex issues like selective breeding could offer huge economic benefits. However more research is needed to understand fully the fundamental relationships between genetic sequences and specific biological phenomena, and we are some distance from having robust, simple instruments that would allow routine use by non-experts for the purpose of mass-screening of livestock. Efforts to control for technical variation will also be crucial if more applied applications are to succeed. Identifying mechanisms to facilitate robust data comparison, such as through the development of appropriate reference standards, will be central to this endeavour.

In the short term, the fastest route for translation of the knowledge gained from genomics to assist in animal health is to use this information to complement and improve on more established approaches. Methods, like the polymerase chain reaction (PCR), that are currently used to identify a specific gene, genotype an animal, measure drug resistance or diagnose an infection can all be made more effective using genomics.

We can soon expect to harness the potential of genomics in the field of animal health and reap major economic and societal rewards from improved disease control (reducing and ultimately eradicating outbreaks), tailored medication and selective breeding. UK science has an opportunity to lead the world in this area, with our leading expertise and research infrastructure in genomics. Within the space of a few years computational power will pick up sufficiently to handle the data generated. In the meantime attention to the AGAH priorities with directed public funding will allow our knowledge to mature sufficiently to ensure market acceptance to embrace fully this transformative technology.

1. S. C. Bishop, J. K. Lunney, M. H. Pinard-van der Laan et al., *BMC Proc* 5 Suppl 4, S1 (2011).

A case study:

Bovine TB – how genomics is helping to fight the disease now and in the future

Genomics is helping in the fight against bovine tuberculosis (TB). Bovine TB is an infectious disease caused by the bacterium *Mycobacterium bovis*. *Mycobacterium bovis* can also cause TB in humans as well as other mammals including badgers and deer. The disease costs the UK government approximately £100 million every year and continues to be one of the most important issues facing the UK farming industry.

TB DNA Fingerprinting: tracking the spread of the disease

Being able to monitor and understand the spread of disease (epidemiology) is a vital part of ultimately controlling them. Epidemiology relies on laboratory tests which allow different strains of organisms to be distinguished and monitored. For TB, the most useful epidemiological tools are based on an understanding of the genomes and genetic variation of *Mycobacterium bovis*, so called molecular epidemiology.

Two techniques are commonly used – TB spoligotyping and VNTR (variable number of tandem repeats). Both are types of TB DNA fingerprinting or genetic typing. Both measure variation in the genomes of TB and allow different strains of TB to be identified and monitored as they spread around the countryside. This information is being used by epidemiologists to identify risk factors and plan the most effective intervention strategies to combat the disease. In Great Britain, the two techniques are routinely used in combination by the Animal Health and Veterinary Laboratories Agency, to support field investigations into the likely source of TB incidents in cattle and other animals.

Using DNA fingerprinting to ensure identified TB infected cattle are removed from farms

DNA fingerprinting can allow genetic identification of individual bovine animals – similar to human DNA fingerprinting used in criminal investigations. This method can be used to detect cases where eartags from TB positive cattle are swapped with less productive animals, sending the less productive (but disease free) animals to slaughter and retaining the infected animals on the farm. To deter strongly this sort of practice DNA samples are now taken from all TB test positive cattle at the time they are disclosed. DNA cross checking (between the animal identified on farm and the animal sent to slaughter) is carried out on a sample basis – or where fraud is suspected – to ensure TB infected cattle are not retained on farms.

The Future...towards better diagnostics, vaccines, medicines and disease control

The two examples above demonstrate how genomics based technology is helping in the fight against TB in the here and now. However, genomics is also underpinning and allowing research to be performed that would have been unthinkable only a few years ago. This research is exploiting techniques based on genomics such as microarrays and next generation sequencing (NGS).

Microarrays can be used to measure the presence or activity of thousands of genes in one experiment (in both *Mycobacterium bovis* and cattle) allowing researchers to understand better how the genome of an organism determines its biology. Using NGS the entire genome of a TB strain can be determined in a matter of hours allowing the differences between strains to be deciphered at a speed and level of detail not previously possible. Interestingly, the improved understanding of how strains differ will lead to molecular epidemiological tools which have advantages over spoligotyping and VNTR – a good example of how genomics can refine and improve current approaches.

Such genomics methods are helping to transform our understanding of fundamental TB biology: how the organism infects cattle, how it causes disease and how the immune response in the cattle fights the disease. These advances in understanding will ultimately lead to development of better TB disease control through improved vaccines, diagnostics and medicines.

TURKEY: ONE OF THE LATEST COUNTRIES TO JOIN THE UK SCIENCE AND INNOVATION NETWORK. BUT WHY?



Dr Başak Candemir
Science and Innovation Officer,
Turkey

In July 2011, the UK Science and Innovation Network established a new post in Turkey, based at the British Consulate-General Istanbul. At a time of budget freezes affecting science and research in the UK, one has to ask why such a decision was taken and what benefits can be afforded to the UK in building a closer science and research relationship with Turkey. Perhaps a 10% GDP growth in 2010 and the doubling of R&D investment over the last decades is a good place to start to answer that question.

Turkey's dance with Europe started in the 1970s and the accession process to the EU has been a long story with many agreements yet to be made. Yet while the negotiations are far from nearing their conclusion, Turkey has become an increasingly important economic partner for the UK; this was demonstrated by the signing of UK-Turkey Strategic Partnership between David Cameron and Turkish Prime Minister Recep Tayyip Erdoğan in July 2010. The dialogue in the economic arena has been extended to science, technology and innovation, given the growing efforts of Turkey in this field. In its accession bid to the EU, the Science and Research Chapter has been the only chapter so far

where Turkey has satisfied the demands presented by the EU. This Chapter closed in 2006 and since then Turkey has been an increasingly active participant in the 6th and 7th EU Framework Programmes; it is

a percentage of GDP, with 0.84% this is still considerably less than the EU and OECD average. Nevertheless with a growth rate of R&D spend only second to China, the future looks promising. In real terms,

... While Turkey has almost doubled its R&D expenditure ...

estimated that Turkey will have contributed around €420 million to the 7th Framework Programme by the end of 2013.

Approaching the centenary in 2023 of the establishment of the Turkish Republic by Kemal Atatürk, Turkey has accelerated its efforts in science and innovation fields and set itself ambitious targets for 2023. "Vision 2023" commits the country's R&D expenditure as a percentage of GDP to rise 2% by 2023. While the growth rate has been extremely impressive, this is nevertheless a challenging target, especially when considering that many leading countries like the UK and on average the EU are currently below 2%. In addition to quantifiable targets, the government and Prime Minister Erdoğan have announced ambitious targets for the centenary such as producing a domestic car, domestic plane and establishing a national space agency.

While Turkey has almost doubled its R&D expenditure as

the expenditure on R&D has more than trebled in the last decade, which is again substantial.

Countries like Turkey and China show trends that differ from traditional players in science and technology like the UK, USA and Japan. In the last decade these countries have seen a decrease in the share of industry-financed R&D and an increase in the share of government-financed R&D; a troublesome trend in the light of economic difficulties that governments face. On the contrary, the share of industry-financed R&D and industry-performed R&D in Turkey has been increasing in the last decade, showing a similar trend to China. The patent-per-R&D ratio of Turkey has increased considerably over the last decade, again being second only to China, where most countries have seen a decline. Turkey has increased its publications by 106% between 2002 and 2008 and had a 50% increase in the world share of publications.

... Turkey's dance with Europe started in the 1970s ...

The UK has been following the developments in Turkey closely and is taking steps to become a partner with Turkey amongst her traditional collaborations such as the USA, Germany and Japan. On 26 September 2011, the UK-Turkey Knowledge Partnership was signed between the UK Secretary of State for Business, Vince Cable, and Turkish Minister of Economy, Zafer Çağlayan. The concept for the Partnership was proposed by Lord Green during his visit to Turkey in April 2011 and it aims to promote new opportunities for collaboration between the research and education institutions, businesses and governments of both countries. The Partnership's stakeholders from the UK side are UK Trade and Investment, Science and Innovation Network and the British Council, which makes it possible to realise opportunities across a spectrum ranging from education to trade. One of the first activities to follow the launch was the UK-Turkey Higher Education



Institutional Partnership call by British Council, which will see 22 projects being funded that include universities and industry from the UK and Turkey.

In the previous 12 months alone, Turkey has received several high-level UK visitors. Vince Cable launched the UK-Turkey Knowledge Partnership in Sabanci University Nanotechnology Application and Research Centre as well as meeting a number of ministers and businesses in Turkey. UK Minister for Universities and Science, David Willetts, came to Turkey in April this year with the largest delegation of university vice-chancellors ever to visit

Turkey. David Willetts met Nihat Ergün, Minister of Science, Industry and Technology where he announced the Knowledge Pathway visa scheme which will ease the visa application process for senior academics in Turkey.

While many positive developments are going forward, Turkey also faces some challenges in its growing

the resignation of around 50 Academy members and letters of concern from international science academies, including the British Academies. The 2010 UNESCO Science Report presents some challenges for Turkey in terms of lower enrolment in tertiary education, underdeveloped venture capital market and an insufficient number of high-growth firms.

... Turkey is about to appoint science attachés to the UK ...

research scene. In August 2011, the government passed a new decree law which sees changes to the election of members to the Turkish Academy of Sciences (TÜBA). While previously TÜBA was able to elect all its members, the new law will now allow one-third of the members to be elected by the Turkish Higher Education Council and one third by the science committee of the Turkish Scientific and Technological Research Council (TÜBİTAK). The Turkish government says this will increase the chances for a fairer election to the Academy although the change resulted in

Turkey is about to appoint science attachés to other countries, which include the UK along with the USA, Germany, Japan and Korea, inspired by the UK Science and Innovation Network (SIN) too. With the activities of UK SIN and the recent Knowledge Partnership, UK has the chance to become a preferred partner for Turkey and make the best of the synergies that will arise through collaboration in science and innovation.

References

UNESCO Science Report 2010
OECD Main Science and Technology Statistics

... industry-financed R&D has been increasing ...

ROCKET SCIENCE: UK AND RUSSIA IN SPACE



Dr Julia Knights
First Secretary, Science & Innovation
Network (SIN) – Russia

The UK-Russia Year of Space 2011-12 has already delivered significant commercial space partnerships and cutting edge joint research. Russia's ambitious plans to gain 10% of the global space market by 2030, their "Glonass" global navigation satellite system to rival the US's GPS, a new spaceport in Russia's Far East and planned Russian missions to the Moon, Mars, Venus and Jupiter offer compelling reasons why the UK

space industry & research community should take note.

From the launch of the first artificial Earth satellite "Sputnik 1" into orbit and first animal in orbit on "Sputnik 2" in 1957 to the first human manned space flight on "Vostok 1" in 1961 and first spacewalk in 1965 by Cosmonaut, Alexey Leonov, Soviet engineers and cosmonauts have made their mark in Space.

Russia is ambitious to modernise and regain its position from Soviet times as a space superpower, with its sights set on becoming one of the top three space nations through a target to increase its share of the global space market from 0.5% to 10% by 2030 – the same target as the UK's.

Russia's Federal Space Agency (Roscosmos) has set out how it will achieve this target





UK & Russia Heads of Space Agencies sign the UK Russia Year of Space in Feb 2011 in the presence of David Willetts MP in Moscow

in their "Space Development Strategy to 2030" – ambitious given Roscosmos's budget in 2012 is around one fifth of NASA's.

Specific plans include a £8.6bn Vostochny cosmodrome in Russia's Far East (funded separately from Roscosmos by Russia's Federal Target Programme) which, from 2018, should bring Russia independence in manned space missions from Baikonur, leased from Kazakhstan. Russia hopes to replace its 40 year-old Proton system for Soyuz spacecraft (which use highly toxic fuel)

be installed on the ExoMars rover, along with instruments. Another set of instruments could be installed on the stationary landing platform.

All these plans offer considerable opportunities for prosperity partnerships between the UK and Russia.

We recently celebrated the end of the UK Russia Year of Space (Feb 2011 to March 2012), designed by the Science & Innovation Network (SIN) – Russia, to highlight the complementary strengths of two leading space nations: including UK's strengths in innovative

... Russia is ambitious to modernise ...

with next-generation Angara rockets to support manned missions to the Moon and unmanned missions to Venus and Jupiter.

Other projects include a £7.35bn "Glonass" global navigation satellite system to rival the US's GPS and joining the European Space Agency's "Exomars" project (a robotic mission to Mars in 2016 and 2018) – in which Russia hopes to provide spectrometers in 2016 developed by Russia's Space Research Institute (IKI) for studying atmospheric gases and traces of volcanic activity and subsurface water on the planet. In 2018, a Russian-built radioactive heat generator would

downstream and upstream space technology and as world number one in small satellites; and Russia's 40% share of global launches.

Timed to coincide with the 50th anniversary of Yuri Gagarin's pioneering flight into orbit, and agreed by the heads of both nations' space agencies (UK Space Agency & Roscosmos) in the presence of David Willetts, Minister for Universities and Science, outcomes were delivered through joint lectures on cutting-edge Space topics under our Global Partnership Fund "UK Russia Space Science Café" lectures.

... considerable opportunities for partnerships between the UK and Russia ...

So far, the Year of Space has delivered:

Commercial outcomes: a £6.5m satellite project to predict earthquakes funded by Skolkovo Space Cluster and University College London and £4.2m of British immersive theatre technology at the Moscow Planetarium (by British SME "Global Immersion").

Research outcomes include joint projects on space medicine and crew psychology for a manned mission to Mars (University College London and the Institute of Biomedical Problems), Fluids in microgravity research at the International Space Station (ISS) (Kingston University & Moscow Aviation Institute) and optical research for telescopes (Glyndwr University & Lytkarino Optical Glass Factory).

Cultural outcomes include the British Council's "Gagarin Week" last summer with the unveiling of a statue of Gagarin near Admiralty Arch in London, and a £2m exhibition on Russia's space achievements at London's Science Museum in 2013. Educational outcomes include Kingston University & Yuri Gagarin 50's zero gravity experiment linking 100 UK and 100 Russian schools with the ISS.

The UK-Russia Year of Space has provided a strong platform from which to deliver prosperity and research partnerships with Russia. We aim to build on this through the visit of a senior Russian delegation to the Farnborough International Air Show this July at which we will see a revised roadmap for collaboration between our two space agencies agreed which

could lead to commercial deals including one with Glonass. A separate Memorandum of Understanding to be signed between the UK's International Space Innovation Centre (ISIC) & Rutherford Appleton Laboratory (RAL) – Space, Harwell, Oxfordshire and the Space Cluster of Russia's \$5bn new Skolkovo Innovation hub on the outskirts of Moscow will also bring opportunities for UK Space SMEs.

World-class scientific link ups are also set to continue through a new Space Science Café series led by SIN-Russia and funded by the Global Partnership Fund with match funding from a Russian philanthropic science NGO: the next lecture will consider the potential impact of solar flares on communication systems during London 2012 and Sochi 2014; another on Exomars and a further lecture on "cryogenics: developing next generation green fuels for space rockets".

SIN-Russia is also extending the UK's reach of space collaboration with the CIS countries through a new Global Partnership Fund Project "Harnessing World-class science in the CIS" and this year we will be holding Expert Innovation Roundtables with Space institutes in Kazakhstan in the areas of satellites for monitoring natural disasters and astrophysics.

To learn more about the work of SIN-Russia on space, please visit us at: <http://ukinrussia.fco.gov.uk/en/about-us/working-with-russia/uk-russia-action/partnership-in-action/093-science-innovation/>

GETTING MORE PEOPLE TO DO PHYSICS, AND DOING IT BETTER

Duncan Chamberlain
Strategic Director, the Physics Factory

There is a shortage of physicists in the workforce. There is a shortage of physicists at university. There is a shortage of teachers of physics to inspire and guide a new generation of physicists. Though it is of interest to explore why has this happened, why the UK is experiencing this more than competitor countries and why there isn't more action to reverse the trend, the situation is so perilous that we need to act now. Too much time, and resources, can be taken by reports and investigations.....but these too often lead to more reports and investigations. This paper contends that much more needs to be actually done to:

- i) get more people doing physics
- ii) get people doing physics better.

THE PROBLEM

In stark figures, here is the problem:

- In the UK only one in seven pupils does A-level physics
- The UK is short of 4000 teachers of physics
- 500 schools in England are without a physics graduate on their staff
- There are Government recognised shortages in a myriad of occupations that require high levels of physics literacy, for example Reactor Physicist, Civil Engineering and Mechanical Engineering

- In the current SET for Britain competition for Early Stage Researchers run in Parliament, which is open to physicists, chemists, bioscientists and engineers, only 11% of entries in 2012 were from physicists compared to 16% from chemists, 43% from bioscientists and 30% from engineers.

In addition, despite the recent popularisation of physics through the prominence of Professor Brian Cox, physics maintains a reputation as being a 'difficult' subject for school pupils, and suffers from an image problem as requiring much hard work but having few financially rewarding career paths. Too few physicists wish to enter teaching and so the shortage will be perpetuated and too few young people understand what physics is and the career paths it can lead to. Whatever the truths of these perceptions, they are sustained.

THE SOLUTION

Successive governments have attempted top down solutions with varied success. The Institute of Physics, amongst other organisations, does much admired work in developing the teachers of the future and in trying to engage with, and attract, some of the brightest and best of our young people to physics. How best can these efforts be supported? Here are some examples from the front line, of a small group of dedicated professionals, who seem to have made substantial progress in:

- i) raising awareness of physics
- ii) breaking down barriers to participate in physics
- iii) raising confidence amongst teachers of physics
- iv) raising confidence amongst school pupils to learn about physics
- v) raising performance and results in physics.

This group is, indeed, getting more people to do physics and doing it better.

Bartley Green in Birmingham may seem an unlikely place for physics revolution. One of the most disadvantaged parts of the West Midlands, its status as a deprived outer suburb, dominated by social housing and physically remote from Birmingham's city centre, do not readily indicate scientific innovation. But it is here that The Physics Factory movement started and now flourishes. With its origins in 2009, the Physics Factory movement is now a registered charity and trading social enterprise. It has grown in size to have now three centres (two in Birmingham, one in London) and has thought through plans for further expansion. The charity's aim is for a national, grass roots movement of Physics Factories that can identify and solve local problems with local solutions.

WHAT THE PHYSICS FACTORY DOES

The Physics Factory is at pains to emphasise that it offers not a 'franchise' solution, a 'one size

fits all' solution but instead a methodology and approach that itself is evolving and can be shared with others and used to varying extents. Localism is the key to the regeneration of physics. The Physics Factories in Birmingham have a very direct approach:

1. The Physics Factory is a centre of physics excellence which is hands on and direct: Physics Factory staff teach pupils; Physics Factory staff teach teachers to teach physics better; Physics Factory staff work with non specialist physics teachers to make them more confident and effective in teaching physics in their schools; Physics Factory staff offer to go to schools to teach pupils in their own schools; Physics Factory staff raise awareness of physics related careers direct with pupils and teaching staff; Physics Factory staff work in the community, building the roots for a longer term recovery of physics as well as shorter term.

2. Physics Factories have specialist and/or designated laboratory and teaching space.

3. Specialist physics teachers teach pupils from schools from across Birmingham. Indeed, 59% of Birmingham secondary schools have sent pupils to be taught GCSE and A Level by the specialist physics staff, which accounts for over 3000 pupils from over 40 schools. This is direct classroom teaching to bridge the gap in terms of the shortage of physics teachers.

4. More young people are doing physics – five schools are offering physics who otherwise wouldn't have been able to, totalling 250 extra pupils studying physics; in 2011-2012 seventy pupils have started A Level physics courses who otherwise would not have.

5. Young people are doing physics better – in 2011, 46% of pupils taught by the Physics Factory exceeding their target grade; number of pupils achieving A*/A grade at GCSE was 16% higher through the Physics Factory than the national average and 3% higher for pupils achieving grades A-C.

6. More staff are teaching physics better and developing their confidence to teach in their own schools. 550 staff have attended the Physics Factories' professional development courses and 99.8% of delegates rate the courses as 'good' or 'very good'.

EXPANDING THE PHYSICS FACTORY

The Physics Factory works. More people are doing physics and doing it better. More school pupils are doing physics, more staff are being upskilled. More schools are offering physics. The Physics Factory, a registered

charity, is a sustainable organisation which has benefited greatly from the renowned Schools of King Edward VI in Birmingham Foundation and Birmingham City Council. The Physics Factory has also received support from the Institute of Physics, Richard Hardie of UBS, and broadcaster John Humphrys, amongst others. It is also building relationships with other organisations in the field, such as the IPEM, the University of Warwick and the University of Birmingham. There is a model here that can be shared, than can lead to action on the ground, that is cost effective and

meets demand. It is a model in the tradition of localism and grass roots, and with a business head on it.

The Physics Factory may well be the next stage of the fight back, to assist and drive the recovery of physics. It works.

If you are interested in knowing more, in visiting the Physics Factory, in helping set up a Physics Factory in a new location, please contact the Physics Factory via its Strategic Director, Duncan Chamberlain (duncan.chamberlain@bridgingtothefuture.co.uk).



Listed opposite (grouped by subject area) is a selection of Debates on matters of scientific interest which took place in the House of Commons, the House of Lords or Westminster Hall between 16th April and 29th June.

SELECTED DEBATES

Defence

- Defence Reform – 26.6.12 HoC 231
- NATO – 29.5.12 HoL 1096

Education

- Education & Training: People with Hidden Disabilities – 28.6.12 HoL 376
- Secondary Education (GCSEs) – 26.6.12 HoC 175

Energy

- Fracking – 22.5.12 HoC 49WH
- Green Economy – 28.6.12 HoC 481
- Science and Technology Committee: Nuclear Research and Development – 19.6.12 HoL GC203

Food

- Food Security Policy – 24.5.12 HoL 904

Environment

- Lineside Vegetation (Network Rail Policy) – 27.6.12 HoC 129WH

Health

- Dementia (support) – 28.6.12 HoL 408
- EU working time Directive (NHS) – 26.4.12 HoC 335WH
- Health Research Authority (Amendment) Regulations 2012 – 13.6.12 HoL GC87
- Neglected Tropical Diseases – 26.6.12 HoC 65WH
- Pancreatic Cancer – 23.4.12 HoL GC241 & 23.5.12 HoC 91WH
- Rare Disease Strategy – 30.4.12 HoC 1363
- Selective Dorsal Rhizotomy – 18.4.12 HoC 474

IT and Telecommunications

- Alan Turing – 27.6.12 HoC 108WH

Transport

- High Speed 2 (Scotland) – 18.4.12 HoC 129WH
- Midland Main Line – 16.4.12 HoC 142





HOUSE OF COMMONS SELECT COMMITTEE ON SCIENCE AND TECHNOLOGY

The Science and Technology Committee is established under Standing Order No 152, and charged with the scrutiny of the expenditure, administration and policy of the Government Office for Science, a semi-autonomous organisation based within the Department for Business, Innovation and Skills.

The current members of the Science and Technology Committee are:

Caroline Dinenage (Conservative, Gosport), Jim Dowd (Labour, Lewisham West and Penge), Gareth Johnson (Conservative, Dartford), Stephen Metcalfe (Conservative, South Basildon and East Thurrock), Andrew Miller (Labour, Ellesmere Port and Neston), Stephen Mosley (Conservative, City of Chester), Pamela Nash (Labour, Airdrie and Shotts), Sarah Newton (Conservative, Truro and Falmouth), Graham Stringer (Labour, Blackley and Broughton), Hywel Williams (Plaid Cymru, Arfon) and Roger Williams (Liberal Democrat, Brecon and Radnorshire).

Andrew Miller was elected by the House of Commons to be the Chair of the Committee on 9th June 2010. The remaining Members were formally appointed to the Committee on 12th July 2010. Caroline Dinenage, Gareth Johnson, Sarah Newton and Hywel Williams were formally appointed to the Committee on 27th February 2012 in the place of Gavin Barwell, Gregg McClymont, Stephen McPartland and David Morris. Jim Dowd was formally appointed to the Committee on 11th June 2012 in the place of Jonathan Reynolds.

CURRENT ENQUIRIES

Engineering in government: follow-up

On 14th September 2011 the Committee announced an inquiry following up its predecessor Committee's inquiry into Engineering in government. The Committee invited written submissions by 1st November 2011.

On 7th December 2011 the Committee took evidence from: Chris Aylett, Chief Executive, Motorsport Industry Association, and Philip Greenish, Chief Executive, Royal Academy of Engineering.

On 14th December 2011 the Committee took evidence from: Sir John Beddington, Government Chief Scientific Adviser.

The written evidence received in this inquiry is on the Committee's website. A Report is being prepared.

The Census and social science

On 9th November 2011 the Committee announced an inquiry into The Census and social science. The Committee invited written submissions by 30th November 2011.

On 7th December 2011 the Committee took evidence from: Professor David Blane, Deputy Director, ESRC International Centre for Life Course Studies, Professor Heather Joshi, President, Society for Lifecourse and Longitudinal Studies, and Professor Les Mayhew, City University.

On 14th December 2011 the Committee took evidence from: Professor Tim Allen, Local Government Association, Aleks Collingwood, Joseph Rowntree Foundation, Professor David Martin, Royal Statistical Society, and Professor Phil Rees, Royal Geographical Society; Adrian Alsop, Director of Research and International Strategy, and Jeremy Neathley, Deputy Director of Policy, Economic and Social Research Council, Glen Watson, Census Director, and Peter Benton, Deputy Director, Office for National Statistics.

On 18th January 2012 the Committee took evidence from: Richard Bartholomew, and Jenny Dibden, Joint Heads of the Government Social Research Service.

The written evidence received in this inquiry is on the Committee's website. A Report is being prepared.

Risk perception and energy infrastructure

On 9th November 2011 the Committee announced an inquiry into Risk perception and energy infrastructure. The Committee invited written submissions by 14th December 2011.

On 18th January 2012 the Committee took evidence from: Andrew Bloodworth, Head of Science – Minerals and Waste, British Geological Survey, Professor Nick Pidgeon, Director of Understanding Risk Programme, Cardiff University, and Professor David Spiegelhalter, Royal Statistical Society.

On 25th January 2012 the Committee took evidence from: Tracey Brown, Managing Director, Sense about Science, Fiona Fox, Director, Science Media Centre, and Mark Henderson, former Science Editor, The Times; Bob Brown, Corporate Director, Sedgemoor District Council, Richard Mayson, Director of Planning and External Affairs for Nuclear New Build, EDF Energy, and Dr Rick Wylie, Executive Director, Applied Policy Sciences Unit, University of Central Lancashire.

On 1st February 2012 the Committee took evidence from: Dr Paul Leinster, Chief Executive, Environment Agency, Dr Jill Meara, Deputy Director of the Centre for Radiation, Chemical and Environmental Hazards, Health Protection Agency, Geoffrey Podger, Chief Executive, Health and Safety Executive, and Dr Mike Weightman, HM Chief Inspector of Nuclear Installations and Executive Head of the Office for Nuclear Regulation.

On 19th March 2012 the Committee took evidence from: Charles Hendry MP, Minister of State for Energy, and Professor David Mackay, Chief Scientific Advisor, Department of Energy and Climate Change.

The written evidence received in this inquiry is on the Committee's website. A Report is being prepared.

Science and international development

On 11th November 2011 the Committee announced an inquiry into Science and



international development. The Committee invited written submissions by 16th December 2011.

On 1st February 2012 the Committee took evidence from: Professor Graham Furniss, Chair of the Africa Panel, British Academy, Professor Peter Guthrie OBE, Fellow, Royal Academy of Engineering, Professor Robert Souhami CBE, Foreign Secretary, Academy of Medical Sciences, and Dr Beth Taylor, Director of Communications and External Relations, Institute of Physics.

On 8th February 2012 the Committee took evidence from: Professor Anthony Costello, Professor of International Child Health and Director, UCL Institute for Global Health, Dr John Kirkland, Deputy Secretary General, Association of Commonwealth Universities, Professor Melissa Leach, Director, STEPS Centre, and Professor Andrew Westby, Director, Natural Resources Institute, University of Greenwich.

On 22nd February 2012 the Committee took evidence from: Dr Jo Beall, Director Education and Society, British Council, Kate O'Shea, Deputy Director, UK Collaborative on Development Sciences, Sir Mark Walport, Director, Wellcome Trust, and John Young, Director of Impact Assessment, Partnerships and Head of the RAPID Programme, Overseas Development Institute.

The Committee held a further oral evidence session on 25th June. The written evidence received in this inquiry is on the Committee's website.

Bridging the "valley of death": improving the commercialisation of research

On 16th December 2011 the Committee announced an inquiry: Bridging the "valley of death": improving the commercialisation of research. The Committee invited written submissions by 8th February 2012.

On 18th April 2012 the Committee took evidence from: Professor Luke Georgiou, Vice-President (Research and Innovation), University of Manchester, Dr Paul Nightingale, Science and Technology Policy Research, University of Sussex, David Connell, Senior Research Fellow, Centre for Business Research/ UK Innovation Research Centre, Judge Business School, University of Cambridge, and Dr Douglas Robertson, Chair, Praxis-Unico. The Committee also heard from: Dr Ted Bianco, Director of Technology Transfer, Wellcome Trust, Dr Ian Tomlinson, Senior Vice President, Head of Worldwide Business Development and Biopharmaceuticals R&D, GlaxoSmithKline, Dr David Tapolczay, Chief Executive Officer, Medical Research Council Technology, Dr Gareth Goodier, Chair, Shelford Group (Chief Executives of ten leading Academic Medical Centres and large teaching hospitals); Chief Executive, Cambridge University Hospitals NHS Foundation Trust, and Dr Andy Richards, Serial biotechnology entrepreneur and business angel.

On 25th April 2012 the Committee took evidence from: Katie Potts, Herald Investment Management, Anne Glover, Amadeus Capital Partners Ltd, Matthew Bullock, and Stephen Welton, Business Growth Fund. The Committee also heard from: Dr Richard Worswick, Cobalt Light Systems, Dr Peter Dean, Cambio, Dr Trevor Francis, Technical Director, Byotrol Technology Ltd.

The Committee expects to hold future oral evidence sessions in June and July. The written evidence received in this inquiry is on the Committee's website.

Medical implants

On 26th March 2012 the Committee announced an inquiry: Regulation of medical implants. The Committee invited written submissions on the following issues by 26th April 2012.

On 23rd May 2012 the Committee took evidence from: Dr Carl Heneghan (GP), Reader in Evidence-Based Medicine, Director of the Centre of Evidence-Based Medicine, Dr Thomas Joyce, Reader in Biotribology, University of Newcastle, Professor Stephen Westaby, Cardiac Surgeon, John Radcliffe Hospital and Dr Suzette Woodward, Director of Patient Safety, National Patient Safety Agency (NPSA).

On 13th June the Committee took evidence from: John Howlett, British Standards Institute (BSi) and Peter Ellingworth, Association of British Healthcare Industries (ABHI). The Committee also heard from: Jacqueline Minor, Director of Consumer Affairs, European Commission. The Committee then heard from: Sir Kent Woods, Chief Executive of Medicines and Healthcare products Regulatory Agency (MHRA) and Lord Howe, Parliamentary Under-Secretary of State for Quality, Department of Health (DH).

The written evidence received in this inquiry will be available on the Committee's website in due course. A report is in preparation.

REPORTS

Engineering in government: follow-up to the 2009 report on Engineering: turning ideas into reality

On 30th April 2012, the Committee published its Fifteenth Report of Session 2010-12, *Engineering in government: follow-up to the 2009 report on Engineering: turning ideas into reality*, HC 1667

GOVERNMENT RESPONSES

Government Response to the Science and Technology Committee report 'Malware and cyber crime'

On 26th March 2012, the Home Office published the Government Response to the Committee's Report on Malware and cyber crime, Cm 8328.

Government Response to the Science and Technology Committee report 'Science in the Met Office'

On 25th May 2012, the Committee published the Government's Response to the Committee's Report on Science in the Met Office, HC 162.

FURTHER INFORMATION

Further information about the work of the Science and Technology Committee or its current inquiries can be obtained from the Clerk of the Committee, Stephen McGinness, or from the Senior Committee Assistant, Darren Hackett, on 020 7219 2792/2793 respectively; or by writing to: The Clerk of the Committee, Science and Technology Committee, House of Commons, 7 Millbank, London SW1P 3JA. Enquiries can also be e-mailed to scitechcom@parliament.uk. Anyone wishing to be included on the Committee's mailing list should contact the staff of

the Committee. Anyone wishing to submit evidence to the Committee is strongly recommended to obtain a copy of the guidance note first. Guidance on the submission of evidence can be found at www.parliament.uk/commons/selcom/witguide.htm.

The Committee has a website, www.parliament.uk/science, where all recent publications, terms of reference for all inquiries and press notices are available.



HOUSE OF LORDS SCIENCE AND TECHNOLOGY SELECT COMMITTEE

The members of the Committee (appointed 16 May 2012) are Lord Broers, Lord Cunningham of Felling, Lord Dixon-Smith, Baroness Hilton of Eggardon, Lord O'Neill of Clackmannan, Lord Krebs (Chairman), Lord Patel, Baroness Perry of Southwark, Lord Rees of Ludlow, the Earl of Selborne, Baroness Sharp of Guildford, Lord Wade of Chortton, Lord Willis of Knaresborough and Lord Winston. Lord Jenkin of Roding and Lord Oxburgh were co-opted to the Committee for the purposes of its inquiry into nuclear research and development capabilities. Lord Lucas of Crudwell and Dingwall has been co-opted to Sub-Committee 1 for the purposes of the inquiry on higher education in STEM subjects.

Higher Education in Science, Technology, Engineering and Maths (STEM) subjects

In September 2011, the Select Committee appointed a Sub-Committee, chaired by Lord Willis of Knaresborough, to conduct an inquiry into higher education in STEM subjects. This is considering how the UK can ensure that the supply of graduates in STEM subjects meets current and future needs, looking at 16-18 supply, undergraduate and postgraduate education, and at what can be learnt from the experience of other countries. A call for evidence was released on 13th September 2011 with a deadline for submissions of 16th December. Oral evidence sessions began in December and finished in April 2012. The Committee will report in the summer.

Sports and exercise science and medicine

In May 2012, the Select Committee launched a short inquiry into sports and exercise science and medicine to consider how the legacy of London 2012 can be used to improve understanding of the benefits exercise can provide for the wider public and in treating chronic conditions. The Committee will explore how robust this science is and how lessons learnt from the study of athletes can be applied to improve the health of the population generally.

The Committee held a seminar on 29th May 2012, and took oral evidence on 12th, 19th and 26th June from sports and exercise scientists and clinicians, UK Sport, and officials and Ministers from the Department of Health and the Department for Culture, Media and Sport. The Committee is due to publish their report before the summer recess.

Regenerative medicine

The Committee is preparing to launch a new inquiry on regenerative medicine before the summer recess.

Science and Heritage follow-up

In December 2011, the Select Committee launched a short follow-up inquiry to its report into science and heritage in session 2005-06. The Committee wrote to Government and contributors to the original inquiry seeking an update of developments since the publication of the original report in 2006 and the update of October 2007. The deadline for written submission was 31st January 2012. Oral evidence sessions were held from February until March 2012. The Committee published their report on 11th May. The report will be debated in the House following receipt of the Government's response.

The role and function of departmental Chief Scientific Advisers (CSAs)

In July 2011, the Select Committee launched an inquiry into the role and function of departmental Chief Scientific Advisers. This looked at a number of aspects concerning the role of CSAs including: the ability of CSAs to provide independent advice to ministers and policy makers; the extent of their influence over research spend; and their role in providing independent challenge and ensuring that departmental policies are evidenced-based. A call for evidence was released on 20th July 2011 with a deadline for submissions of 16th September. The Committee took oral evidence from October to December and published their report on 29th February 2012. The Government published their response to the report on 11th May 2012. It is anticipated that the report will be debated in the House in the current session.

Nuclear research and development capabilities

In March 2011, the Select Committee launched an inquiry to investigate whether the UK's nuclear research and development (R&D) capabilities are sufficient to meet its future nuclear energy requirements to 2050.



The inquiry focused on what the Government should be doing to ensure that the UK's R&D capabilities are sufficient to meet the UK's future nuclear energy requirements. It examined the R&D implications of scenarios up to 2050 and whether the UK has adequate R&D capabilities, including infrastructure, to meet its needs for a safe and secure supply of nuclear energy.

The report was published on 22nd November 2011 and the Government response was received on 17th February 2012. The report was debated in the House on 19th June 2012.

Behaviour change policy interventions

In June 2010, a Sub-Committee, under the chairmanship of Baroness Neuberger, conducted an inquiry into the effectiveness of behaviour change interventions in achieving government policy goals and helping to meet societal challenges.

The Committee considered the current state of knowledge about which behaviour change interventions are effective, whether the Government's current behaviour change interventions are evidence-

based and subject to robust evaluation, and how such interventions are coordinated across departments. The Committee also looked at the role of industry and the voluntary sector in shaping behaviour patterns and the social and ethical issues surrounding behaviour change interventions by government. The inquiry included two case studies, one on obesity and the other on reducing car use in towns and cities. The Committee published its report on 19th July 2011. The Government response was published on 15th September. It is anticipated that the report will be debated in the House in the current session.

FURTHER INFORMATION

The written and oral evidence to the Committee's inquiries mentioned above, as well as the Calls for Evidence and other documents can be found on the Committee's website. Further information about the work of the Committee can be obtained from Chris Atkinson, Committee Clerk, atkinsoncl@parliament.uk or 020 7219 4963. The Committee Office email address is hlsce@parliament.uk.



HOUSE OF COMMONS LIBRARY SCIENCE AND ENVIRONMENT SECTION

Scientists and other staff in the Science and Environment Section provide confidential, bespoke briefing to Members and their offices on a daily basis. They also provide support to Committees, and produce longer notes and research papers which can be accessed on line at <http://www.parliament.uk/topics/pical-issues.htm>

Opposite are summaries of some recently updated published briefings.

For further information contact
Dr Patsy Richards Head of Section
Tel: 020 7219 1665
email: richardspa@parliament.uk

The draft Energy Bill 2012 SN/SC/6324

On 9th May 2012 the Queen's Speech announced that "My Government will propose reform of the electricity market to deliver secure, clean and affordable electricity and ensure prices are fair". This will be done through the latest in a line of energy bills. This note outlines the bill's likely main provisions and the background to these.

On 22nd May 2012 the Department for Energy and Climate Change (DECC) published a draft energy bill, for pre-legislative scrutiny alongside a series of technical updates, aide-memoires and impact assessments. The Energy and Climate Change Select Committee will examine the bill with a view to reporting before summer recess (17th July 2012).

Initial press coverage has focused on support for nuclear generation, which the bill proposes through 'contracts for difference', along with other low-carbon generation. As with other such support mechanisms, these costs will be passed on to consumers via their bills. Some commentators have speculated that wider 'electricity market reform' is unlikely to engage the public. But get this, and related issues, right, one commentator argues, and electricity market reform could lay the groundwork for a low carbon economy.

Consents for Wind Farms – Onshore SN/SC/4370

Wind farms require either planning permission or consent under the Planning Act 2008. Nearly half of applications for onshore wind farms were rejected before and after the General Election. The main reason was concern that a large wind farm would damage the landscape. Some applications have been approved, partly because their visual impact was considered to be limited.

The Localism Act 2011 is abolishing Regional Spatial Strategies, including regional targets for renewable energy. It will also introduce a neighbourhood planning regime. It is unlikely that neighbourhood plans could be used to prevent the building of wind farms.

DCLG intend to allow local authorities to retain more business rates from development, including wind farms. This is expected to come into force in April 2013.

On 27th March 2012, DCLG published the final version of the National Planning Policy Framework. It came into effect immediately, superseding the 2011 draft and other planning guidance. It is shorter than previous guidance and it is unclear what effect it might have on the applications for consent for wind farms.



The CRC Energy Efficiency Scheme SN/SC/6333

The CRC (Carbon Reduction Commitment) Energy Efficiency Scheme (EES) is a mandatory carbon dioxide emission reporting and trading scheme for public and private sector organisations. They have to report their emissions to create performance league tables, and larger organisations also have to trade allowances to emit carbon.

However, the CRC EES has been criticised by businesses who say it is too complex. Also, following changes made by the 2010 Spending Review, any revenues raised through trading will not be recycled to the best-performing companies as originally planned, but instead be retained by the Treasury. The scheme's full implementation was delayed by the Review, and the first performance league table was produced in November 2011. In May 2012 a draft order was laid to allow the trading of allowances (retrospectively, for 2011/12).

However, following Budget 2012, the CRC EES is now under full review through a DECC consultation. The Chancellor has said that if the scheme cannot be simplified to produce "very significant administrative savings" for businesses, then it will be replaced by "an alternative environmental tax" on which the Government will consult in Autumn 2012.

Renewable Heat Incentive SN/SC/6328

The Renewable Heat Incentive (RHI) has been put in place to mirror the support provided to renewable electricity suppliers by the Feed in Tariffs. As with the Feed-in Tariffs it will pay a certain amount per kWh generated for a fixed period of time, in this case 20 years, which will rise with inflation.

The RHI was originally intended to be funded by energy companies. However in October 2010 the Government announced that funding would be provided by the Treasury. The start of the scheme was postponed, but it was up and running by November 2011 for non-domestic customers. Domestic customers will be provided with some interim funding, and included from 2013.

The Government has also consulted on bringing in a cost control system for RHI to ensure that the scheme is not damaged by an unexpectedly high take up.

Agriculture and Climate Change SN/SC/3763

Within the next decades, climate change is likely to have effects on UK agriculture. Increased numbers of extreme events – such as floods – may be the most serious immediate problem. Such effects may be partially mitigated by planting different crops and developing new varieties.

The position is complicated because local effects of global warming are extremely difficult to estimate. Although the UK has been getting warmer, we have had record floods in the summer of 2007, then two cold winters in 2009/10 and 2010/11. Short-term uncertainty makes planning difficult.

A Met Office report in December 2011 shows the difficulty of trying to reach an agreed conclusion about the effects on UK agriculture.

In the longer term, rising sea level will be a severe problem because so much of the UK's most fertile land is close to the sea and at a low altitude.

A Defra risk assessment in 2012 emphasises potential benefits and business opportunities as well as threats.

Dangerous Dogs SN/SC/4348

This note summarises the existing breed based legislation on dangerous dogs, under the Dangerous Dogs Act 1991, together with the proposals to amend it. This has been a response to the increased number of people prosecuted over attacks by dogs since 2005 and the lack of legislation covering attacks that take place on private property.

The latest consultation on tackling irresponsible dog ownership was published by Defra on 23rd April 2012, with a closing date of 15th June 2012. New, tougher sentencing guidelines were published in May 2012.

Since 2010 there has been legislation in Scotland, which requires all owners to keep control of their dogs in private and public places, regardless of their breed.

Homeopathy and the consolidation of UK medicines legislation SN/SC/6350

UK medicines legislation (including homeopathy) is being consolidated. The law is not being changed. The consolidation will happen through the Human Medical Regulations 2012, which were due to come into force in July 2012. They will be laid under the negative resolution procedure.

Some homeopathic practitioners are concerned that following the consolidation the law will be enforced. This could constrain some homeopathic practices. They are seeking a change in the law although it is not clear that this is possible at a UK level.

In 2010 the Science and Technology Select Committee found that homeopathic products are placebos. It was concerned that prescribing such products on the NHS might be unethical and that licensing such products provided "spurious medical legitimacy" to them. The Government rejected substantive changes to regulation or policy on homeopathy.

Food Advertising on Television SN/SC/4020

The Government is continuing the policy of restricting advertising of unhealthy food during children's TV.

The Public Health White Paper in November 2004 said that the Labour Government wanted progress on the advertising of unhealthy food for children. After a review and consultation, Ofcom decided to ban the promotion of unhealthy food (as defined by the Food Standards Agency) for programmes aimed at children under 16. Further restrictions on promotion of such food – including a ban on the use of celebrity characters – were also introduced.

Ofcom's final review of the advertising ban, in July 2010, estimated that children had watched 37% less advertising for junk food than before the 2007 ban.

Research published in 2012 suggests that the amount of junk food advertising watched by children is higher than before the ban.

Neighbourhood Planning in Localism Act SN/SC/5838

The Localism Act 2011 provides for a completely new neighbourhood planning regime. The Act allows parish councils to draw up draft neighbourhood plans, which must have regard to national policies and conform to local strategic policies. In areas without a parish council, another body could be designated.

The draft plans would have an independent check. If it passes the independent check, the plan would be put to a local referendum. If 50% of those who vote are in favour the local planning authority must adopt the plan, unless it conflicts with the European Convention on Human Rights or EU policy.

The Act contains a similar procedure for neighbourhood development orders, which would have to go through the same stages. Community Right to Build is covered in a similar manner although the criteria for an appropriate body, other than a parish council, are slightly different. Government publications stress that neighbourhood planning should not be a way to block necessary development.



PARLIAMENTARY OFFICE OF SCIENCE AND TECHNOLOGY (POST)

RECENT POST PUBLICATIONS

Assessing Energy Efficiency

May 2012

POSTnote 409

Climate change, finite supplies of fossil fuels, and rising and volatile fuel prices all drive the need to improve energy efficiency. This POSTnote examines definitions of energy efficiency, looks at methods to verify energy savings and summarises UK and EU policies to promote efficiency.

Bioenergy

May 2012

POSTnote 410

Bioenergy is the use of renewable natural material for power, heat and liquid fuels. Currently, the UK sources approximately 3% of its primary energy from bioenergy feedstocks. This POSTnote considers the opportunities and challenges of producing bioenergy sustainably to meet greenhouse gas reduction targets.

ICT for Disabled People

May 2012

POSTnote 411

Information and Communication Technologies (ICT) underpin many aspects of modern living, so for the 10 million disabled people in the UK access to ICT is an important factor in their quality of life. This POSTnote summarises the issues that disabled people face in using ICT and looks at progress towards achieving equivalent access to services for disabled and non-disabled users.

GM in Agricultural Development

June 2012

POSTnote 412

Almost 2 billion people suffer from chronic hunger and malnutrition in developing countries. The UK funds research into genetic modification (GM) as one option for agricultural development. This POSTnote examines the potential benefits and challenges of using genetically modified crops to improve food security in developing countries.

Open Source and Open Standards

June 2012

POSTnote 413

Open source software (OSS) offers an alternative to proprietary or closed software, and is usually free to obtain, use, edit and redistribute. Open standards facilitate interoperability between all types of software, making them important for the development and uptake of OSS. This note examines the quality, cost and security of OSS and considers government plans to adopt open standards.

CURRENT WORK

Biological Sciences – Review of Stem Cell Research, HIV – Developments in Prevention and Treatment, Drug-resistant TB, Measuring Wellbeing, Assessing Disability, Mental Health in the Workplace and Preventing Diabetes.

Environment and Energy – Heat Pumps, Drought Resilience, Energy Behaviours, Land Sharing versus Land Sparing.

Physical sciences and IT – Open Public Sector Data, Advanced Manufacturing.

Science Policy – Science, Technology, Engineering, and Mathematics (STEM) Education for 14-19 years old.

CONFERENCES AND SEMINARS

Low Carbon Road Freight

On 12th June, POST organised a parliamentary seminar to discuss the opportunities and challenges for reducing the carbon footprint of road freight.

Two-thirds of the UK's domestic freight is transported by road in heavy goods vehicles (HGVs), which account for 17% of the UK's transport greenhouse gas emissions. The government's 2011 "Carbon Plan" suggests that to meet the long-term target of the Climate Change Act (2008) – to reduce greenhouse gas emissions to 80% below 1990 levels by 2050 – emissions from transport will need to be reduced. Options include fuel efficient driving behaviour, logistics management, vehicle efficiency improvements and switching to lower carbon fuels.

The event was chaired by Lord Oxburgh. Presentations were made by: Professor Alan McKinnon, Head of Logistics, The Kühne Logistics University, Hamburg; Rachael Dillon, Climate Change Policy Manager, Freight Transport Association; Jonathan Murray, Deputy Director, Low Carbon Vehicle Partnership; and Prof Roderick Smith, Chief Scientific Advisor, Department for Transport.

Neuroscience, Children and the Law

On 19th June, POST organised a parliamentary seminar in conjunction with the Economic and Social Research Council to discuss how policymaking – from setting the age of criminal responsibility to protecting vulnerable children in the justice system – could take account of the latest neuroscience research.

Neuroscience offers insights into how brain development and function can affect behaviour. Factors that influence brain development in childhood may affect the likelihood of a child committing an offence, their ability to understand criminal proceedings and inform which interventions could decrease their risk of re-offending. For example, emerging research shows links between childhood brain injury and future offending. But how can these discoveries inform the law and legal proceedings? And what are the repercussions for determining whether a child is legally responsible for an offence?

The event was chaired by Lord Ramsbotham. Presentations were made by: Professor Nigel Eastman, Professor of Law and Ethics in Psychiatry, Honorary Consultant Forensic Psychiatrist, St George's University of London; Dr Eileen Vizard, Consultant Child and Adolescent Psychiatrist, Institute of Child Health, University College London; Laura Hoyano, Hackney Fellow and Tutor in Law, Wadham College, University of Oxford; Dr Eamon McCrory, Consultant Clinical Psychologist, University College London; Dr Seena Fazel, Consultant Forensic Psychiatrist, University of Oxford; Professor Huw Williams, Associate Professor of Clinical Neuropsychology, Exeter University; Dr Karen McAuliffe, Lecturer in Law, Exeter University; and, Dr Atina Krajewska, Lecturer in Law, Cardiff University.

The event concluded with a discussion panel, participants on the panel being: Dr Andrew Curren, Consultant Paediatric Neurologist, Alder Hey Children's NHS Foundation Trust, Liverpool; Professor Michael Kopelman, Consultant Neuropsychiatrist, King's College, London; and, Professor Sarah-Jayne Blakemore, Professor of Cognitive Neuroscience, University College London.

STAFF, FELLOWS AND INTERNS AT POST

Fellows

Dr Stuart Basten, Oxford University

Gemma Cassells, Edinburgh University, Natural Environment Research Council

Helen Hicks, Centre for Ecology and Hydrology, Natural Environment Research Council

Dr Craig Childs, University College London

Amanda Quigley, Imperial College London, Biotechnology and Biological Sciences Research Council

Dr Sridhar Venkatapuram, London School of Hygiene and Tropical Medicine, Wellcome Trust Bioethics Programme

Georgina Sheedy Collier, Durham University

Jack Snape, University of York, Engineering and Physical Sciences Research Council.

Staff

Dr Chris Tyler, previously Executive Director of the Centre for Science and Policy at the University of Cambridge, was appointed Director of POST from 11th June.

INTERNATIONAL ACTIVITIES

Dr Chandrika Nath was invited to give a talk on parliamentary capacity building at the annual meeting of the PISCES bioenergy consortium in Arusha, Tanzania, from 5th to 9th June.

POST African Parliaments Programme

POST's capacity building programme with African Parliaments, funded by the Gatsby Charitable Foundation, comes to a close at the end of September 2012. The programme has focused on Uganda but many of its activities have involved staff and MPs from other African Parliaments. POST is working closely with colleagues in Uganda to help them find ways of sustaining activities after September 2012. Final evaluation of the Ugandan programme will start in July 2012, and a seminar and publicity material to mark the end of the programme are in planning. POST is looking into options for continuing its activities with African Parliaments after September 2012.

GOVERNMENT CHIEF SCIENTIFIC ADVISER



The Government has announced the appointment of Sir Mark Walport as the new Government Chief Scientific Adviser (GCSA). Sir Mark is currently the Director of the Wellcome Trust.

He will take up the position on 1 April 2013 replacing the current GCSA, Professor Sir John Beddington, who has served in the post since January 2008.



SCIENCE DIRECTORY

DIRECTORY INDEX

Aerospace and Aviation

EPSRC
Institution of Engineering Designers
National Physical Laboratory
The Welding Institute

Agriculture

BBSRC
CABI
The Food and Environment Research Agency
Institution of Engineering Designers
LGC
PHARMAQ Ltd
Royal Society of Chemistry
Society for Applied Microbiology
Society for General Microbiology
Society of Biology
UFAW

Animal Health and Welfare, Veterinary Research

ABPI
Academy of Medical Sciences
LGC
The Linnean Society of London
PHARMAQ Ltd
The Physiological Society
Society for Applied Microbiology
Society for General Microbiology
Society of Biology
UFAW

Astronomy and Space Science

Institute of Physics
Institution of Engineering Designers
Natural History Museum
STFC

Atmospheric Sciences, Climate and Weather

The Geological Society
Institute of Marine Engineering, Science & Technology
Met Office
Natural Environment Research Council
STFC

Biotechnology

BBSRC
Biochemical Society
CABI
Eli Lilly and Company Ltd
Institution of Chemical Engineers
LGC
National Physical Laboratory
Royal Society of Chemistry
Society for Applied Microbiology
Society for General Microbiology
Society of Biology

Brain Research

ABPI
Eli Lilly and Company Ltd
MSD
Society of Biology
The Physiological Society

Cancer Research

ABPI
Eli Lilly and Company Ltd
Institute of Physics and Engineering in Medicine
National Physical Laboratory
The Physiological Society
Society of Biology

Catalysis

Institution of Chemical Engineers
Royal Society of Chemistry

Chemistry

EPSRC
Institution of Chemical Engineers
LGC
The Royal Institution
Royal Society of Chemistry
STFC
Society of Biology

Colloid Science

Royal Society of Chemistry

Construction and Building

The Geological Society
Institution of Civil Engineers

Institution of Engineering Designers
Institution of Engineering and Technology
National Physical Laboratory
The Welding Institute

Cosmetic Science

LGC
Royal Society of Chemistry
Society of Cosmetic Scientists

Earth Sciences

The Geological Society
Institute of Marine Engineering, Science & Technology
The Linnean Society of London
Natural Environment Research Council
Natural History Museum
Society of Biology

Ecology, Environment and Biodiversity

The British Ecological Society
CABI
Economic and Social Research Council
The Food and Environment Research Agency
Institution of Chemical Engineers
Institution of Civil Engineers
Institution of Mechanical Engineers
LGC
The Linnean Society of London
Marine Biological Association
Met Office
National Physical Laboratory
Natural Environment Research Council
Natural History Museum
Royal Botanic Gardens, Kew
Royal Society of Chemistry
Society for Applied Microbiology
Society for General Microbiology
Society of Biology
Society of Maritime Industries

Economic and Social Research

Economic and Social Research Council

Education, Training and Skills

ABPI
Academy of Medical Sciences
AIRTO
Biochemical Society
British Science Association
The British Ecological Society
British Nutrition Foundation
British Pharmacological Society
British Society for Antimicrobial Chemotherapy
CABI
Clifton Scientific Trust
Economic and Social Research Council
EPSRC
EngineeringUK
Institute of Marine Engineering, Science & Technology
Institute of Measurement and Control
Institute of Physics
Institution of Chemical Engineers
Institution of Civil Engineers
Institution of Engineering and Technology
Institution of Mechanical Engineers
LGC
The Linnean Society of London
NESTA
National Physical Laboratory
Natural History Museum
The Nutrition Society
The Physiological Society
Royal Botanic Gardens, Kew
The Royal Institution
The Royal Society
Royal Society of Chemistry
Society of Biology
The Welding Institute

Energy

CABI
EPSRC
GAMBICA Association Ltd
Institute of Marine Engineering, Science & Technology
Institute of Measurement and Control
Institute of Physics
Institution of Chemical Engineers
Institution of Civil Engineers
Institution of Engineering Designers
Institution of Engineering and Technology
Institution of Mechanical Engineers
LGC

Royal Society of Chemistry

STFC
Society of Biology
The Welding Institute

Engineering

EPSRC
EngineeringUK
GAMBICA Association Ltd
Institute of Marine Engineering, Science & Technology
Institute of Measurement and Control
Institute of Physics and Engineering in Medicine
Institution of Chemical Engineers
Institution of Civil Engineers
Institution of Engineering Designers
Institution of Engineering and Technology
Institution of Mechanical Engineers
National Physical Laboratory
The Royal Academy of Engineering
Society of Maritime Industries
STFC
The Welding Institute

Fisheries Research

Institute of Marine Engineering, Science & Technology
Marine Biological Association
Society of Biology

Food and Food Technology

British Nutrition Foundation
CABI
The Food and Environment Research Agency
Institute of Food Science & Technology
Institution of Chemical Engineers
LGC
The Nutrition Society
Royal Society of Chemistry
Society for Applied Microbiology
Society for General Microbiology
Society of Biology

Forensics

Institute of Measurement and Control
LGC
The Linnean Society of London
Royal Society of Chemistry
Society of Biology

Genetics

ABPI
BBSRC
LGC
The Linnean Society of London
Natural History Museum
The Physiological Society
Royal Botanic Gardens, Kew
Society of Biology

Geology and Geoscience

The Geological Society
Institution of Civil Engineers
Natural Environment Research Council
Royal Society of Chemistry
Society of Maritime Industries

Hazard and Risk Mitigation

The Geological Society
Institute of Marine Engineering, Science & Technology
Institute of Measurement and Control
Institution of Chemical Engineers
LGC
Met Office
Society of Biology
Royal Society of Chemistry
The Welding Institute

Health

ABPI
Academy of Medical Sciences
Biochemical Society
British In Vitro Diagnostics Association
British Nutrition Foundation
British Pharmacological Society
British Society for Antimicrobial Chemotherapy
Economic and Social Research Council
Eli Lilly and Company Ltd
EPSRC
The Food and Environment Research Agency
GAMBICA Association Ltd
Institute of Physics and Engineering in Medicine

LGC
Medical Research Council
National Physical Laboratory
The Nutrition Society
The Physiological Society
The Royal Institution
Royal Society of Chemistry
Society for Applied Microbiology
Society for General Microbiology
Society of Biology
The Welding Institute

Heart Research

ABPI
Eli Lilly and Company Ltd
The Physiological Society
Society of Biology

Hydrocarbons and Petroleum

The Geological Society
Institution of Chemical Engineers
LGC
Natural History Museum
Royal Society of Chemistry

Industrial Policy and Research

AIRTO
Economic and Social Research Council
GAMBICA Association Ltd
Institution of Civil Engineers
Institution of Engineering and Technology
The Royal Academy of Engineering
STFC
Society of Biology
The Welding Institute

Information Services

AIRTO
CABI
LGC
The Welding Institute

IT, Internet, Telecommunications, Computing and Electronics

EPSRC
Institution of Civil Engineers
Institution of Engineering and Technology
National Physical Laboratory
STFC
The Welding Institute

Intellectual Property

ABPI
The Chartered Institute of Patent Attorneys
Eli Lilly and Company Ltd
NESTA
Society of Biology
Royal Society of Chemistry

Large-Scale Research Facilities

The Food and Environment Research Agency
National Physical Laboratory
Natural History Museum
STFC
The Welding Institute

Lasers

Institute of Physics
National Physical Laboratory
STFC
The Welding Institute

Manufacturing

ABPI
AMPS
EPSRC
GAMBICA Association Ltd
Institution of Chemical Engineers
Institution of Engineering Designers
Institution of Engineering and Technology
Institution of Mechanical Engineers
National Physical Laboratory
Society of Maritime Industries
The Welding Institute

Materials

Institution of Chemical Engineers
Institution of Engineering Designers
LGC
National Physical Laboratory
Royal Society of Chemistry
STFC
The Welding Institute



Mathematical Sciences

Council for the Mathematical Sciences:
Institute of Mathematics and its Applications
London Mathematical Society
Royal Statistical Society
Operational Research Society
Edinburgh Mathematical Society

Medical and Biomedical Research

ABPI
Academy of Medical Sciences
Biochemical Society
British Pharmacological Society
British Society for Antimicrobial Chemotherapy
CABI
Eli Lilly and Company Ltd
LGC
Medical Research Council
MSD
The Physiological Society
The Royal Institution
Society of Biology
UFAW
The Welding Institute

Motor Vehicles

Institution of Engineering Designers
The Welding Institute

Oceanography

The Geological Society
Institute of Marine Engineering, Science
& Technology
Met Office
National Physical Laboratory
Natural Environment Research Council
Royal Society of Chemistry
Society of Biology
Society of Maritime Industries

Oil

The Geological Society
Institute of Marine Engineering, Science
& Technology
Institution of Chemical Engineers
LGC
The Welding Institute

Particle Physics

Institute of Physics
STFC

Patents

The Chartered Institute of Patent Attorneys
NESTA
Society of Biology
Royal Society of Chemistry

Pharmaceuticals

ABPI
AMPS
British Pharmacological Society
British Society for Antimicrobial Chemotherapy
Eli Lilly and Company Ltd
Institution of Chemical Engineers
LGC
MSD
PHARMAQ Ltd
Royal Botanic Gardens, Kew

Royal Society of Chemistry
Society of Biology

Physical Sciences

Cavendish Laboratory
EPSRC
The Geological Society
Institute of Marine Engineering, Science
& Technology
Marine Biological Association
National Physical Laboratory
Royal Society of Chemistry

Physics

Cavendish Laboratory
Institute of Physics
Institute of Physics and Engineering in
Medicine
National Physical Laboratory
STFC

Pollution and Waste

ABPI
The Geological Society
Institute of Marine Engineering, Science
& Technology
Institution of Chemical Engineers
Institution of Civil Engineers
LGC
Marine Biological Association
National Physical Laboratory
Natural Environment Research Council
Royal Society of Chemistry
Society of Biology
Society of Maritime Industries
The Welding Institute

Psychology

British Psychological Society
Economic and Social Research Council
Society of Biology

Public Policy

Biochemical Society
The British Ecological Society
British Nutrition Foundation
British Society for Antimicrobial Chemotherapy
Economic and Social Research Council
EngineeringUK
The Food and Environment Research Agency
Institution of Civil Engineers
Institution of Chemical Engineers
Institution of Engineering and Technology
LGC
The Linnean Society of London
NESTA
The Physiological Society
Prospect
Royal Society of Chemistry
Society of Biology

Quality Management

GAMBICA Association Ltd
LGC
National Physical Laboratory
The Welding Institute

Radiation Hazards

Institute of Physics and Engineering in
Medicine

Institution of Engineering and Technology
LGC
Society of Biology

Science Policy

ABPI
Academy of Medical Sciences
Biochemical Society
The British Ecological Society
British Nutrition Foundation
British Pharmacological Society
British Science Association
CABI
Clifton Scientific Trust
Economic and Social Research Council
Eli Lilly and Company Ltd
EPSRC
EngineeringUK
The Food and Environment Research Agency
GAMBICA Association Ltd
Institute of Physics
Institution of Chemical Engineers
Institution of Civil Engineers
Institution of Engineering and Technology
LGC
The Linnean Society of London
Marine Biological Association
Medical Research Council
NESTA
National Physical Laboratory
The Physiological Society
Prospect
Research Councils UK
The Royal Academy of Engineering
Royal Botanic Gardens, Kew
The Royal Institution
The Royal Society
Royal Society of Chemistry
STFC
Society of Biology
UFAW

Sensors and Transducers

GAMBICA Association Ltd
Institute of Measurement and Control
Institution of Engineering and Technology
STFC
Society of Maritime Industries
The Welding Institute

SSSIs

The Geological Society
The Linnean Society of London
Royal Botanic Gardens, Kew
Society of Biology

Statistics

Economic and Social Research Council
EPSRC
EngineeringUK

Surface Science

STFC

Sustainability

The British Ecological Society
CABI
EPSRC
The Food and Environment Research Agency

The Geological Society
Institute of Marine Engineering, Science
& Technology
Institution of Chemical Engineers
Institution of Civil Engineers
The Linnean Society of London
Royal Botanic Gardens, Kew
Royal Society of Chemistry
Society of Biology
The Welding Institute

Technology Transfer

AIRTO
CABI
The Food and Environment Research Agency
Institute of Measurement and Control
Institution of Engineering and Technology
LGC
NESTA
National Physical Laboratory
Research Councils UK
Royal Society of Chemistry
STFC
Society of Biology
The Welding Institute

Tropical Medicine

The Linnean Society of London
Natural History Museum
Royal Botanic Gardens, Kew
Society for Applied Microbiology
Society for General Microbiology
Society of Biology

Viruses, Fungi and Bacteria

ABPI
The Linnean Society of London
Society for Applied Microbiology
Society for General Microbiology
Society of Biology

Water

The Geological Society
Institute of Measurement and Control
Institution of Chemical Engineers
Institution of Civil Engineers
LGC
Marine Biological Association
Royal Society of Chemistry
Society for Applied Microbiology
Society for General Microbiology
Society of Biology
Society of Maritime Industries

Wildlife

The British Ecological Society
The Food and Environment Research Agency
The Linnean Society of London
Marine Biological Association
Natural History Museum
Royal Botanic Gardens, Kew
Society of Biology
UFAW



Contact: Dr Helen Munn,
Executive Director
Academy of Medical Sciences
41 Portland Place
London W1B 1QH
Tel: 020 3176 2150
E-mail: info@acmedsci.ac.uk
Website: www.acmedsci.ac.uk

The Academy of Medical Sciences promotes advances in medical science and campaigns to ensure these are converted into healthcare benefits for society. The Academy's Fellows are the United Kingdom's leading medical scientists and scholars from hospitals, academia, industry and the public service. The Academy provides independent, authoritative advice on public policy issues in medical science and healthcare.

Association of the British Pharmaceutical Industry



Contact: Dr Louise Leong
Head of Research & Development
7th Floor, Southside, 105 Victoria Street,
London SW1E 6QT
Tel: 020 7747 7193
Fax: 020 7747 1447
E-mail: lleong@abpi.org.uk
Website: www.abpi.org.uk

The ABPI is the voice of the innovative pharmaceutical industry, working with Government, regulators and other stakeholders to promote a receptive environment for a strong and progressive industry in the UK, one capable of providing the best medicines to patients.

The ABPI's mission is to represent the pharmaceutical industry operating in the UK in a way that:

- assures patient access to the best available medicine;
- creates a favourable political and economic environment;
- encourages innovative research and development;
- affords fair commercial returns

AIRTO



Contact: Professor Richard Brook OBE FREng
AIRTO Ltd: Association of Independent
Research & Technology Organisations Limited
c/o The National Physical Laboratory
Hampton Road
Teddington
Middlesex TW11 0LW
Tel: 020 8943 6600
Fax: 020 8614 0470
E-mail: enquiries@airto.co.uk
Website: www.airto.co.uk

AIRTO – The Association for Independent Research and Technology Organisations – is the foremost membership body for organisations operating in the UK's intermediate research and technology sector. AIRTO's members deliver vital innovation and knowledge transfer services which include applied and collaborative R&D, frequently in conjunction with universities, consultancy, technology validation and testing, incubation of commercialisation opportunities and early stage financing. AIRTO members have a combined turnover of over £2Bn from clients both at home and outside the UK, and employ over 20,000 scientists, technologists and engineers.



AMPS

AMPS

The Association of
Management and
Professional Staffs.

Contact:

Tony Harding
01604 764 160 for all queries whether for
membership or assistance.
Branch Office Address:
Merchant Quay,
Salford Quays,
Salford
M50 3SG.

Website: www.amps-tradeunion.com

We are a Trades Union for Management and Professional Staff working in the pharmaceutical, chemical and allied industries.

We also have a section for Professional Divers working globally. We represent a broad base of both office and field based staff and use our influence to improve working conditions on behalf of our members.

We are experts in performance based and field related issues and are affiliated to our counterparts in EU Professional Management Unions.



Biochemical Society
Advancing Molecular Bioscience

Contact: Kate Baillie, CEO
Biochemical Society
Charles Darwin House
12 Roger Street
London WC1N 2JU
Tel: 020 7685 2433
Email: kate.baillie@biochemistry.org
Website: www.biochemistry.org

The Biochemical Society exists to promote and support the Molecular and Cellular Biosciences. We have nearly 6000 members in the UK and abroad, mostly research bioscientists in universities or in industry. The Society is also a major scientific publisher. In addition, we promote science policy debate and provide resources, for teachers and pupils, to support the bioscience curriculum in schools. Our membership supports our mission by organizing scientific meetings, sustaining our publications through authorship and peer review and by supporting our educational and policy initiatives.

The British Ecological Society



British Ecological Society

The British Ecological Society
Contact: Ceri Margerison, Policy Manager
British Ecological Society
Charles Darwin House, 12 Roger Street,
London, WC1N 2JU
Email: ceri@britishecologicalsociety.org
Tel: 020 7685 2500 Fax: 020 7685 2501
Website: www.BritishEcologicalSociety.org
Ecology into Policy Blog
<http://britishecologicalsociety.org/blog/>

The British Ecological Society's mission is to advance ecology and make it count. The Society has 4,000 members worldwide. The BES publishes five internationally renowned scientific journals and organises the largest scientific meeting for ecologists in Europe. Through its grants, the BES also supports ecologists in developing countries and the provision of fieldwork in schools. The BES informs and advises Parliament and Government on ecological issues and welcomes requests for assistance from parliamentarians.

British In Vitro Diagnostics Association (BIVDA)

BIVDA

Contact: Doris-Ann Williams MBE
British In Vitro Diagnostics Association
(BIVDA), 1 Queen Anne's Gate,
London SW1H 9BT

Tel: 020 7957 4633
Fax: 020 7957 4644
E-mail: doris-ann@bivda.co.uk
Website: www.bivda.co.uk

BIVDA is the UK industry association representing companies who manufacture and/or distribute the diagnostics tests and equipment to diagnose, monitor and manage disease largely through the NHS pathology services. Increasingly diagnostics are used outside the laboratory in community settings and also to identify those patients who would benefit from specific drug treatment particularly for cancer.

British Nutrition Foundation



Contact: Professor Judy Buttriss,
Director General
52-54 High Holborn, London WC1V 6RQ

Tel: 020 7404 6504
Fax: 020 7404 6747
Email: postbox@nutrition.org.uk
Websites: www.nutrition.org.uk
www.foodafactoflife.org.uk

The British Nutrition Foundation (BNF) was established over 40 years ago and exists to deliver authoritative, evidence-based information on food and nutrition in the context of health and lifestyle. The Foundation's work is conducted and communicated through a unique blend of nutrition science, education and media activities.

BRITISH PHARMACOLOGICAL SOCIETY



Today's science, tomorrow's medicines

Contact: Jonathan Brūn
Chief Executive
British Pharmacological Society
16 Angel Gate, City Road
London EC1V 2PT
Tel: 020 7417 0110
Fax: 020 7417 0114
Email: jb@bps.ac.uk
Website: www.bps.ac.uk

The British Pharmacological Society has been supporting pharmacology and pharmacologists for over 80 years. Our 3,000+ members, from academia, industry and clinical practice, are trained to study drug action from the laboratory bench to the patient's bedside. Our aim is to improve quality of life by developing new medicines to treat and prevent the diseases and conditions that affect millions of people and animals. Inquiries about drugs and how they work are welcome.

The British Psychological Society



The
British
Psychological
Society

Contact: Lucy Chaplin
PR & Marketing Manager
The British Psychological Society
St Andrews House
48 Princess Road East
Leicester LE1 7DR
Tel: 0116 252 9910
Email: lucy.chaplin@bps.org.uk
Website: www.bps.org.uk

The British Psychological Society is an organisation of over 48,000 members governed by Royal Charter. It maintains the Register of Chartered Psychologists, publishes books, 11 primary science Journals and organises conferences. Requests for information about psychology and psychologists from parliamentarians are welcome.

British Science Association



Contact: Sir Roland Jackson Bt,
Chief Executive
British Science Association,
Wellcome Wolfson Building, 165 Queen's Gate,
London SW7 5HD.

E-mail:
Roland.Jackson@britishscienceassociation.org
Website: www.britishscienceassociation.org

Our vision is a society in which people are able to access science, engage with it and feel a sense of ownership about its direction. In such a society science advances with, and because of, the involvement and active support of the public.

Established in 1831, the British Science Association is a registered charity which organises major initiatives across the UK, including National Science and Engineering Week, the British Science Festival, programmes of regional and local events and the CREST programme for young people in schools and colleges. We provide opportunities for all ages to discuss, investigate, explore and challenge science.

British Society for Antimicrobial Chemotherapy

Mrs Tracey Guise
Executive Director
British Society for Antimicrobial Chemotherapy
Griffin House
53 Regent Place
Birmingham B1 3NJ
T: 0121 236 1988
W: www.bsac.org.uk

Founded in 1971, and with 800 members worldwide, the Society exists to facilitate the acquisition and dissemination of knowledge in the field of antimicrobial chemotherapy. The BSAC publishes the *Journal of Antimicrobial Chemotherapy* (JAC), internationally renowned for its scientific excellence, undertakes a range of educational activities, awards grants for research and has active relationships with its peer groups and government.



CABI
Science and development
organization



www.cabi.org

Contact: Dr Joan Kelley, Executive Director,
Global Operations, CABI
Bakeham Lane, Egham, Surrey TW20 9TY
Tel: 01491 829306 Fax: 01491 829100
Email: c.scotter-mainprize@cabi.org
Website: www.cabi.org

CABI is an international not-for-profit development organization, specializing in scientific publishing, research and communication. We create, communicate, and apply knowledge in order to improve people's lives by finding sustainable solutions to agricultural and environmental issues.

We work for and with universities, national research and extension institutions, development agencies, the private sector, governments, charities and foundations, farmers, and non-governmental organizations. We also manage one of the world's largest genetic resource collections: the UK's National Collection of Fungus Cultures.

**Cavendish
Laboratory**



UNIVERSITY OF
CAMBRIDGE

The Administrative Secretary, The Cavendish
Laboratory,
J J Thomson Avenue, Cambridge CB3 0HE, UK.
E-mail: dhp24@cam.ac.uk
http://www.phy.cam.ac.uk

The Cavendish Laboratory houses the Department of Physics
of the University of Cambridge.

The research programme covers the breadth of
contemporary physics

Extreme Universe: Astrophysics, cosmology and high
energy physics

Quantum Universe: Cold atoms, condensed matter theory,
scientific computing, quantum matter and semiconductor
physics

Materials Universe: Optoelectronics, nanophotonics,
detector physics, thin film magnetism, surface physics and
the Winton programme for the physics of sustainability

Biological Universe: Physics of medicine, biological
systems and soft matter

The Laboratory has world-wide collaborations with other
universities and industry

Chartered Institute of Patent Attorneys



Contact: Lee Davies – Chief Executive
The Chartered Institute of Patent Attorneys
95 Chancery Lane, London WC2A 1DT
Tel: 020 7405 9450
Fax: 020 7430 0471
E-mail: mail@cipa.org.uk
Website: www.cipa.org.uk

CIPA's members practise in intellectual property,
especially patents, trade marks, designs, and
copyright, either in private partnerships or industrial
companies. Through its new regulatory Board, CIPA
maintains the statutory Register. It advises
government and international circles on policy
issues and provides information services, promoting
the benefits to UK industry of obtaining IP
protection, and to overseas industry of using British
attorneys to obtain international protection.

**Clifton
Scientific
Trust**



CLIFTON SCIENTIFIC
Trust

Contact: Dr Eric Albone
Clifton Scientific Trust
49 Northumberland Road, Bristol BS6 7BA
Tel: 0117 924 7664 Fax: 0117 924 7664
E-mail: eric.albone@clifton-scientific.org
Website: www.clifton-scientific.org

**Science for Citizenship and Employability,
Science for Life, Science for Real**

We build grass-roots partnerships between school and
the wider world of professional science and its
applications

- for young people of all ages and abilities
 - experiencing science as a creative, questioning,
human activity
 - bringing school science added meaning and
motivation, from primary to post-16
 - locally, nationally, internationally
(currently between Britain and Japan)
- Clifton Scientific Trust Ltd is registered charity 1086933

**The Council
for the
Mathematical Sciences**



The Council for the
Mathematical
Sciences

Contact: Anne Bennett
CMS Secretariat
De Morgan House
57-58 Russell Square, London WC1B 4HS
Tel: 020 7927 0803
Fax: 020 7323 3655
Email: cms@lms.ac.uk
Website: www.cms.ac.uk

The Council for the Mathematical Sciences is an
authoritative and objective body that works to develop,
influence and respond to UK policy issues affecting
mathematical sciences in higher education and
research, and therefore the UK economy and society by:

- providing expert advice;
- engaging with government, funding agencies and
other decision makers;
- raising public awareness; and
- facilitating communication between the
mathematical sciences community and other
stakeholders

**Eli Lilly and
Company
Ltd**



Answers That Matter.

Contact: Thom Thorp, Head External Affairs
Tel: 01256 315000
Fax: 01256 775858
Eli Lilly and Company Ltd, Lilly House
Priestley Road, Basingstoke, Hants,
RG24 9NL
Email: thorp@lilly.com
Website: www.lilly.co.uk

Lilly UK is the UK affiliate of a major American
pharmaceutical manufacturer, Eli Lilly and Company
of Indianapolis. This affiliate is one of the UK's top
pharmaceutical companies with significant
investment in science and technology including a
neuroscience research and development centre and
bulk biotechnology manufacturing operations.

Lilly medicines treat schizophrenia, diabetes, cancer,
osteoporosis, attention deficit hyperactivity
disorder, erectile dysfunction, severe sepsis,
depression, bipolar disorder, heart disease and
many other diseases.

EngineeringUK



Contact: Miriam Laverick
PR and Communications Manager
EngineeringUK
Weston House, 246 High Holborn
London WC1V 7EX
Tel: 020 3206 0444
Fax: 020 3206 0401
E-mail: MLaverick@engineeringuk.com
Website: www.EngineeringUK.com

EngineeringUK is an independent organisation that
promotes the vital role of engineers, engineering
and technology in our society. EngineeringUK
partners business and industry, Government and the
wider science and technology community:
producing evidence on the state of engineering;
sharing knowledge within engineering, and
inspiring young people to choose a career in
engineering, matching employers' demand for
skills.

**The Food and
Environment
Research Agency**



fera
The Food and Environment
Research Agency

Contact: Professor Robert Edwards
Chief Scientist
The Food and Environment Research Agency
Sand Hutton, York, YO41 1LZ
Tel: 01904 462415
Fax: 01904 462486
E-mail: robert.edwards@fera.gsi.gov.uk
Website: www.defra.gov.uk/fera

The Food and Environment Research Agency's over
arching purpose is to support and develop a
sustainable food chain, a healthy natural
environment, and to protect the global community
from biological and chemical risks.

Our role within that is to provide robust evidence,
rigorous analysis and professional advice to
Government, international organisations and the
private sector.

**GAMBICA
Association Ltd**



GAMBICA
AUTOMATION
INSTRUMENTATION & CONTROL
LABORATORY TECHNOLOGY

Contact: Dr Graeme Philp
Broadwall House
21 Broadwall
London SE1 9PL
Tel: 020 7642 8080
Fax: 020 7642 8096
E-mail: assoc@gambica.org.uk
Website: www.gambica.org.uk

GAMBICA Association is the UK trade association
for instrumentation, control, automation and
laboratory technology. The association seeks to
promote the successful development of the industry
and assist its member companies through a broad
range of services, including technical policy and
standards, commercial issues, market data and
export services.



The Geological Society

serving science & profession



The Geological Society

Contact: Nic Bilham
Head of Strategy and External Relations
Burlington House
Piccadilly
London W1J 0BG
Tel: 020 7434 9944
Fax: 020 7439 8975
E-mail: nic.bilham@geolsoc.org.uk
Website: www.geolsoc.org.uk

The Geological Society is the national learned and professional body for Earth sciences, with 10,000 Fellows (members) worldwide. The Fellowship encompasses those working in industry, academia and government, with a wide range of perspectives and views on policy-relevant science, and the Society is a leading communicator of this science to government bodies and other non-technical audiences.

Institute of Food Science & Technology



Contact: Angela Winchester
5 Cambridge Court
210 Shepherds Bush Road
London W6 7NJ
Tel: 020 7603 6316
Fax: 020 7602 9936
E-mail: A.Winchester@ifst.org
Website: www.ifst.org

IFST is the independent qualifying body for food professionals in Europe. Membership is drawn from all over the world from backgrounds including industry, universities, government, research and development and food law enforcement.

IFST's activities focus on disseminating knowledge relating to food science and technology and promoting its application. Another important element of our work is to promote and uphold standards amongst food professionals.

Institute of Marine Engineering, Science and Technology (IMarEST)



Contact: John Wills
Institute of Marine Engineering, Science and Technology (IMarEST), Aldgate House, 33 Aldgate High Street, London, EC3N 1EN
Tel: +44(0) 20 7382 2600
Fax: +44(0) 20 7382 2667
E-mail: technical@imarest.org
Website: www.imarest.org

Established in London in 1889, the IMarEST is a leading international membership body and learned society for marine professionals, with over 15,000 members worldwide. The IMarEST has an extensive marine network of 50 international branches, affiliations with major marine societies around the world, representation on the key marine technical committees and non-governmental status at the International Maritime Organization (IMO) as well as other intergovernmental organisations.

The Institute of Measurement and Control



Contact: Mr Peter Martindale,
CEO and Secretary
The Institute of Measurement and Control
87 Gower Street, London WC1E 6AF
Tel: +44 (0) 20 73874949
Fax: +44 (0) 20 73888431
E-mail: ceo@instmc.org.uk
Website: www.instmc.org.uk
Reg Charity number: 269815

The Institute of Measurement and Control provides a forum for personal contact amongst practitioners, publishes learned papers and is a professional examining and qualifying organisation able to confer the titles Eurling, CEng, IEng, EngTech; Companies and Universities may apply to become Companions. Headquartered in London, the Institute has a strong regional base with 15 UK, 1 Hong Kong and 1 Malaysia Local Section, a bilateral agreement with the China Instrument Society and other major international links.

IOP Institute of Physics

Contact: Joseph Winters
76 Portland Place, London W1B 1NT
Tel: 020 7470 4815
E-mail: joseph.winters@iop.org
Website: www.iop.org

The Institute of Physics is a leading scientific society promoting physics and bringing physicists together for the benefit of all.

It has a worldwide membership of around 40,000 comprising physicists from all sectors, as well as those with an interest in physics. It works to advance physics research, application and education; and engages with policymakers and the public to develop awareness and understanding of physics. Its publishing company, IOP Publishing, is a world leader in professional scientific publishing and the electronic dissemination of physics. Go to www.iop.org



Institute of Physics and Engineering in Medicine

Contact: Rosemary Cook CBE (CEO)
Fairmount House, 230 Tadcaster Road,
York, YO24 1ES
Tel: 01904 610821 Fax: 01904 612279
E-mail: rosemary.cook@ipem.ac.uk
Website: www.ipem.ac.uk
(Robert Neilson retires 31st July)

IPeM is a registered, incorporated charity for the advancement, in the public interest, of physics and engineering applied to medicine and biology. It accredits medical physicists, clinical engineers and clinical technologists through its membership register, organises training and CPD for them, and provides opportunities for the dissemination of knowledge through publications and scientific meetings. IPeM is licensed by the Science Council to award CSci, RSci and RSciTech, and by the Engineering Council to award CEng, IEng and EngTech.

ICChemE

ADVANCING
CHEMICAL
ENGINEERING
WORLDWIDE

The Institution of Chemical Engineers

With over 33,000 members in 120 countries, ICChemE is the global membership organisation for chemical engineers. A not for profit organisation, we serve the public interest by building and sustaining an active professional community and promoting the development, understanding and application of chemical engineering worldwide.

Matt Stalker, Communications manager
+44 (0)1788 534455
mstalker@icheme.org
www.icheme.org

Kuala Lumpur | London | Melbourne | Rugby | Shanghai | Wellington

Institution of Civil Engineers



Contact: Joanna Gonet,
Public Affairs Manager,
One Great George Street, Westminster,
London SW1P 3AA, UK
Tel: 020 7665 2123
Fax: 020 7222 0973
E-mail: Joanna.gonet@ice.org.uk
Website: www.ice.org.uk

ICE aims to be a leading voice in infrastructure issues. With over 80,000 members, ICE acts as a knowledge exchange for all aspects of civil engineering. As a Learned Society, the Institution provides expertise, in the form of reports, evidence and comment, on a wide range of subjects including infrastructure, energy generation and supply, climate change and sustainable development.

Institution of Engineering Designers



Contact: Libby Brodhurst
Courtleigh
Westbury Leigh
Westbury
Wiltshire BA13 3TA
Tel: 01373 822801
Fax: 01373 858085
E-mail: ied@ied.org.uk
Website: www.ied.org.uk

The only professional membership body solely for those working in engineering and technological product design. Engineering Council and Chartered Environmentalist registration for suitably qualified members. Membership includes experts on a wide range of engineering and product design disciplines, all of whom practise, manage or educate in design.





Contact: Paul Davies
IET,
Michael Faraday House,
Six Hills Way,
Stevenage,
SG1 2AY
Tel: +44(0) 1438 765687
Email: pdavies@theiet.org
Web: www.theiet.org

The IET is a world leading professional organisation, sharing and advancing knowledge to promote science, engineering and technology across the world. Dating back to 1871, the IET has 150,000 members in 127 countries with offices in Europe, North America, and Asia-Pacific.

Institution of Mechanical Engineers



Contact: Kate Heywood
1 Birdcage Walk
London SW1H 9JJ
Tel: 020 7973 1293
E-mail: publicaffairs@imeche.org
Website: www.imeche.org

The Institution provides politicians and civil servants with information, expertise and advice on a diverse range of subjects, focusing on manufacturing, energy, environment, transport and education policy. We regularly publish policy statements and host political briefings and policy events to establish a working relationship between the engineering profession and parliament.

LGC



Setting standards
in analytical science

Queens Road, Teddington
Middlesex, TW11 0LY
Tel: +44 (0)20 8943 7000
Fax: +44 (0)20 8943 2767
E-mail: info@lgcgroup.com
Website: www.lgcgroup.com

LGC is an international science-based company and market leader in the provision of analytical, forensic and diagnostic services and reference standards to customers in the public and private sectors.

Under the Government Chemist function, LGC fulfils specific statutory duties as the referee analyst and provides advice for Government and the wider analytical community on the implications of analytical chemistry for matters of policy, standards and regulation. LGC is also the UK's designated National Measurement Institute for chemical and biochemical analysis.

With headquarters in Teddington, South West London, LGC has 36 laboratories and centres across Europe and at sites in China, Brazil, India and the US.



Contact: Dr Elizabeth Rollinson,
Executive Secretary
The Linnean Society of London
Burlington House, Piccadilly,
London W1J 0BF
Tel: 020 7434 4479 ext 12
E-mail: elizabeth@linnean.org
Website: www.linnean.org

The Linnean Society of London is a professional learned body which promotes natural history in all its branches, and was founded in 1788. The Society is particularly active in the areas of biodiversity, conservation and sustainability, supporting its mission through organising open scientific meetings and publishing peer-reviewed journals, as well as undertaking educational initiatives. The Society's Fellows have a considerable range of biological expertise that can be harnessed to inform and advise on scientific and public policy issues.

A Forum for Natural History

Marine Biological Association



Contact: Dr Matthew Frost
Marine Biological Association, The
Laboratory, Citadel Hill, Plymouth, PL1 2PB
Tel: 07848028388
Fax: 01752 633102
E-mail: matfr@mba.ac.uk
Website: mba.ac.uk

For over 125 years the Marine Biological Association has been delivering its mission 'to promote scientific research into all aspects of life in the sea, including the environment on which it depends, and to disseminate to the public the knowledge gained.' The MBA has extensive research and knowledge exchange programmes and a long history of providing evidence to support policy. It represents its members in providing a clear independent voice to government on behalf of the marine biological community.

Met Office



Contact: John Harmer
Met Office
127 Clerkenwell Road
London EC1R 5LP
Tel: 020 7204 7469
E-mail: john.harmer@metoffice.gov.uk
Website: www.metoffice.gov.uk

The Met Office doesn't just forecast the weather on television. Our forecasts and warnings protect UK communities and infrastructure from severe weather and environmental hazards every day – they save lives and money. Our Climate Programme delivers evidence to underpin Government policy. Our Mobile Meteorological Unit supports the Armed Forces around the world. We build capacity overseas in support of international development. All of this built on world-class environmental science.



Contact: Rob Pinnock
Licensing & External Research, Europe
Hertford Road
Hoddesdon
Herts EN11 9BU
Tel: 01992 452850
Fax: 01992 441907
e-mail: rob_pinnock@merck.com
www.merck.com

MSD is a tradename of Merck & Co., Inc., with headquarters in Whitehouse Station, N.J., U.S.A.

MSD is an innovative, global health care leader that is committed to improving health and well-being around the world. MSD discovers, develops, manufactures, and markets vaccines, medicines, and consumer and animal health products designed to help save and improve lives.

The National Endowment for Science, Technology and the Arts



Guy Bilgorri
Public Affairs Officer
1 Plough Place
London EC4A1DE
Tel: 020 7438 2611
Fax: 020 7438 2501
Email: guy.bilgorri@nesta.org.uk
Website: www.nesta.org.uk

NESTA is the National Endowment for Science, Technology and the Arts – an independent organisation with a mission to make the UK more innovative. It operates in three main ways: by investing in early-stage companies; informing and shaping policy; and delivering practical programmes that inspire others to solve the big challenges of the future. NESTA's expertise in this field makes it uniquely qualified to understand how the application of innovative approaches can help the UK to tackle two of the biggest challenges it faces: the economic downturn and the radical reform of public services.

National Physical Laboratory



Contact: Fiona Auty
National Physical Laboratory
Hampton Road, Teddington
Middlesex TW11 0LW
Tel: 020 8977 3222
Website: www.npl.co.uk/contact-us

The National Physical Laboratory (NPL) is the United Kingdom's national measurement institute, an internationally respected and independent centre of excellence in research, development and knowledge transfer in measurement and materials science. For more than a century, NPL has developed and maintained the nation's primary measurement standards – the heart of an infrastructure designed to ensure accuracy, consistency and innovation in physical measurement.



Natural History Museum



Contact: Joe Baker
The Director's Office
Natural History Museum
Cromwell Road, London SW7 5BD
Tel: +44 (0)20 7942 5478
Fax: +44 (0)20 7942 5075
E-mail: joe.baker@nhm.ac.uk
Website: www.nhm.ac.uk

We maintain and develop the collections we care for and use them to promote the discovery, understanding, responsible use and enjoyment of the natural world.

We are part of the UK's science base as a major science infrastructure which is used by our scientists and others from across the UK and the globe working together to enhance knowledge on the diversity of the natural world.

Our value to society is vested in our research responses to challenges facing the natural world today, in engaging our visitors in the science of nature, in inspiring and training the next generation of scientists and in being a major cultural tourist destination.

The Nutrition Society



Contact: Frederick Wentworth-Bowyer,
Chief Executive, The Nutrition Society,
10 Cambridge Court, 210 Shepherds Bush Road
London W6 7NJ
Tel: +44 (0)20 7602 0228
Fax: +44 (0)20 7602 1756
Email: f.wentworth-bowyer@nutsoc.org.uk
www.nutritionssociety.org

Founded in 1941, The Nutrition Society is the premier scientific body dedicated to advance the scientific study of nutrition and its application to the maintenance of human and animal health.

Highly regarded by the scientific community, the Society is the largest learned society for nutrition in Europe. Membership is worldwide and is open to those with a genuine interest in the science of human or animal nutrition. Principal activities include:

1. Disseminating scientific information through its programme of scientific meetings and publications
2. Publishing internationally renowned scientific learned journals, and textbooks
3. Promoting the education and training of nutritionists
4. Engaging with external organisations and the public to promote good nutritional science

PHARMAQ

PHARMAQ Ltd

Contact: Dr Benjamin P North
PHARMAQ Ltd
Unit 15 Sandleheath Industrial Estate
Fordingbridge
Hants SP6 1PA.
Tel: 01425 656081
Fax: 01425 657992
E-mail: ben.north@pharmaq.no
Website: www.pharmaq.no
Web shop: www.pharmaqwebshop.co.uk/shop

PHARMAQ is the only global pharmaceutical company with a primary focus on aquaculture. Specialising in the manufacture and supply of veterinary pharmaceuticals for the global aquaculture industry including vaccines, anaesthetics, antibiotics, sea lice treatments and biocide disinfectants.



The Physiological Society

Contact: Dr Philip Wright
Chief Executive
Peer House, Verulam Street
London WC1X 8LZ
Tel: +44 (0) 20 7269 5716
Fax: +44 (0) 20 7269 5720
E-mail: pwright@physoc.org
Website: www.physoc.org

The Physiological Society brings together over 3000 scientists from over 60 countries. Since its foundation in 1876, our Members have made significant contributions to the understanding of biological systems and the treatment of disease. The Society promotes physiology with the public and Parliament alike, and actively engages with policy makers. It supports physiologists by organising world-class conferences and offering grants for research. It also publishes the latest developments in the field in its two leading scientific journals, The Journal of Physiology and Experimental Physiology.

Prospect



Contact: Sue Ferns,
Prospect Head of Research and Specialist Services, New Prospect House
8 Leake St, London SE1 7NN
Tel: 020 7902 6639 Fax: 020 7902 6637
E-mail: sue.ferns@prospect.org.uk
www.prospect.org.uk

Prospect is an independent, thriving and forward-looking trade union with 122,000 members across the private and public sectors and a diverse range of occupations. We represent scientists, technologists and other professions in the civil service, research councils and private sector.

Prospect's collective voice champions the interests of the engineering and scientific community to key opinion-formers and policy makers. With negotiating rights with over 300 employers, we seek to secure a better life at work by putting members' pay, conditions and careers first.



The Royal Academy of Engineering

Contact: Iffat Memon
Public Affairs Manager
The Royal Academy of Engineering
3 Carlton House Terrace
London SW1Y 5DG
Tel: 020 7766 0653
E-mail: iffat.memon@raeng.org.uk
Website: www.raeng.org.uk

Founded in 1976, The Royal Academy of Engineering promotes the engineering and technological welfare of the country. Our activities – led by the UK's most eminent engineers – develop the links between engineering, technology, and the quality of life. As a national academy, we provide impartial advice to Government; work to secure the next generation of engineers; and provide a voice for Britain's engineering community.

Royal Botanic Gardens, Kew



RBG Kew is a centre of global expertise in plant and fungal diversity, conservation and sustainable use housed in two world-class gardens. Kew receives approximately half of its funding from government through Defra. Kew's Breathing Planet Programme has seven key priorities:

- Accelerating discovery and global access to plant and fungal diversity information
- Mapping and prioritising habitats most at risk
- Conserving what remains
- Sustainable local use
- Banking 25% of plant species in the Millennium Seed Bank Partnership
- Restoration ecology
- Inspiring through botanic gardens

Contact: The Director's Office
Tel: 020 8332 5112
Fax: 020 8332 5109
Email: director@kew.org
Website: www.kew.org

Inspiring and delivering science-based plant conservation worldwide, enhancing the quality of life

The Royal Institution



Contact: Dr Gail Cardew
Director of Science and Education
The Royal Institution
21 Albemarle Street, London W1S 4BS
Tel: 020 7409 2992 Fax: 020 7670 2920
E-mail: gail@ri.ac.uk
Website: www.rigb.org
Twitter: [rigb_science](https://twitter.com/rigb_science)

The core activities of the Royal Institution centre around four main themes: science education, science communication, research and heritage. It is perhaps best known for the Ri Christmas Lectures, but it also has a major Public Events Programme designed to connect people to the world of science, as well as a UK-wide Young People's Programme of science and mathematics enrichment activities. Internationally recognised research programmes in bio- and nanomagnetism take place in the Davy Faraday Research Laboratory.

The Royal Society



Contact: Dr Peter Cotgreave
Director of Fellowship and Scientific Affairs
The Royal Society, 6-9 Carlton House Terrace
London SW1Y 5AG.
Tel: 020 7451 2502 Fax: 020 7930 2170
Email: peter.cotgreave@royalsociety.org
Website: www.royalsociety.org

The Royal Society is the UK academy of science comprising 1400 outstanding individuals representing the sciences, engineering and medicine. It has had a hand in some of the most innovative and life-changing discoveries in scientific history. Through its Fellowship and permanent staff, it seeks to ensure that its contribution to shaping the future of science in the UK and beyond has a deep and enduring impact.



RSC | Advancing the Chemical Sciences The Royal Society of Chemistry

Contact: Mr Wes Ball, Parliamentary Affairs Manager
Royal Society of Chemistry, Burlington House
Piccadilly, London W1J 0BA
Tel: 020 7440 3306
Fax: 020 7440 3393
Email: ballw@rsc.org

Website: <http://www.rsc.org>
<http://www.chemsoc.org>

The Royal Society of Chemistry is a learned, professional and scientific body of over 46,000 members with a duty under its Royal Charter "to serve the public interest". It is active in the areas of education and qualifications, science policy, publishing, Europe, information and internet services, media relations, public understanding of science, advice and assistance to Parliament and Government.

Society for Applied Microbiology



Contact: Philip Wheat
Society for Applied Microbiology
Bedford Heights, Brickhill Drive
Bedford MK41 7PH
Tel: 01234 326661
Fax: 01234 326678
E-mail: pfwheat@sfam.org.uk
Website: www.sfam.org.uk

SfAM is the oldest UK microbiological society and aims to advance, for the benefit of the public, the science of microbiology in its application to the environment, human and animal health, agriculture and industry.

SfAM is the voice of applied microbiology with members across the globe and works in partnership with sister organisations to exert influence on policy-makers world-wide.

society for general Microbiology

Contact: Daniel Burdass
Head of Communications
Society for General Microbiology
Marlborough House, Basingstoke Road,
Spencers Wood, Reading RG7 1AG.
Tel: 0118 988 1802 Fax: 0118 988 5656
E-mail: pa@sgm.ac.uk
Website: www.sgm.ac.uk

SGM is the largest microbiological society in Europe. The Society publishes four journals of international standing, and organises regular scientific meetings.

SGM also promotes education and careers in microbiology, and it is committed to represent microbiology to government, the media and the public.

An information service on microbiological issues concerning aspects of medicine, agriculture, food safety, biotechnology and the environment is available on request.

Society of Biology



SOCIETY OF
Biology

Contact: Dr Stephen Benn
Director Parliamentary Affairs
Charles Darwin House
12 Roger Street
London WC1N 2JU
Tel: 020 7685 2550
E-mail: stephenbenn@societyofbiology.org

The Society of Biology has a duty under its Royal Charter "to serve the public benefit" by advising Parliament and Government is a single unified voice for biology: advising Government and influencing policy; advancing education and professional development; supporting our members, and engaging and encouraging public interest in the life sciences. The Society represents a diverse membership of over 80,000 - including, students, practising scientists and interested non-professionals - as individuals, or through learned societies and other organisations.

Society of Cosmetic Scientists

SOCIETY OF
COSMETIC
SCIENTISTS



Contact: Gem Bektas,
Secretary General
Society of Cosmetic Scientists
Langham House West
Suite 5, Mill Street, Luton LU1 2NA
Tel: 01582 726661
Fax: 01582 405217
E-mail: ifsc.scs@btconnect.com
Website: www.scs.org.uk

Advancing the science of cosmetics is the primary objective of the SCS. Cosmetic science covers a wide range of disciplines from organic and physical chemistry to biology and photo-biology, dermatology, microbiology, physical sciences and psychology.

Members are scientists and the SCS helps them progress their careers and the science of cosmetics ethically and responsibly. Services include publications, educational courses and scientific meetings.

Society of Maritime Industries



Society of
Maritime
Industries

Contact: John Murray
Society of Maritime Industries
28-29 Threadneedle Street,
London EC2R 8AY
Tel: 020 7628 2555 Fax: 020 7638 4376
E-mail: info@maritimeindustries.org
Website: www.maritimeindustries.org

The Society of Maritime Industries is the voice of the UK's maritime engineering and business sector promoting and supporting companies which design, build, refit and modernise ships, and supply equipment and services for all types of commercial and naval ships, ports and terminals infrastructure, offshore oil & gas, maritime security & safety, marine science and technology and marine renewable energy.

Universities Federation for Animal Welfare



Contact: Dr James Kirkwood
Chief Executive and Scientific Director
The Old School, Brewhouse Hill
Wheathampstead, Herts. AL4 8AN.
Tel: 01582 831818. Fax: 01582 831414.
Email: ufaw@ufaw.org.uk
Website: www.ufaw.org.uk
Registered in England Charity No: 207996

UFAW is an international, independent scientific and educational animal welfare charity. It works to improve animal lives by:

- supporting animal welfare research.
- educating and raising awareness of welfare issues in the UK and overseas.
- producing the leading journal Animal Welfare and other high-quality publications on animal care and welfare.
- providing expert advice to government departments and other concerned bodies.



Contact: Chris Eady
The Welding Institute, Granta Park, Great
Abington, Cambridge, CB21 6AL

Tel: 01223 899614
Fax: 01223 894219
E-mail: chris.eady@twi.co.uk
Website: www.twi.co.uk

The Welding Institute is the leading engineering institution with expertise in solving problems in all aspects of manufacturing, fabrication and whole-life integrity management.

Personal membership provides professional development for engineers and technicians, and registration as Chartered or Incorporated Engineer, or Engineering Technician.

Industrial membership provides access to one of the world's foremost independent research and technology organisations.

TWI creates value and enhances quality of life for Members and stakeholders through engineering, materials and joining technologies.



Research Councils UK

Contact: Alexandra Saxon
Head of Communications
Research Councils UK
Polaris House
North Star Avenue
Swindon SN2 1ET

Tel: 01793 444592
E-mail: communications@rcuk.ac.uk
Website: www.rcuk.ac.uk



Each year the Research Councils invest around £3 billion in research covering the full spectrum of academic disciplines from the medical and biological sciences to astronomy, physics, chemistry and engineering, social sciences, economics, environmental sciences and the arts and humanities.

Research Councils UK is the strategic partnerships of the seven Research Councils. It aims to:

- increase the collective visibility, leadership and influence of the Research Councils for the benefit of the UK;
- lead in shaping the overall portfolio of research funded by the Research Councils to maximise the excellence and impact of UK research, and help to ensure that the UK gets the best value for money from its investment;
- ensure joined-up operations between the Research Councils to achieve its goals and improve services to the communities it sponsors and works with.

Biotechnology and Biological Sciences Research Council (BBSRC)



Contact: Matt Goode
Head of External Relations
BBSRC, Polaris House, North Star Avenue
Swindon SN2 1UH. Tel: 01793 413299
E-mail: matt.goode@bbsrc.ac.uk
Website: www.bbsrc.ac.uk

BBSRC invests in world-class bioscience research and training on behalf of the UK public. Our aim is to further scientific knowledge to promote economic growth, wealth and job creation and to improve quality of life in the UK and beyond. BBSRC research is helping society to meet major challenges, including food security, green energy and healthier, longer lives and underpins important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.

Economic and Social Research Council



Contact: Jacky Clake, Head of Communications,
Economic and Social Research Council,
Polaris House, North Star Avenue,
Swindon SN2 1UJ
Tel: 01793 413117
Jacky.Clake@esrc.ac.uk
<http://www.esrc.ac.uk>

The ESRC is the UK's leading research and training agency addressing economic and social concerns. We pursue excellence in social science research; work to increase the impact of our research on policy and practice; and provide trained social scientists who meet the needs of users and beneficiaries, thereby contributing to the economic competitiveness of the United Kingdom, the effectiveness of public services and policy, and quality of life. The ESRC is independent, established by Royal Charter in 1965, and funded mainly by government.

EPSRC

Engineering and Physical Sciences
Research Council

Contact: Jenny Aranha,
Public Affairs Manager,
EPSRC, Polaris House,
North Star Avenue, Swindon SN2 1ET
Tel: 01793 442892
E-mail: jenny.aranha@epsrc.ac.uk
Website: www.epsrc.ac.uk

EPSRC is the UK's main agency for funding research in engineering and physical sciences, investing around £800m a year in research and postgraduate training, to help the nation handle the next generation of technological change.

The areas covered range from information technology to structural engineering, and mathematics to materials science. This research forms the basis for future economic development in the UK and improvements for everyone's health, lifestyle and culture. EPSRC works alongside other Research Councils with responsibility for other areas of research.

Medical Research Council



Contact: Sophie Broster-James, Public
Affairs and External Comms Manager
14th Floor, One Kemble Street, London
WC2B 4AN.
Tel: 020 7395 2275 Fax: 020 7395 2421
E-mail: sophie.broster-james@headoffice.mrc.ac.uk
Website: www.mrc.ac.uk

For almost 100 years, the MRC has been improving the health of people in the UK and around the world by supporting the highest quality science on behalf of UK taxpayers. We work closely with the UK's Health Departments, the NHS, medical research charities and industry to ensure our research achieves maximum impact as well as being of excellent scientific quality. MRC-funded scientists have made some of the most significant discoveries in medical science – from the link between smoking and cancer to the invention of therapeutic antibodies – benefiting millions of people.

Natural Environment Research Council



Contact: Judy Parker
Head of Communications
Polaris House, North Star Avenue
Swindon SN2 1EU
Tel: 01793 411646 Fax: 01793 411510
E-mail: requests@nerc.ac.uk
Website: www.nerc.ac.uk

The UK's Natural Environment Research Council funds and carries out impartial scientific research in the sciences of the environment. NERC trains the next generation of independent environmental scientists.

NERC funds research in universities and in a network of its own centres, which include:

British Antarctic Survey, British Geological Survey, Centre for Ecology and Hydrology, and National Oceanography Centre.

Science & Technology Facilities Council



Mark Foster
Public Affairs Manager
Rutherford Appleton Laboratory
Harwell Science & Innovation Campus
Didcot OX11 0QX
Tel: 01235 778328 Fax: 01235 445 808
E-mail: mark.foster@stfc.ac.uk
Website: www.stfc.ac.uk

The Science and Technology Facilities Council is one of Europe's largest multidisciplinary research organisations supporting scientists and engineers world-wide. The Research Council operates world-class, large-scale research facilities and provides strategic advice to the UK Government on their development. The STFC partners in two of the UK's Science and Innovation Campuses. It also manages international research projects in support of a broad cross-section of the UK research community, particularly in the fields of astronomy, nuclear physics and particle physics. The Council directs, co-ordinates and funds research, education and training.



SCIENCE DIARY

THE PARLIAMENTARY AND SCIENTIFIC COMMITTEE

Tel: 020 7222 7085
annabel.lloyd@parliament.uk
www.scienceinparliament.org.uk

Annual Lunch

Wednesday 31 October

Discussion meeting dates

Tuesday 16 October 17.30

Energy of the last Millennium

Tuesday 6 November 17.30

Energy of the next century

Tuesday 11 December 17.30

Climate Change and the Polar Regions

2013

Tuesday 22 January 17.30

Tuesday 26 February 17.30

THE ROYAL SOCIETY

Website: royalsociety.org

The Royal Society hosts free events, including evening lectures and conferences, covering the whole breadth of science, engineering and technology for public, policy and scientific audiences. Events are held at the Royal Society's offices in London, at the Kavli Royal Society International Centre at Chicheley Hall, Buckinghamshire and other venues.

Many past events are available to watch or listen to online at <http://royalsociety.tv>. The collection includes events with speakers such as David Attenborough, Margaret Atwood and Lord Rees FRS.

Highlights in the next few months include the following. Details of how to attend, plus information on many more events can be found on our website at royalsociety.org/events:

Wednesday 5 to Friday 7 September
Complex patterns in wave functions – drums, graphs, and disorder

Theo Murphy International Scientific Meeting organised by Dr Sven Gnutzmann and Professor Uzy Smilansky

Friday 21 September, 13.00

The Centenary of the Discovery of Cosmic Rays: the end of the beginning.

Sir Arnold Wolfendale FRS, 14th Astronomer Royal

Monday 24 and Tuesday 25 September

Magnetoelectric phenomena and devices

Discussion Meeting organised by Dr Neil Mathur and Professor James Scott FRS

Wednesday 26 and Thursday 27 September

Magnetoelectrics at the mesoscale

Satellite meeting organised by Dr Neil Mathur and Professor James Scott FRS

Friday 28 September 13.00

Natural History and the Rights of Woman

Professor Sharon Ruston

Tuesday 2 October 18.30

Public lecture by Professor Ben Green FRS

Friday 5 October 13.00

The Royal Society in the Mendel wars of the early 20th century

Dr Gregory Radick

Thursday 4 and Friday 5 October

Handling uncertainty in weather and climate prediction, with application to health, agronomy, hydrology, energy and economics

Theo Murphy international scientific meeting organised by Professor Tim Palmer FRS

Friday 12 October 13.00

The Notorious Sir John Hill: Georgian Celebrity Science and Attacks on the Royal Society

Professor George Rousseau, University of Oxford

Friday 19 October 13.00

The zoological world of Edward Lear

Dr Clemency Fisher

Monday 22 and Tuesday 23 October

Regulation from a distance: long-range control of gene expression in development and disease

Scientific discussion meeting organised by Professor Wendy Bickmore and Professor Veronica van Heyningen FRS

Wednesday 24 and Thursday 25 October

Regulation of gene expression from a distance: exploring mechanisms

Satellite meeting organised by Professor Wendy Bickmore and Professor Veronica van Heyningen FRS

Details of these, and further events in press, will be available on our website at royalsociety.org/events

THE ROYAL INSTITUTION

21 Albemarle Street
London W1S 4BS.

All events take place at the Royal Institution. Details of future events can be found at www.rigb.org

BRITISH SCIENCE ASSOCIATION

Tuesday 4 to Sunday 9 September

British Science Festival

in Aberdeen

For further information visit

<http://www.britishsocietyassociation.org/web/BritishScienceFestival/>

THE LINNEAN SOCIETY OF LONDON

Burlington House

Piccadilly

London W1J 0BF

Tel: +44 (0)20 7434 4479 ext 11

Visit www.linnean.org for further details

Unless otherwise stated events are held at the Linnean Society of London and are free and open to all

Thursday 20 September 10.00-17.00

Online Taxonomy Meeting

Thursday 20 September 18.00-19.30

Paleoclimatic Impacts on Biodiversity and Ecosystems- Insights from Eco-informatics

Professor Jens-Christian Svenning

Thursday 27 September 18.00-19.30

The Remarkable Nature of Edward Lear

Mr Robert McCracken Peck

Monday 8 October 18.00-19.30

Darwin Lecture

Professor Sir Leszek Borysiewicz

Wednesday 17 October 18.00-19.30

Why did Darwin change his mind about sex ratio?

Professor Elliott Sober

Thursday 18 October 18.00-19.30

FW Frohawk (1861-1946) Zoological Artist and Butterfly Specialist: a window on the world of Victorian and Edwardian natural history

Ms June Chatfield



OFFICERS OF THE PARLIAMENTARY & SCIENTIFIC COMMITTEE

President: The Rt Hon the Lord Jenkin of Roding
Chairman: Mr Andrew Miller MP
Deputy Chairman: Mr Tom Blenkinsop MP
Hon Treasurer: The Lord Willis of Knaresborough
Hon Secretary: Mr Stephen Mosley MP
Vice-Presidents: Dr David Dent
Professor Peter Saunders
Mr Robert Freer
Dr Douglas Naysmith

Advisory Panel:

Secretariat:

Dr Desmond Turner
Mr Robert Key
Mr Paul Ridout
Mr Philip Greenish CBE
Mr John Slater
Dr Stephen Benn
Mr David Youdan
Dr Stuart Taylor
Professor Alan Malcolm
Mrs Annabel Lloyd



3 Birdcage Walk
London SW1H 9JJ
T: 020 7222 7085
F: 020 7222 7189

www.scienceinparliament.org.uk

Editor: Professor Alan Malcolm
Editorial Assistant: Annabel Lloyd

The production of this issue has been supported by contributions from the Society of Biology, The Materials Knowledge Transfer Network, the British Psychological Society and those organisations who have entries in the Science Directory (pages 52-60).



Going for gold

The greatest psychological show on earth

The British Psychological Society's Division of
Sport & Exercise Psychology reveals the
role of psychology in sport.

Many competitors claim the moments just
before a sporting encounter can be important
to the final result. What would you do?
Take part in our online experiment.

For videos, free journals articles and expert
psychologists' comments on news visit
www.bps.org.uk/winning

This project is funded by a public engagement
grant from the British Psychological Society.

