The research commercialisation office of the University of Oxford, previously called **Isis Innovation**, has been renamed **Oxford University Innovation**

All documents and other materials will be updated accordingly. In the meantime the remaining content of this Isis Innovation document is still valid.

URLs beginning www.isis-innovation.com/... are automatically redirected to our new domain, www.innovation.ox.ac.uk/...

Phone numbers and email addresses for individual members of staff are unchanged

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Isis insights

Issue 70 Winter 2012

Data
Connecting and protecting

Also inside: The Kennedy Trust, Expert Witness Consulting, MS Prognostic and more

The latest innovations, collaborations and technology transfer

ISIS INNOVATION

Issue 70
Winter 2012

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Connecting and protecting

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Information

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Inspiration

Ii is produced by Isis Innovation Ltd, the technology transfer company owned by the University of Oxford.

Cover image: Conceptual image of data security and wireless data connection

ISIS INNOVATION

Newsflash

Isis is a research and technology commercialisation company owned by the University of Oxford.

The webcam will see you now...

Isis' latest spin-out from Oxford's Institute of Biomedical Engineering, Oxehealth, has developed software that allows patient monitoring using the webcam on a PC. Sensing pulse, breathing rate, and oxygen saturation without the need for any other hardware, the NHS-supported innovation offers massive savings in cost and convenience for health providers and patients as visits to doctors and hospitals can be reduced. IP Group has committed up to £500,000 in funding, subject to certain milestones being met.

Making an Impact

University of Oxford researchers generate a vast amount of Intellectual Property, much of which Isis commercialises for the benefit of mankind and to provide a return to the University. Several recent successes are showcased in a new Isis publication, simply called 'Impacts', including case studies from healthcare, education, software and others. 'Impacts' is available online; please do ask for a printed copy if you would like one.

International engagement

With offices in Oxford, Hong Kong, Madrid and Kyoto, Isis is well-placed to support customers worldwide. We are currently helping clients from the research base in Mexico and Colombia develop their technology transfer capabilities, and in China are supporting the development of new technology companies in Jiangsu Province. Isis' Head of Technology Transfer and Consulting, Linda Naylor, recently visited Brazil on a mission led by David Willetts, the UK Minister of State for Universities and Science, to highlight the successful partnerships between UK and Brazilian research institutions, as well as promote new engagements with different partners. The University of Oxford is a key partner of Brazil and plays an important role in bilateral innovation collaborations.

Software from Oxford

Two new ventures from the Isis Software Incubator presented at the Isis Angels Network meeting in October. iMotiva, which encourages and incentivises individuals to participate in exercise, and VerifyRecruit, which offers in-depth background checks on job applicants for SMEs, took full advantage of Software Incubator support to develop products quickly. A previous software-based Oxford spin-out, NaturalMotion, was recently featured at the launch of the Apple iPhone 5, and has attracted $11 million in investment this year to expand further.

Enterprising Consultancy

News from **Isis Enterprise** and **Oxford University Consulting**

Encrypting Google Documents

SafeGDocs is a software application that enables a user to encrypt their Google Documents whilst still allowing collaborative document sharing. It is being released as a web browser plugin that intercepts the data sent to and from the cloud and seamlessly encrypts it. Documents can be shared without compromising security or relying on a third party due to a special method of securely storing the encryption keys within the Google Drive account.

The cloud is revolutionising everyday interactions with information technology because it offers access to email and documents from anywhere, anytime, backed up and at greatly reduced cost. However, a frequent barrier to adoption of cloud services such as Google Drive is the issue of security.

Journalists or lawyers, for example, may need to protect their information against the threat of espionage but many personal users also wish to achieve this high level of security. Users may need to comply with corporate or government security policies requiring all sensitive information to be encrypted or simply want to provide an additional level of password protection to their documents beyond the login to their Gmail account.

The work is part of a wider project on cloud security at the Gradiant research centre in Spain, in collaboration with the University of Vigo, supported by Fundación Barrié and assisted by Isis Enterprise.

www.SafeGDocs.com

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Expert Witness Consulting

When it comes to legal or patent disputes, the role of an expert witness often forms a critical part of the process for guiding strategy and informing the decision making process of the parties involved, providing invaluable insight that may help determine a settlement or move to court proceedings.

As a centre of world-leading research across vast areas of knowledge, academics and researchers from the University of Oxford represent prime candidates to act as such experts and Oxford University Consulting (OUC) works at the interface to facilitate such interactions.

OUC already works closely with academics active in this field to arrange and support them in their expert witness work and encourages those academics who are interested in getting involved to get in touch and discuss the practicalities. Tangible support is provided through contract negotiation and the provision of liabilities insurance. OUC recently complemented this by arranging a seminar, led by two experienced solicitors from a commercial litigation team, that highlighted changes that abolished the immunity from liability in negligence that expert witnesses had previously enjoyed under English law.

Externally, OUC regularly receives enquiries from leading legal firms and, through its network, OUC is able to quickly connect them with the right expert and facilitate the engagement efficiently. Typical projects include support for patent opposition proceedings, legal disputes or scientific review for early-stage strategy planning. The projects have spanned a wide range of disciplines from human therapeutics through mechanical engineering to environmental sciences and have included essential advice and expertise, provision of expert statements or reports, as well as attendance in court.

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The portfolio

The latest **spin-out** and **investment** news

Developing vaccines for the developing world

Oxford Vacmedix UK Limited (OVM UK) has been spun out to commercialise a novel vaccine design technology platform for a range of infectious diseases and cancers, focusing initially on those of importance to the developing world. The proprietary recombinant overlapping peptide (ROP) technology that the company has been founded on has been developed by Dr Shisong Jiang, Department of Oncology (and at the Weatherall Institute of Molecular Medicine pre-September 2011) at the University of Oxford and will be exclusively licensed from Isis.

OVM UK will facilitate the essential further development required to achieve commercial validation of the technology platform. Creation of a technical dossier of the technology is required in order to demonstrate its inherent potential and to provide a base upon which therapeutics and diagnostics for infectious diseases and cancers can be developed from the core IP.

This University spin-out holds the exclusive worldwide licence, in all fields, to the intellectual property currently owned and managed by Isis Innovation. OVM UK will have overall responsibility for development of the technology and the prosecution of the IPR.

A key aspect of the business plan has included the formation of a joint venture in Hong Kong between OVM UK and Chinese investors to exploit the technology in specific disease areas. The joint venture will take advantage of science park facilities in Changzhou province, China, where the lead inventor, Dr Jiang, has being successful in securing seed investment from the Changzhou local government to exploit this technology.

The University spin-out holds the exclusive worldwide licence

Provisions of the support from Changzhou province include laboratory space in a new science business incubation centre managed by Isis and additional funding for key workers.

Data generated through validation of these initial disease applications will demonstrate further the potential of this approach to vaccine development and open up additional opportunities for exploitation of the platform as a whole.

OVM UK will own and have access to use this data, enabling it to benefit from commercialisation in the initial disease areas and exploit the platform in other disease indications, through its own development or sublicensing.

OVM UK will retain the rights for the rest of the world and will be able to implement further development programmes of its own, or sub-licence deals, in order to fully exploit this novel vaccine design technology platform.

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Aptuit

Founded in 2005, OIS member **Aptuit** has become a leader in delivering outsourced drug discovery, development and manufacturing services to the pharmaceutical and biotech industries. Jim Beaumont gives an overview of their activities.

Aptuit serves nearly 600 clients worldwide each year. This client base spans small companies that may not maintain in-house technical expertise to multinational pharmaceutical companies that are looking to outsource large, integrated projects. The latter group turns to Aptuit because they lack certain skills in a specific therapeutic area or they no longer have the capacity to advance the volume of work in their portfolio. Significantly, Aptuit is involved in 20 percent of the 10,000 molecules that are under development at any place in the world at any given time.

Aptuit's success in taking the client's molecule all the way from discovery through to finished drug product with maximum cost and time efficiencies is distinguished by our Integrated Knowledge. The phrase stands for the fact that clients benefit from the combined capabilities of the best of both worlds – the efficiency of a contract research organisation with the scientific expertise of a large pharmaceutical research and development engine. Specifically, Integrated Knowledge represents layers of understanding and insight that enable us to see the entire picture, speeding the drug development process while also addressing challenges that may disrupt the future path. It's a concept that applies to both stand alone services and integrated development programmes that utilise multiple business operations.

From seven locations around the world, including a strategic partner in India, clients gain unparalleled advantages when they work with Aptuit.

Aptuit maintains fully integrated services at The Aptuit Center for Drug Development & Discovery in Verona. Formerly The GlaxoSmithKline Medicines Centre, this world-class facility is now part of Aptuit's global organisation, acquired in 2010. Aptuit Verona scientists represent a knowledgeable group comprised of some of the industry's foremost drug discovery and development specialists in neuroscience, antibacterial, oncology, cardiovascular, respiratory and other key therapeutic areas. The site's broad range of capabilities includes Drug Design and Discovery, CMC (Chemistry, Manufacturing and Control), Preclinical Biosciences, Clinical Sciences and Integrated Drug Discovery and Development programmes. From this facility, a breadth of state-of-the-art, comprehensive, customised drug development services are applied to a variety of molecules, including Gene Therapy Medicinal Products.

Other unique capabilities are found at SSCI, a division of Aptuit that is recognized around the world as the industry leader in solid state chemistry services. Located in Indiana, Aptuit SSCI's screening and selection capabilities lead the way from generating the first crystal, polymorph screen, salt or co-crystal selection to developing robust crystallisation processes. Aptuit SSCI also provides DiscoverScreens™. These low cost screens are ideal for early discovery clients challenged by budget, material and time constraints with no need for complex traditional screens.

From Aptuit's Glasgow site, sterile fill/finish and formulation development are available for a wide range of dosage forms such as liquid, lyophilization, ophthalmics, nasal sprays, liposomes and other complex delivery systems. Aptuit can provide sterile fill/finish services for a variety of materials including small molecules, biologics, cytotoxics and controlled substances.

Dedicated Active Pharmaceutical Ingredient (API) facilities in the United States and Europe, along with a strategic partner in India, provide Aptuit with a global API capability. Their competencies include process research and development, analytical and chemical development, preclinical and clinical supply, high potency APIs and cytotoxics, pilot manufacturing and commercial scale manufacturing.

Because Aptuit fully understands that time and costs are major industry challenges, the company has innovated Aptuit INDiGO®. This accelerated development process uses integrated, parallel development tracks to advance API to regulatory submission in as few as 26 weeks. In just 52 weeks, compounds can progress from candidate selection to regulatory submission, a highly desirable alternative to the industry average of 122 weeks. By adding another 30 weeks, Aptuit INDiGO® takes the compound into the clinical phase and provides human safety, tolerability and pharmacokinetics results from the First Time In Human study.

Secure in its scientific capabilities performed by the industry's brightest "heads for science", Aptuit's people with "hearts for service" are dedicated to professionalism, courtesy, clear accountability and a sense of urgency, with the desire to transform customer service into customer delight.

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Aptuit delivers early to mid phase drug development capabilities that include:

- Drug Design and Discovery
- Preclinical Biosciences
- Active Pharmaceutical Ingredient (API) Development and Manufacture
- Solid State Chemistry
- Sterile Fill/Finish
- Formulation Development
- Clinical Sciences
- Integrated Drug Discovery and Development
- Consulting
- Aptuit INDiGO® (an accelerator programme for early drug candidates).

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Innovation in Oxford - a century of change

Having initially been undermined by events in the 1920s, in which academic-turned-sugar-entrepreneur Brynar Owen filed fraudulent patents that resulted in Oxford University being sued[1], the climate for innovation at Oxford has improved immeasurably over the last 35 years. **Lucius Cary** recounted the Owen affair and gave his own eye-witness account of the improving climate when he presented to the Oxford Innovation Society in September.

In 1972 I experienced at first hand the difficulty of raising capital to start my first business. I eventually received funding from four individuals, who today would be called business angels, by means of a small ad in the FT. But I was very lucky to succeed. In 1978, by which time this business employed 50 people, I decided to start Venture Capital Report to provide for other entrepreneurs what I had needed myself: a means for entrepreneurs to approach several hundred potential investors.

The climate for business that year was terrible. The top rate of income tax was 98 percent (83 percent income tax plus 15 percent surcharge on any unearned income.) The government ran all major industries (telecoms, steel, coal, water, railways, electricity etc) and had a monopoly on all research coming out of universities and state research establishments. The result was a dead economy. This was the low point, both for innovation in the UK and for innovation in Oxford. Since then there has been steady improvement.

A change of political leadership saw the top rate of tax cut to 60 percent in 1979 and then to 40 percent in 1988. Many measures aimed at encouraging the funding of innovation were introduced, including the Business Start-Up scheme and the Business Expansion Scheme.

In 1983, by which time VCR had 900 subscribers and was being quite effective at enabling entrepreneurs to

Lucius Cary

raise capital, I started my first seed capital fund to invest in technology start-ups. Three years later I moved to Oxford. I have since invested in more than 100 technology start-ups, all based in or near Oxford, through a total of 11 funds.

1983 also marked the year Oxford Instruments floated. In 1985 Martin and Audrey Wood founded The Oxford Trust "to encourage the study and application of science and technology". In 1988 Isis was founded. Soon after, Magdalen College opened the first building on the Oxford Science Park, allowing small start-up companies to rent space by the month, thus removing one of their greatest barriers. Oxford Molecular, Oxford Asymmetry and Oxford Glycosciences were founded.

In 1995, The Oxford Trust founded OION, Oxford's first business angels network, now one of the most successful such networks in the UK. Oxford was one of 15 universities, two years later, to be awarded a University Challenge Fund, money specifically for investing in technology start-up businesses.

Begbroke Science Park was opened in 1998 and two years later the Isis College Fund raised £10m to invest in businesses emerging from the University. The same year, IP Group invested £20m in the Department of Chemistry for the right to a 50 percent share in the proceeds of commercialisation of everything coming out of the department for the next 15 years. This led to Oxford Nanopore, Oxford Advanced Surfaces and Oxford Catalysts among others.

Venturefest started at the turn of the millennium and now represents one of the major networking events for all those involved in the creation of new technology businesses in Oxfordshire. The Saïd Foundation, Oxford's Business School, was also established and moved into its current site in 2001. In 2003, the Oxford Entrepreneurs' Society was formed. This has since grown to include 7,500 members, the largest such society in the world. There have been several dozen student start-ups since then. In 2008 Isis established OSEM (Oxford Spin-out Equity Management) to look after its portfolio of 54 investee companies, in which the University now has shareholdings currently valued at around £45m.

The message is that the climate for innovation in Oxford has improved immeasurably. Doubtless it could still improve more.

References

[1] Details of the Owen Affair are given in: Science at Oxford 1914 - 1939 Jack Morrell Clarendon Press

- All figures c/o Lucius Cary

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Isis Innovation: Invention 9

Living organs for life

Speaking at the Oxford Innovation Society Meeting in September, OrganOx founder and Nuffield surgeon **Professor Peter Friend** described significant developments in organ transplantation and introduced OrganOx.

Professor Peter Friend

Clinical organ transplantation is a medical success story of the last 50 years. Tens of thousands of patients living normal lives are a testimony to the effectiveness of this therapy. However, increasing success has driven demand and the supply of suitable donor organs now exceeds the supply. Many patients die on transplant waiting lists.

Historically, most transplanted organs have originated from previously young and healthy donors, certified brain dead by neurological tests. These 'ideal' organs have been the essential basis of successful transplantation. As the demand has increased, surgeons have turned to the use of less ideal organs – those from older and less healthy donors – and to use of organs from donors declared dead by cardiovascular tests. Such organs inevitably sustain damage due to oxygen deprivation (ischaemia) before retrieval. The successful use of these 'high-risk' organs is essential if clinical need is to be met.

The preservation of the organ between retrieval and implantation is based on the infusion of a specialist preservation solution and cooling to ice temperature. However, the cooled tissue continues to metabolise without oxygen (anaerobic), consuming energy and accumulating metabolites that trigger a biochemical cascade at the moment of transplantation. This leads to 'ischaemia-reperfusion injury' and is much more severe in already-damaged (high-risk) organs.

OrganOx has developed a novel approach to preservation of the liver, which avoids the two factors that are so injurious to high-risk organs: cooling and ischaemia. Instead of placing the liver in ice, oxygenated blood and nutrients are circulated through the liver at normal body temperature (normothermia) with physiological flow and pressures, to create an environment for the liver which resembles that in the body.

This new method avoids cooling and anaerobic metabolism during preservation, allows recovery from acute injury sustained in retrieval (particularly ischaemia) and also enables the function of the organ to be measured during preservation. The key clinical benefits in the case of high risk organs are: (i) organ repair after retrieval; (ii) viability assessment before the transplant; (iii) minimisation of ischaemia-reperfusion injury after the transplant.

Much experimental work has confirmed the theoretical benefits of this approach. Livers have been transplanted successfully after ischaemic injuries and preservation times that were not sustainable using conventional ice preservation. OrganOx was established to translate this technology from the laboratory to the clinic; to construct a fully-automated and transportable normothermic clinical-grade liver preservation device. Normothermic technology is inherently more expensive than ice cooling and commercial success will depend on the device enabling the safe transplantation of organs that cannot be transplanted using current techniques.

OrganOx was established in April 2008 by two University of Oxford academic founders, Professor Constantin Coussios, Institute of Biomedical Engineering, and Professor Peter Friend, Nuffield Department of Surgery, with CEO, Dr Les Russell. Funding rounds in 2008, 2011 and 2012 have raised a total of £5.25 million. Design, prototyping and manufacture have been largely outsourced to enable the company to run with very low overheads and to progress rapidly to clinical trials.

After initial testing of the automation systems, a mobile prototype was the basis of the current clinical device, the OrganOx Metra. This is currently undergoing phase 1 clinical trial testing at King's College Hospital, which will support an application for a CE mark. A larger, randomised and controlled clinical trial will start in 2013 as part of an EU-funded multi-centre European collaboration. Sales will start in late 2013 and entry into the USA and other non-European markets will follow.

OrganOx has developed a unique product to address a clear clinical need and, as a result of a very targeted and clinically-driven approach, should be in a position to generate sales within 5 years of initial funding.

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Spontaneous security

Dr Andy Robertson describes the work of researchers in the Department of Computer Science on protocols which can create secure communication where none exists.

Global credit and debit card losses due to fraud amounted to $7.6 billion in 2010 and these protocols have the potential to reduce this thorough enhancing security of card-present transactions and extending Chip and PIN security to online card-not-present transactions.

One solution to computer security is to rely on trusted third parties or so-called Public Key Infrastructure (PKI), whereby a trusted authority issues certificates to validate the identity of a machine. Such infrastructures are expensive to maintain and, for lightweight applications, require too much computing power. The more informal the security setting, the less appropriate they are; non-experts routinely misuse PKIs. There is a great need for systems that can "bootstrap" their own secure communications spontaneously as and when required, without reliance on a PKI.

Face-to-face with a new security protocol

Researchers at the Department of Computer Science have invented protocols for securing an existing, but initially insecure high-bandwidth communication channel through the use of a second low-bandwidth channel. The Oxford method allows users to instantly create their own secure network without the use of a PKI. The key requirement is that this second empirical channel must not be susceptible to "spoofing". Perhaps surprisingly, it is not even a requirement that this channel cannot be listened-in to. Using an empirical channel is comparable to holding a face-to-face conversation where we know who it is talking to us, but are unconcerned who else is listening. The protocols, technically characterised as Hash Commitment Before Knowledge (HCBK), also make use of a 'digest' function to optimise the amount of security provided for a given amount of human effort. The digest function itself can be implemented extremely efficiently in either hardware or software. As a consequence, digest functions can be used independently of HCBK to improve methods for authenticating large volumes of data e.g. in the distribution of electronic content.

Range of applications

The HCBK protocols are demonstrably immune from many security threats including the notorious "man-in-the-middle" and "birthday" attacks. The Oxford approach is particularly suited to cases where either a high level of security must be created where none exists or where additional security, such as enhanced authentication, must be provided between several parties in an existing network. A good example of the first case is "coalition working", which allows individuals or parties to join together to create a secure network for a specific mission. The researchers have recently demonstrated how HCBK protocols can deliver a secure disaster management system with a map-based interface for operating in this scenario.

The key applications for the second case lie in providing additional security for financial transactions. Global credit and debit card losses due to fraud amounted to $7.6 billion in 2010 and these protocols have the potential to reduce this thorough enhancing security of card-present transactions and extending Chip and PIN security to online card-not-present transactions. The researchers have successfully demonstrated both these applications and others, including peer-to-peer payments between mobile phones.

Patent protection secured

The HCBK protocols and their applications are the subject of a number of ongoing patent applications. The application related to the protocol family itself has now been granted in the United States as US 8,230,229. This work is rated at Technology Readiness Level 4 as validation in a laboratory environment has been successfully completed. Video demonstrations of some potential applications for this technology are available on the researchers' website. Isis is looking for commercial partners interested in licensing this technology and its applications.

Web Link

HCBK Group in the Department of Computer Science:
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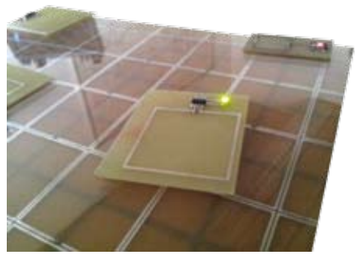
Cable-free connection

Dr Mark Gostock explores the endless possibilities of a world without cables and wires, made possible from simple and inexpensive Oxford technology that transmits power and data through free space.



Multiple devices powered wirelessly from a metamaterials platform

Hardwired copper cables have traditionally offered the most effective form of connection between devices to supply both power and data. Driven by a demand for convenience, wireless data transmission protocols have improved dramatically, whereas power transfer has mostly continued to rely on tethered, wired connections.

Wifi, Bluetooth and Mobile Data (3G, 4G etc) have all improved wireless data transfer and although some cable free charging systems exist, their power output and range tend to be very limited. No device currently offers the ability to wirelessly transfer power and data simultaneously over distance. However, technology developed at Oxford now provides a means to wirelessly power and exchange data using simple and inexpensive 'printed circuit board type' engineering.

Effortless connection

The Oxford innovation employs metamaterials, or materials that act as magneto-inductive wave guides and magneto-inductive power surfaces, allowing the rapid transfer of power and data between electronic devices without the constraints of physical connections such as soldered joints. The technology can be readily integrated into almost any surface, (desk tops, electrical devices, flooring, wallpaper, clothing etc) to provide an environment where data and power can be sent to any device in near proximity.

Homes and workspaces which have limited design layout possibilities due to the arrangement of hardwired power outlets can be reconfigured and redesigned effortlessly. Living rooms of the future could have stereo, home-cinema, TV, DVD and satellite box powered and linked through carpet and wallpaper. Office desks will be free of cables and leads as PCs, monitors, keyboards and printers will all connect and receive power directly after placing them on table tops. Travellers' luggage will no longer be burdened by power chargers, data cables and adaptors for laptops, phones and cameras. Mobile devices will be able to charge and connect wirelessly in airport lounges, cars, hotels, restaurants and coffee shops.

Smart clothing will also be a possibility, allowing for efficient 'body area networking'; headphones, mobile phones, cameras and music devices could all be linked up through clothing. Devices can be completely encapsulated, making them waterproof and robust. This characteristic makes metamaterials attractive for service in the military, aerospace, automotive and medical sectors.

Commercial opportunity

The technology platform forms part of a portfolio of National and PCT phase patent applications and Isis welcomes contact from parties interested in licensing this extraordinary technology.

We can have smart medical sensors in the form of a sticking plaster that can act as a diagnostic tool as well as powering something like an implanted insulin pump.

Benefits of metamaterial cable free technology:

- No wires or cables
- No limit to number of connected devices
- No vulnerable connectors to wear or disconnect
- No external connectors, for truly waterproof devices
- Simple and inexpensive PCB technology
- Integrated into almost any type of surface
- Woven into flexible materials and clothes
- Frequency tuneable and safe

Metamaterial technology may replace existing, often congested electrical/ data infrastructures in:

- Office spaces
- Domestic applications and home environment
- Consumer electronics
- Automotive industry
- Coffee shops, cinemas, restaurants etc
- Medical devices
- Aerospace and defence
- Clothing and fabrics

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Superior quality diagnostics

Dr Ruth Barrett showcases a new method by which electrochemical impedance spectroscopy (EIS) biomarkers of superior performance can be developed quickly and at low cost.

Point-of-care testing is an active area of research, the goal of which is to develop medical tests that are performed close to the patient as opposed to in central hospital labs. Accurate and meaningful results are returned to the clinician in minutes rather than hours or days in the case of tests carried out in central labs. This manner of 'bedside testing' allows for faster clinical decision-making, improved diagnosis or prognosis, better treatment choice, immediate patient counselling and a greater degree of certainty for both doctor and patient.

Electrochemical biosensors, such as glucose biosensors, offer a cheap, fast, portable and sensitive way of diagnosing and monitoring disease and as such are ideal for development into point of care tests. Of the electrochemical technologies available, electrochemical impedance spectroscopy (EIS) offers the most flexible and sensitive way of creating a diagnostic system comprising consumable sensors measuring multiple analytes in undiluted bodily fluids in one test within minutes, plus a point-of-care handheld or bench-top reader that reads the device and returns the results.

The Oxford invention

Oxford researchers have created a method by which EIS biomarker sensors of superior performance can be developed more quickly and cheaply than achieved by conventional methods. Software automatically applies the methodology; there is little need for user intervention and no need for post-analysis modelling. Through using the methodology, it is possible to calculate the concentration of analytes in biological liquids at high accuracy using impedance data, without having to interpret the data using an assumed 'equivalent circuit'. The use of equivalence circuits requires a considerable degree of knowledge of the electrochemistry at the relevant electrochemical interface – a hurdle to successful sensor development that this method completely avoids.

Broad applicability

This method is broadly applicable and so far has been validated using markers of inflammation and cardiovascular disease (CRP), diabetes (insulin) and neurodegeneration (Parkinson's disease markers) in patients' undiluted serum or CSF. Assays with a linear response have been successfully created over the full clinical range required in each case.

The invention can be applied to standard EIS hardware configurations without modification, allowing easy evaluation within potential partners' laboratories.

The invention can be applied to standard EIS hardware configurations without modification, allowing easy evaluation within potential partners' laboratories. The invention is being developed primarily for point-of-care use, but may also be applied to sensors for use in the field, or to detect food or water contaminants.

Clinical validation

Miniaturised sensing strips are being designed on which to show how the technology may be applied to panels of markers. Funding is being sought to develop a handheld or benchtop reader instrument. Collaborations are underway to prove the utility of the method through analysis of patient samples from large-scale multi-centre trials.

Patent portfolio

Isis has filed a UK patent application covering this method and, as yet, the work is unpublished. Patent filings around cardiovascular, diabetes and Parkinson's disease assays now in development will become available via Isis over the coming weeks. Isis would like to speak with companies interested in developing the technology to enhance their diagnostic or electrochemical programmes.

Use of the method results in an optimised sensor with:

- Maximised sensitivity
- Lower limit of detection
- Extended linear range
- Reduced coefficient of variance

Panels of markers may be read almost simultaneously whilst maintaining the above benefits.

This invention allows for lower sample requirements (<10ul) and the ability to follow smaller changes in analyte concentration over shorter times, empowering enhanced decision-making in the clinic.

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Cooking faster using less energy

Evert Geurtsen introduces a remarkable new pan design which increases the efficiency of the energy transfer from a gas flame into a vessel from 30 percent to 80 percent.

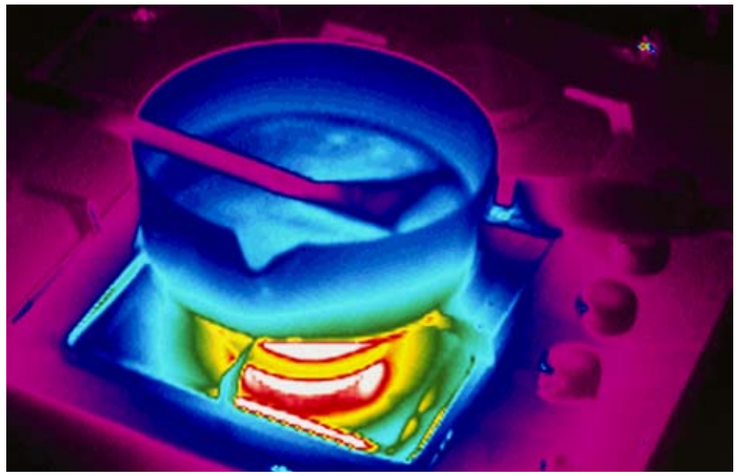
When it comes to energy saving, one area that is often overlooked is cooking. Nevertheless, this essential function represents 4 to 5 percent of the total energy bill of a typical household and that bill is now on average £1,252 per year – and rising. The majority of households use gas hobs and many cooks prefer gas over electric. Unfortunately, a typical gas pan only captures 40 percent of the available heat . Researchers in the Oxford Thermofluids Laboratory, part of the Engineering Science Department, have studied the heat transfer in cooking pans and as a result of their research developed a striking new pan design that reduces the fuel burnt by up to 50 percent. Moreover, it reduces boiling time dramatically; in one typical experiment the time taken to boil one litre of water reduced from 2 minutes, 50 seconds to 1 minute, 26 seconds.

Cooking pan designs have not changed much over many years. Typically, they will have a flat base and a circular side wall, designed to contain a volume within which liquid and foodstuffs can be heated. The researchers at Oxford recognised, however, that such pans, particularly when used on gas stoves, allow a large proportion of heat energy from the heat source to dissipate into the surrounding atmosphere rather than being captured by the pan to heat its contents. This results in the heating of the pan contents being far from efficient, wasting time and energy.

Based on extensive and detailed research and testing, the Oxford invention provides an improved heating pan design. The invention provides a special heat transfer structure so that more of the heat of the stove can be captured by this structure and conducted into the walls of the pan. This contrasts with existing cooking pans in which much of the heat from the gas flame and the heated air passing up by the side of the pan is lost. The increased heat energy available for heating the contents thus greatly increases the efficiency of the heating process. The design has been found to increase the efficiency with which energy available from a gas flame is transferred into the vessel from 30 percent to 80 percent, with the greatest benefit being obtained when the gas flame is largest, i.e. when the user wants the fastest cooking process.

The invention is particularly suitable for placing on a gas stove because of the resultant flame and hot air which pass up the side wall of the pan. However, pans in accordance with the design do not only work on gas stoves. The technology can be applied to a number of different heat sources such as hot plates, induction heaters, electric rings and halogen hobs. The invention can be used in any container which is suitable for heating liquid or food contents. Examples include, but are not limited to, cooking pans, frying pans, woks, steamers, pressure cookers, kettles and hot chocolate makers.

Isis is now seeking a partner to develop a product range based on the design, which is patent protected and design-registered. With demonstrably improved cooking times, reduced energy use and a striking visual design, this is an opportunity for a highly marketable new product.



Standard cooking pans do not use all the energy available to them, particularly from gas stoves.

The invention can be used in any container which is suitable for heating liquid or food contents. Examples include, but are not limited to, cooking pans, frying pans, woks, steamers, pressure cookers, kettles and hot chocolate makers.

References

[1] uSwitch Survey 2012
[2] Lawrence Berkeley National Laboratory(LBNL)

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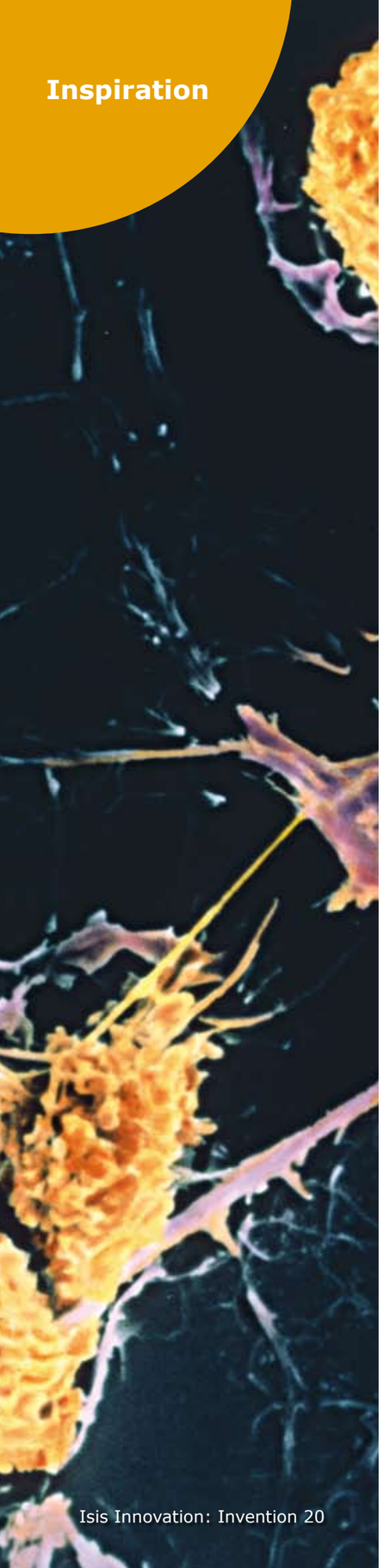

Multiple Sclerosis prognostic

Dr Natasha Tian introduces a method for distinguishing between different Multiple Sclerosis (MS) stages, thereby informing appropriate treatment.

The different clinical stages of MS vary in severity and are difficult to distinguish using clinical scales and magnetic resonance imaging due to low sensitivity, poor pathogen specificity and patient and clinician subjectivity. Ambiguous diagnoses hinder clinicians from administering treatment appropriate to the particular stage of MS at an early stage. Current disease-modifying agents, such as corticosteroids and interferons, only target inflammatory mechanisms that predominate during the relapsing phase. These are ineffective in progressive disease when disability accrues, yet patients may be treated inappropriately with therapies that cause serious side effects. Understanding differences between the MS phenotypes promises to identify key mechanisms driving progression, and is the first step in developing effective new therapies to prevent disability and offer early, tailored treatment.

Metabolite signatures

Oxford researchers have discovered metabolite signatures in urine and blood samples from MS patients that accurately predict MS disease stage (primary progressive, secondary progressive and relapsing-remitting) at the level of the individual. This is the first time that inflammatory biomarkers (indicative of relapsing-remitting MS) have been separated clearly from neurodegenerative biomarkers (indicative of the secondary progressive MS). This approach contrasts with previous studies that focused on measuring a single specific metabolite in biological fluids, which had low predictive value at the individual level. Further work is planned in larger cohorts to validate the metabolite signatures and establish links between pathology, clinical signs and individual metabolites.

Competitive advantages

- Accurate diagnostic and prognostic tool to distinguish between different MS stages with high specificity and sensitivity and inform appropriate treatment
- Objective clinical outcome measure to detect progression from relapsing-remitting to secondary progressive
- Surrogate biomarkers for evaluating neuroprotective treatments
- Non-invasive, cheap and high throughput method – metabolites can be measured from urine or blood samples without invasive tests or serial magnetic resonance imaging
- Potential to apply this metabolic profiling method to other neurodegenerative diseases

Commercial opportunity

MS affects over 2.5 million people worldwide with a global market size of $7.3 billion for MS treatments in 2009. Market revenue for MS treatments in Europe equated to $2.61 billion in 2010 with a projected increase to $4.85 billion by 2017, at a compound annual growth rate of 9.2 percent. The rate of disease incidence is also projected to rise, partly due to growing awareness of the disease. There is a strong need for accurate MS prognostic tests to track disease progression so that patients can be offered appropriate or new treatments as soon as possible after onset or according to their disease stage. In addition, there is a growing requirement for more sensitive clinical outcome measures for new therapeutics in development, such as new oral therapies.

Technology maturity/ patent status

A UK priority patent application has been filed for this technology, claiming an in vitro diagnostic/prognostic method for MS. Isis is seeking potential licensees and collaborators to develop and commercialise this technology.

Image: SEM of oligodendrocyte cell eaten in MS

How multiple sclerosis manifests itself

MS is a chronic incurable autoimmune disorder of the central nervous system. The disease causes the patient's immune system to attack myelin, which surrounds and insulates nerve fibres in the brain and spinal cord. Demyelination causes damaged 'sclerotic' areas to accumulate, disrupting the transmission of nerve impulses and leading to symptoms that may include loss of vision, difficulties with balance and coordination, spasticity and fatigue.

Disease course

From onset, MS follows either a relapsing-remitting or primary progressive course. Relapsing-remitting MS is the most common subtype, characterised by alternating periods of remission with mild or non-existent symptoms, and periods of sudden relapse. Over fifty percent of relapsing-remitting MS cases develop secondary progressive MS, where symptoms gradually worsen and periods of remission become less frequent or cease. Primary progressive is the least common MS subtype; symptoms become progressively worse with no periods of remission. Although inflammation generally predominates during the relapsing phase, whilst demyelination and neurodegeneration predominate during the progressive phase, this distinction is not clear-cut.

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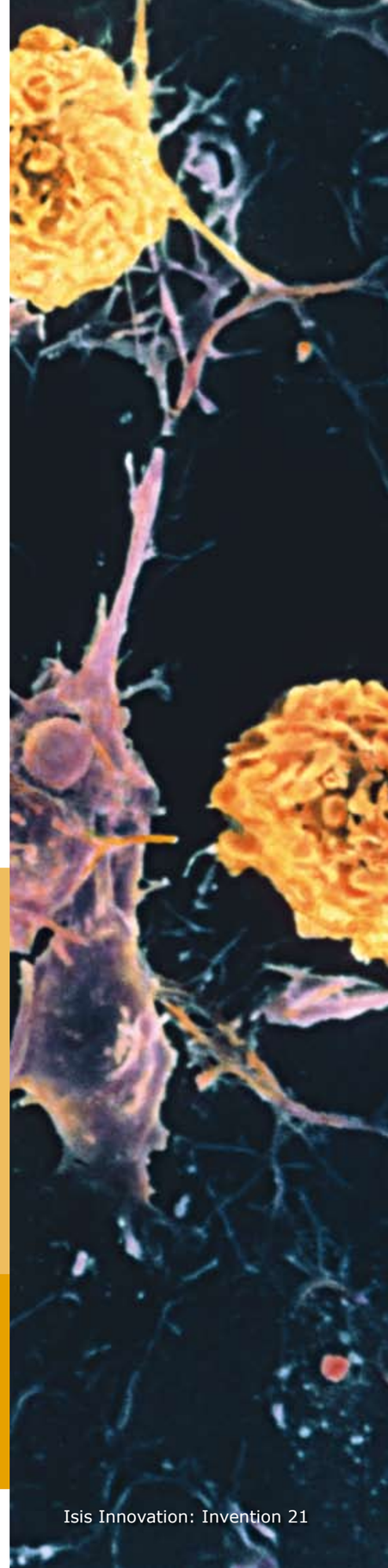

Antibodies against HIV-1

Dr Richard Reschen explains how a new vaccination strategy developed by researchers at the University of Oxford and the Karolinska Institute in Sweden may help in the search for an effective HIV-1 vaccine.

HIV-1 is responsible for one of the most devastating pandemics in history. Since the infection was first detected in 1983, 30 million people have died of Acquired Immune Deficiency Syndrome (AIDS), the end state of HIV-1 infection in untreated patients (Source: IAVI). Despite advances in anti-retroviral treatment, the pandemic is still spreading and for every three people who receive anti-retroviral treatment, five new people become infected (Source: IAVI; WHO). Additionally, it is expensive to treat people with HIV-1 medications, meaning a vaccine represents the only real solution for curbing the pandemic, particularly in impoverished regions with limited medical infrastructure such as sub-Saharan Africa. Scientists from the University of Oxford and the Karolinska Institute have now developed a vaccination strategy which may improve the body's ability to fight HIV-1 infection.

Most existing vaccines work by stimulating immune cells called B-cells, which produce antibodies against the immunogens found in the vaccine. Components of the Envelope (Env) protein of HIV-1 are usually the preferred target for HIV-1 vaccines because antibodies raised against the Env protein can target HIV-1 particles. In order for a vaccine to be effective against HIV-1, it must target a conserved part of the Env protein because HIV-1 has a high mutation rate and the target sites change rapidly. During the last few years, considerable knowledge has been gained about the binding sites for antibodies capable of neutralising a broad range of HIV-1 strains. However, there is still a knowledge gap as to how to focus B-cell responses to vulnerable conserved (unchanging) sites within the HIV-1 Env protein.

Using a new vaccination strategy, the scientists have generated antibodies which cross-react with a wide range of HIV-1 Env proteins and target vulnerable envelope regions, such that HIV-1 may not be able to bypass them. To generate broadly neutralising antibodies, researchers have tended to use sequential injections (prime and boost vaccinations) against different human HIV-1 Env proteins, in the hope that this will teach the body to produce antibodies that neutralise different strains. However, the researchers realised that the limited effectiveness of this strategy might be because the proteins were not sufficiently different. Using an animal model, they therefore decided to see what would happen if they vaccinated first with a human HIV-1 Env protein, and then with the Env protein from the Monkey Simian Immunodeficiency Virus (SIV). SIV is very similar to HIV-1 and has the capability to bind to receptors found on human cells (although it does not infect humans). This strategy proved able to generate antibodies which could neutralise a broad range of HIV-1 strains.

Additional work showed that particularly broad antibodies could be elicited if the booster vaccination consisted of a specific SIV Env protein known as SIVmac239. Most HIV-1 Env proteins can adopt numerous protein conformations, and scientists have previously hypothesised that this might be partially responsible for the poor antibody response to vaccinations with these proteins. This research has demonstrated that SIVmac239 is much more stable than equivalent human HIV-1 Env proteins, as it is stabilised by the presence of additional covalent bonds known as disulphide bridges. This may prevent it from adopting different conformations that obscure the vulnerable conserved regions, explaining why it makes such an excellent immunogen.

Licensing opportunity

This new vaccination strategy may represent an important step along the road to producing an effective HIV-1 vaccine. To be useful as a vaccine it will need to be combined with other components to stimulate a T-cell response, as an antibody-only response is not likely to be sufficient in preventing HIV-1 infection.
Isis Innovation is now looking for commercial partners interested in developing this technology further.

Image: HIV enzyme protein, molecular model

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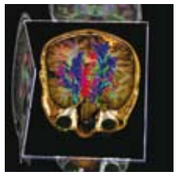
Particle accelerators… everywhere

From finding the Higgs Particle to treating brain disorders, the Department of Physics demonstrates how the same fundamental science solves deep questions about the universe while also tackling medical problems that afflict humanity. Oxford University Consulting's **Gurinder Punn** recounts a recent collaboration between the Department and an international cancer innovations company that underlines the range of their work.



Towards the end of 2011, Oxford University Consulting (OUC) was asked to assist the John Adams Institute for Accelerator Science, a division of the Department of Physics, to establish a closer working relationship with Elekta, a Swedish company that provides radiation therapy, radiosurgery, related equipment and clinical management for the treatment of cancer and brain disorders.

Elekta is the world leader in image guided and stereotactic clinical solutions for radiosurgery and radiation therapy, giving radiation oncologists and neurosurgeons an unmatched capability to aggressively treat tumours and functional targets with ultra-high precision while sparing healthy tissue.

Working with Elekta's teams in Crawley, OUC's involvement was to negotiate a contractual framework that would allow the Department of Physics to engage with Elekta's scientist on discrete projects in an open-ended arrangement. OUC would then manage the subsequent administrative project activity arising from each statement of work, arrange regular review meetings to discuss progress on existing projects and discuss new ones that could be developed, invoice Elekta upon completion of the work and ensure that the Department of Physics received the fees. Working in collaboration with their key scientist and Elekta's legal consul, OUC agreed a Consultancy Framework Agreement which allowed the first project to start early in 2012 and this has been followed by a number of others throughout the year.

John Allen, the Chief Scientist at Elekta, commented that the company are "pleased to be working with Oxford University Consulting and the John Adams Institute for Accelerator Research in the Department of Physics. They bring specialised technical expertise from their work on leading edge accelerator designs, which Elekta has been able to transfer to more commercial accelerators."

Oxford Physics

Oxford's Department of Physics is one of the largest physics departments in the world, employing about 475 people and recording an annual turnover of about £33m. The John Adams Institute is a centre of excellence for advanced and novel accelerator technology that is used in a host of areas including the LHC in CERN and hospitals around the world. There are a number of supporting activities within the Department that support the practical and experimental aspects of the cutting edge research into accelerator science and initially it was the Mechanical Workshop and the Electronics Group that were able to assist Elekta with their requirements.

The Mechanical Workshop provides manufacturing and technical support for projects, not only to the Physics Department but also all Departments across the University as well as industrial organisations. With modern and state of the art design and manufacturing facilities, the Workshop provides a wide range of precision components and large fabricated assemblies which are often required to operate in hostile environments.

The Electronics Group, operating in a similar manner to the Mechanical Workshop, specialises in custom design of electronics systems from prototype to small production runs. Encompassing design manufacture and commissioning of turnkey electronics systems, programming of logic devices, design, assembly and test of PCBs, and the assembly of fibre optic components, the Electronics Group has contributed to high profile research projects such as the ATLAS and LHCb projects for the LHC at CERN.

The relationship that has now been established between Elekta, the Department of Physics and OUC demonstrates that there is demand from the industrial sector to work with the Departments of the University of Oxford and that the skills, expertise, design manufacturing and test facilities within the University can add value to the activities of industry.

Images: border, particle rays; inset, brain tumour DTI and MRI scans

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The Kennedy portfolio

Isis Enterprise's **Gaurav Misra** and **Dr Sarah Bond** present a selection of biomedical patent families for licensing and collaborative development, which hold tremendous potential for improving patient outcomes across the world.

The Kennedy Trust for Rheumatology Research is a UK charity that funds the Kennedy Institute of Rheumatology, a leading research organisation that first identified the role of TNFα (Tumour Necrosis Factor-alpha) in the inflammatory processes active in rheumatoid arthritis. The Institute adopts a multidisciplinary approach using state-of-the-art services to bear on many aspects of a disease at once. Its size and reputation brings together a critical mass of scientists and clinicians, all with the common aim of discovering the underlying cause of rheumatic diseases, designing new therapies and organising clinical trials to test their effectiveness. In 2010, the Institute officially joined the Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences at the University of Oxford.

This world-leading team has accrued a number of granted patents in the field of immunology and intra-cellular communication. Isis Enterprise is looking for partners to work with the Kennedy Trust to take these discoveries further and into clinical and research practice. Parties interested in knowing more about these assets are encouraged to contact Isis Enterprise for further discussions.

Reduced Patient Mortality in Acute Coronary Syndrome (ACS) or Acute Stroke

These patents stem from the surprising discovery that inhibition of the biological activity of TNFα reduces fibrinogen and platelet levels, which play integral roles in the formation of blood clots. Reducing the concentration of platelets and fibrinogens in the blood will reduce the risk of thromboses, allowing crucial time to apply life-saving procedures. Modulation of this pathway can therefore be used to reduce patient mortality in a range of conditions such as ACS and acute stroke. These patents provide an opportunity for manufacturers of currently approved TNF-inhibitors to expand into another clinical indication. Alternatively, they may be used as a market-entry launch pad for upcoming follow-on biologics.

Platform for Vaccine Adjuvants

Despite advances in gene sequencing of many pathogens, there are still no effective vaccines for diseases that require an inherent, cellular-based immunity. The problem is widely acknowledged to be the lack of effective adjuvants to enhance vaccine immunogenicity. These patents propose that new adjuvant approaches must target the dendritic cells by up-regulating the NF-κB (a protein complex) at the time of vaccination. They further suggest possible types of agents spanning entire molecular pathways that may be employed to elicit the 'adjuvanticity', either directly or indirectly via Toll-Like Receptor signalling. The patents and related papers present data in murine models which needs to be validated in large animal systems where long-lasting memory is vital. The ability of this class of adjuvants to develop strong Th1 immunity and their lack of systemic toxicity suggest they have great promise for the future. Over 10 granted patents protect this invention in all major jurisdictions.

The agreement with the University of Oxford provides for the creation of a new Kennedy Research Institute on the University's Old Road Campus adjacent to the UK's largest musculoskeletal clinical centre, the Nuffield Orthopaedic Centre.

Effectively Screening Drug Candidates for Chronic Inflammation

The process of effectively validating drug targets for autoimmune conditions prior to human trials continues to be expensive with low probabilities of success. This patent family claims a method whereby the lead generation and optimisation stages of drug discovery are much improved, permitting drug developers to start clinical trials with a higher level of confidence.

For example, the method identifies compounds that selectively inhibit T-cell induced production of TNFα by monocytes. Such selective inhibition assures that the antigen receptor-stimulated T-cells are not inhibited by the compound, thereby enabling fast identification of drug candidates that warrant further testing. Such a compound could be an antibody that is effective for treating rheumatoid arthritis or other chronic inflammatory conditions. A patent covering this invention has been granted in the US and a broad basket of EU jurisdictions. The Japanese application is under examination.

Suppression of TNF-α and IL-12 in therapy

The invention covers a method of combining TNF antagonists and Interleukin-12 (IL-12) antagonists to derive greater efficacy via a synergistic co-administration. The claims may be employed to achieve a rapid and sustained reduction in the symptoms observed in TNF-mediated diseases such as Rheumatoid Arthritis or Crohn's Disease. The invention further details many vectors of the proposed co-administration, including formulations, compositions, dosing schedules, etc. A number of IL-12 antagonists are in development and trial phases, and this invention provides an additional application for such drug candidates.

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Oxford Innovation Society

Forthcoming meetings of the Oxford Innovation Society will be held on the following dates:

- Thursday 6 December 2012
- Thursday 21st March 2013
- Thursday 19 September 2013

Meetings are held in Oxford for OIS members and invited guests, and are followed by a formal reception and dinner in an Oxford college hall.

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