
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

Email : enquiries@innovation.ox.ac.uk

Issue 63 Spring 11

# Isis insights

The latest innovations, collaborations and technology transfer

## Healthy futures

Screening for discovery...

ISIS INNOVATION

# Ii Contents

Issue 63

# Healthy futures

## Screening for discovery...



Ii is produced by Isis Innovation Ltd, the technology transfer company owned by the University of Oxford. To receive your free copy of Ii, email innovation@isis.ox.ac.uk
**www.isis-innovation.com**

*Cover image: Ampoules, such as those used for packaging injectable medicines and vaccines.*

# Newsflash

## Technology Transfer – Spinning Out New Companies

*Building integrated photovoltaics*

Oxford Photovoltaics is the latest spin-out from Isis, based upon research in Oxford's Physics Department. Isis is responsible for managing the formation of new spin-out companies from the University of Oxford with the academic founders, on behalf of the University of Oxford. Isis raises the first round of investment into these companies, and in the last ten years Isis has helped create 58 new spin-outs from Oxford, raising a first rounds total of £40m. The Isis Angels Network provides opportunities for investors to learn of new opportunities to invest. Isis manages the Oxford University Challenge Seed Fund and the Oxford Invention Fund, which co-invest in first rounds with angel and seed investors.
*(See page twenty two for full story.)*

## Technology Transfer – Licensing

*Taste masking drug delivery technology*

Isis signed a licensing agreement with Oxford Nutrascience Group plc, the AIM listed medicine delivery systems developer. Oxford Nutrascience will develop and commercialise products utilising a taste-masking drug delivery technology developed by Professor Dermot O'Hare and colleagues in the University's Chemistry Department. The licence gives Oxford Nutrascience significant firepower to innovate and extend the lifecycle of existing branded generic medicines and soon to be off-patent APIs. "The superior taste masking of ibuprofen and ease of formulation delivered by Isis Innovation's drug delivery technology will enable us to develop next generation ibuprofen products for markets worldwide," said Professor O'Hare.
*(See page seven for full story.)*

## Oxford University Consulting & Nokia

*The secrets of online popularity*

Nokia commissioned Oxford University Consulting to put together a report into the secrets of online popularity. The Nokia Soci@lite Report, written by Dr. Bernie Hogan, investigates the secrets to the popularity of a new group of digital social media networkers named 'Soci@lites', defined as people with 5,000 friends.
*(See page seven for full story.)*

## Isis Enterprise

*SQUIDs from Ukraine*

A technology once used to locate submarines has been redeveloped by scientists at the Science and Technology Centre in the Ukraine into a vital diagnostic tool, Cardiomox, for cardiac disorders such as arrhythmias and arterial blockages. Isis Enterprise has been working with the Ukrainian inventors for two years to advance the commercialisation of this uniquely valuable cardiac diagnostic technology, which is already in limited clinical use in the Ukraine. Isis is seeking partners and investors to bring Cardiomox equipment to the market, to secure funding for further clinical trials in the UK as well as equipment production.

SQUIDs – superconducting quantum interference devices – were originally developed by two soviet weapons scientists for use in locating submarines deep in the ocean. Dr Volodymyr Sosnytskyy and Dr Illya Chaykovskyy realised that this technology could have potential uses in the diagnosis of cardiac conditions. The result is a system that has proved extremely effective for first level screening of patients at risk of heart disease, artery blockages and subtle heart arrhythmias that are often missed with the standard electrocardiogram (ECG) procedure.
*(See page thirty for full story.)*

The latest news from **Oxford University Consulting** and **Isis Enterprise**

# The Loop

## Isis Enterprise agrees Mexico research partnership

Mexico has launched a major technology commercialisation project involving four leading research institutes. Funded by Mexico's National Council for Science and Technology (CONACYT), Isis is partnering with the four institutes to assist them in structuring improved technology commercialisation operations.

The institutes involved are focussed on diverse technology and industrial segments including aerospace, automotive, consumer appliances and aquaculture. Three of the institutes, CIATEQ, CIDESI and CIDETEQ are located in central Mexico. The fourth, CIBNOR, situated on the southern tip of Baja, conducts research in aquaculture, fisheries, agriculture and land regulation by promoting eco-efficiency as well as sustainability.

Isis is advising the institutes on the optimum structure and procedures for the technology transfer offices, training managers and technology transfer staff, and evaluating and prioritising invention disclosures from the institutes. Robert Swerdlow and Chris Moody are providing Isis's consulting services in Mexico along with associate consultants retained for this project.

It is hoped that this will be the beginning of a long term relationship between these institutes, the Mexican government and Isis.

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## Social Sciences Division helps young people maximise their money

MyBnk MONEY WORKS

**Consultancy takes several forms and in Social Sciences this creates many opportunities for academics to make a real impact and contribution to society.**

Geoff Hayward – former Director of Research at the Department of Education – and his team are doing just that, appointed by Oxford University Consulting to work with MyBnk to evaluate and advise on the effectiveness of their programmes.

MyBnk is an award-winning educational social enterprise based in London, concerned with empowering young people to build the knowledge, skills and confidence to manage their money effectively and make enterprising choices throughout their lives. The organisation has worked with 25,000 young people in 150 schools and youth organisations over the last three years.

MyBnk run a number of educational programmes including MyBnk-in-a-Box, the first ever FSA approved independent banking scheme run for young people, by young people. Another scheme, the Savvy Savings Assembly, is described as a high energy informative assembly which gets teenagers thinking about saving.

"The work done by MyBnk is very important," says Geoff. "It has the potential to make a positive impact on the futures of young people in Lambeth by enabling them to develop their financial expertise.

"The work done by MyBnk … has the potential to make a positive impact on the futures of young people in Lambeth by enabling them to develop their financial expertise."

We are delighted to be working with them through this evaluation programme."

A particularly high profile MyBnk scheme is their Money Works Programme, a financial education programme designed to empower young adults aged 16-24, not in education, employment or training, to confront their money worries and gain financial control of their lives. Meanwhile their 'Uni Dosh Workshop' is aimed at students about to leave school or college to move on to university or independent living.

The study is being sponsored by JP Morgan Chase Foundation.

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

# The Portfolio

**Essential proteins in vaccine-related biomedical research**

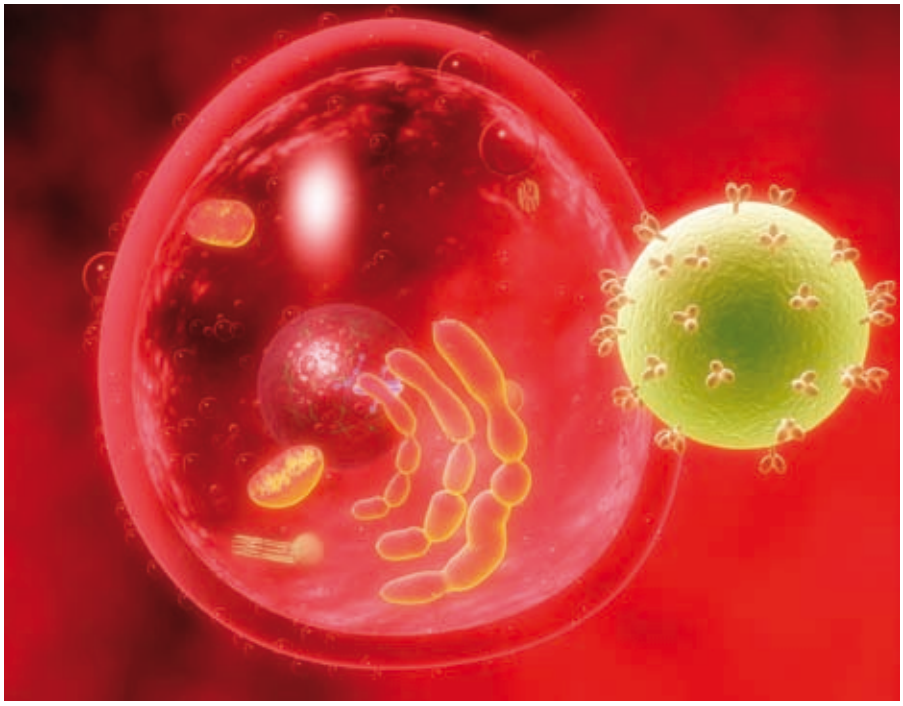
Oxford Immunogens, a newly emerging company set to spin-out of the University of Oxford, produces envelope proteins essential in vaccine-related biomedical research. Its current product portfolio contains over 20 products specifically targeted towards the HIV/AIDS research industry.

Over the last two years, Oxford Immunogens has generated over £160,000 of revenue supplying a single customer with the contents of this portfolio. The company now seeks to continue providing this product line to its existing clientele while expanding the customer base across additional research sectors, including academic, biotech/pharma, antibody production disciplines etc. as well as geographically.

Today, Oxford Immunogens has two managers: Guillaume Stewart-Jones, the company's Technology Advisor and Simon Bennett, appointed as CEO. Guillaume is a principal investigator at Oxford, whilst Simon has broad experience in developing businesses in the biotech sector. On formation, a laboratory technician will be hired to meet current orders, and the company has already identified a number of candidates for this position.

Oxford Immunogens requires an investment of £75,000 to rent and equip a laboratory to manufacture its first products outside of the University. The acquisition of capital equipment will be triggered by the first customer order, to be expected no later than the first quarter of 2011.

Oxford Immunogens also develops new synthetic routes to important Immunogens in HIV vaccine research and is able to do this at high gross margins: therefore increasing profitability significantly with growing volumes of sales. Subsequently, there is further opportunity to build a GMP-certified manufacturing facility in the future and the technology platform could be expanded to develop similar proteins for use in research of other diseases such as viral cancer.



*The HIV virus about to snag a host T-cell receptor in preparation to merge into the host T-cell's cytoplasm.*

The product has been tested and found to be of higher quality than current competitors, and the innovative approach to manufacturing allows it to be produced in an extremely cost efficient manner. So it not only enters the market at a higher quality, but also with low costs while maintaining margins.

Oxford Immunogens' business model suggests that it can be cash flow positive and in a profitable position at the end of its first year – which is very unusual for an early-stage technology investment proposition. By purchasing used laboratory equipment and renting local laboratory space, the business will be able to keep year one costs low. The company's business model anticipates that it will increase its revenues to £175,000 in the first year by employing its first formal business development function.

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# Technology Steps Forward

## Isis Outcomes reaches healthy landmark

**The Great Ormond Street Hospital for Children has become the 100th licensee this financial year of health questionnaires created in Oxford.**

These copyrighted questionnaires record Patient Reported Outcomes (PROs) for a variety of medical conditions from orthopaedic complaints to Parkinson's disease. The rate of adoption of Isis Outcomes' PROs has grown with the widespread recognition that they are the gold standard for studies requiring the measurement of patient reported outcome.

David Churchman of Isis Outcomes said, "We are very pleased to be able to assist the research at Great Ormond Street Hospital by providing the rights to use the Oxford Ankle Foot Questionnaire for Children. The achievement of this milestone is especially important to us as it is with such a high-profile and prestigious organisation."

Isis Outcomes is an activity within Technology Transfer at Isis Innovation Ltd, dedicated to the provision and support of the highest quality PROs for healthcare providers and the pharmaceutical industry. It manages a large library of over 100 translated versions of the Oxford PROs, commissions user support materials, such as manuals, and arranges consultancy advice to customers from PRO experts in Oxford.

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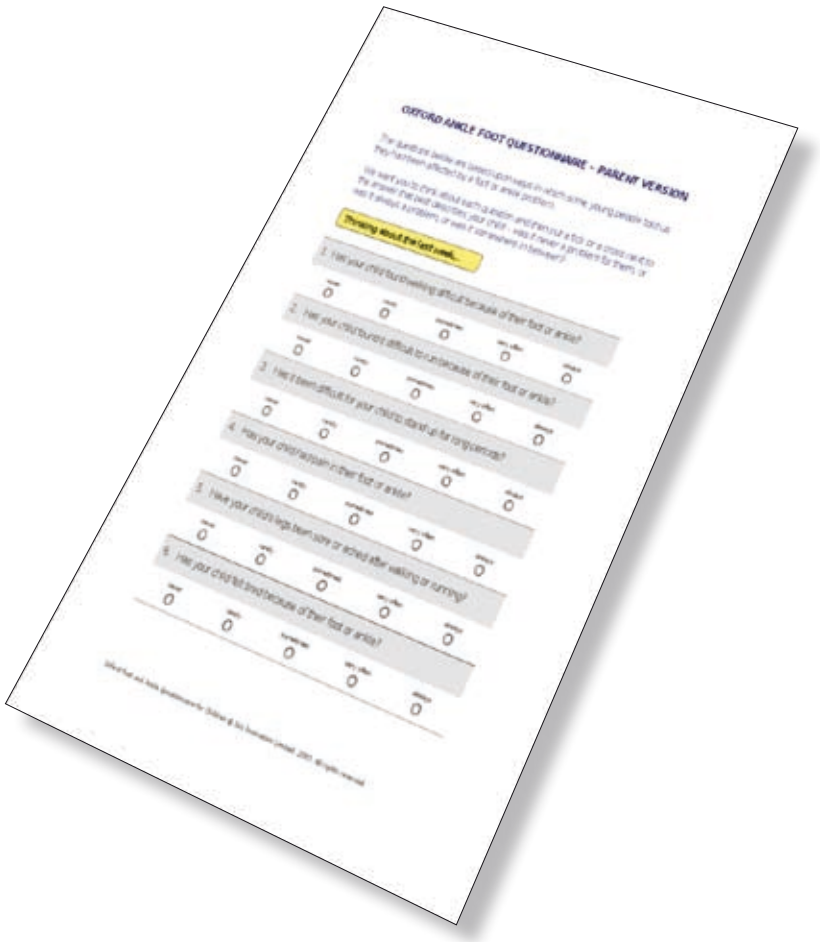
*See page 28 for a full profile on PROs.*




## ISIS and IXO to treat inflammatory diseases

**Isis Innovation is participating in the formation of IXO Therapeutics Ltd, a new biotechnology company formed to research and develop novel medicines from natural sources for the treatment of immune-mediated and inflammatory diseases.**

The new company, a start-up from the Natural Environment Research Council (NERC), is focussed on the development of intellectual property (IP) derived from both NERC and the University of Oxford, aims to develop recombinant protein products that will treat inflammation and diseases that affect the body's immune system. These proteins are all derived from natural sources and several are already being developed which will address unmet clinical and commercial needs.

The portfolio of products is based on the work of Professor Pat Nuttall's group at NERC's Centre for Ecology & Hydrology, in collaboration with research groups at the University of Oxford.

Professor Nuttall said, "The launch of IXO is an important step forward as the research is now at a transitional stage. IXO expects to develop and produce a number of anti-inflammatory compounds that will target diseases such as rheumatoid arthritis and psoriasis, conditions that are in urgent need of new clinical approaches."

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# The latest **licence agreements** signed by **Isis**

## Isis secures drug delivery tie-in with Oxford Nutrascience Group

**Oxford Nutrascience Group plc has signed a worldwide exclusive licensing agreement with Isis to develop and commercialise products utilising a novel drug delivery technology.**

The technology is applicable to a broad range of pharmaceuticals including major drug categories such as NSAIDS (Non-steroidal Anti-inflammatory drugs) and statins.

The drug delivery technology, which has been developed by Professor Dermot O'Hare and his research group at the University of Oxford's world renowned chemistry department, provides for outstanding taste masking, enhanced drug stability and potential for tuneable drug release properties.

"We're delighted to be working with Oxford Nutrascience on these exciting new developments," said Professor O'Hare.

Oxford Nutrascience has recently been developing taste masking for ibuprofen, a popular pain relief drug that is available over the counter (OTC), using Isis's drug delivery technology. The company has recently established proof of concept for the taste masking of ibuprofen, which has removed the typical burning sensation on the throat. Following the signing of the licence with Isis, Oxford Nutrascience is now proceeding to develop "no burn" chewable and liquid ibuprofen products which it intends to commercialise via the OTC and prescription markets.

Isis's drug delivery technology is currently protected by a patent granted in the UK, Germany and France and an application has been made for the US. The company is sponsoring research at the University of Oxford and is looking to file further patent applications during 2011.

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## OUC helps Nokia judge online popularity contest

**Surprising results from OUC research suggests that the most popular users of social networks like Facebook tend to dislike following crowds but enjoy outdoor activities.**

Nokia commissioned OUC to put together a report into the secrets of online popularity. The Nokia Soci@lite Report, written by Dr. Bernie Hogan, investigated the secrets behind the popularity of a new group of digital social media networkers named 'Soci@lites', defined as people with 5,000 friends or more.

The characteristics, social interests and average age of users with the highest number of online friends were accessed to form the unique profile of a Soci@lite, after the activity of social media users throughout 2010 was analysed. The Nokia Soci@lite Report also indicated – perhaps less surprisingly – that popular social network members frequently headed to online discussion forums.

The report was commissioned to celebrate the launch of Nokia's C7 Social Challenge, which offers Facebook users the opportunity to gather votes for themselves through Nokia's fan page.

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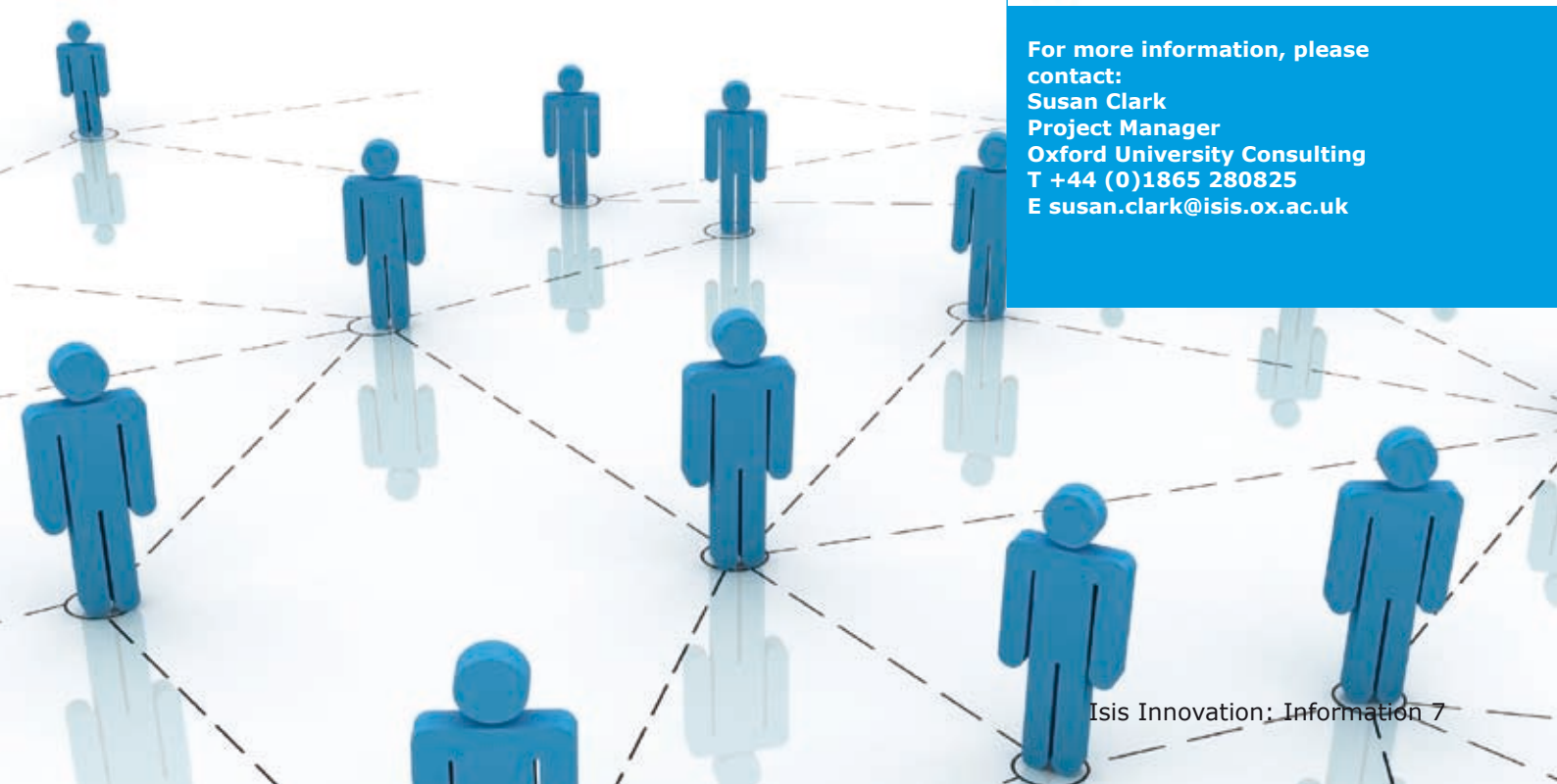

# Scouting for Success

Oxford Innovation Society member **The Dow Chemical Company** provides an insight into effectively managing innovation.

## Accelerating Innovation

As a world leader in applied chemistry, Dow is uniquely positioned to drive change by delivering innovative solutions to everyday problems. The company utilises a technology scouting programme that searches for early-stage, entrepreneurial companies with disruptive technologies or approaches to markets that are strategic for Dow. The scouting programme serves several corporate innovation groups including Dow Venture Capital (DVC), Ventures & Business Development (V&BD) and Dow Technology Licensing (DTL).

- DVC aims to accelerate Dow's new business growth through investing in high growth potential, private companies where Dow is a differentiated, strategic investor.
- V&BD is responsible for cultivating Dow's innovation pipeline and managing a portfolio of technology and business opportunities that position the company for growth.
- DTL provides leadership, management and expertise in the transfer of intellectual assets and technology inside and outside of Dow to strengthen current Dow businesses.

These entities are aligned and challenged with the common objective of accelerating the development of value creation opportunities for Dow.

## Energetic Enterprise

Dow is committed to finding and providing solutions to problems in order to help society. The company vision is to be both the world's most respected science-driven chemical company and also the most profitable.

Focused on four key global megatrends – infrastructure and transportation, energy, consumerism, and health and nutrition – Dow draws on its unique science capabilities and technologies to provide innovative products where they are needed most.

Innovations from Dow address current and emerging customer concerns including reducing greenhouse gas emissions, increasing fuel efficiency, reducing the cost of solar energy and delivering clean and safe water.

## Managing Innovation

Dow employs dedicated scouts who build relationships directly with innovation sources and networks, as well as fostering open innovation via Dow's external and internal innovation portals to indentify and collect opportunities. Dow's increasing innovation network includes employees, customers, universities, suppliers, government laboratories, financial institutions, entrepreneurs, R&D networks, research institutes and more.

A multilayered, formal screening process based on a multifunctional expert review is continuously applied to evaluate market value, technology differentiation and the strategic fit with Dow. High potential opportunities advance to a thorough value analysis performed by V&BD. Depending on the analysis outcome steps are taken towards business modelling and deal creation with the potential involvement of the VC and DTL groups.

## Championing Commercialisation

A successful recent product launch facilitated by the V&BD group involved HYPOD™ Polyolefin Dispersions, a unique dispersion of high molecular weight plastic in water. The product enables customers to create structures in new ways, eliminate the use of solvents and lower system costs.

This new technology is already having an impact on several key industries including the carpet industry. HYPOD™ Polyolefin Dispersions can facilitate easier recycling at the end of the carpet's life.

The dispersions also use less material, which may help preserve resources and energy. Carpet backing made with HYPOD™ Polyolefin Dispersions emits low odour and volatile organic compounds, key concerns for homeowners.

## Collaboration

Dow is constantly scouting the world for enabling technologies and opportunities to drive Dow's growth strategies.

A new website has recently been launched to boost collaboration and innovation. The Collaborate to Innovate site (www.dow.com/innovation) serves as an idea generation portal, welcoming innovative ideas, products, technologies, businesses and business models from a variety of potential collaborators including entrepreneurs, academia, customers and venture capitalists.

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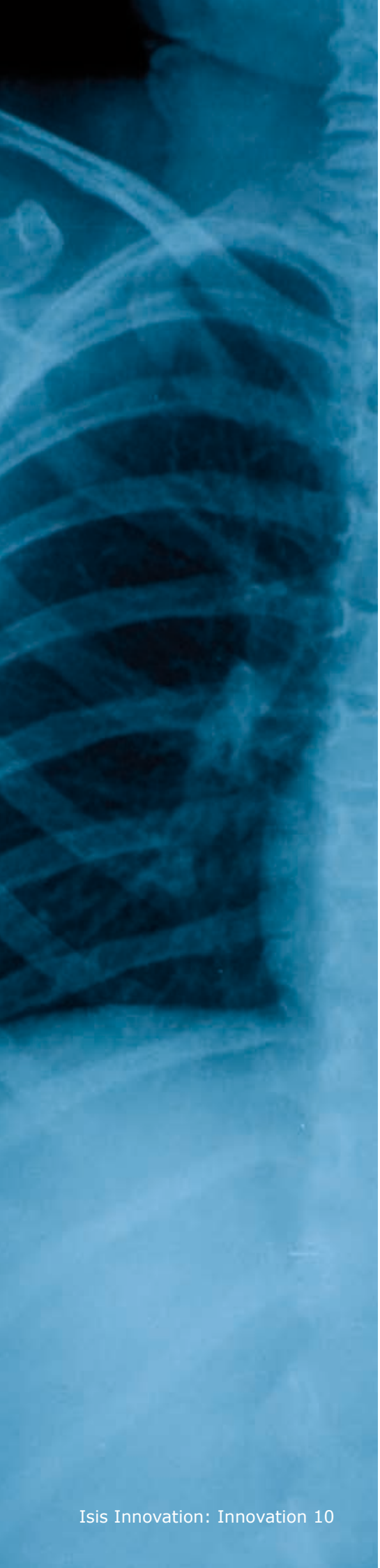

# Tackling Tuberculosis

**Dr Helen McShane,** of the Jenner Institute, discusses the development of a new TB vaccine being trialled in South Africa and why further research is now more important than ever.

## A vaccine for a new generation

Tuberculosis (TB) remains a significant cause of disease and death throughout the world. Despite the advent of effective antibiotics almost 50 years ago, the global incidence of TB has continued to rise over the last few decades, only beginning to plateau very recently.

An explanation for the continued impact of TB partially lies in the fact that only one licensed vaccine – *M. bovis* Bacille Calmette Guerin (BCG) – has been in operation since 1921. Over the last ninety years BCG has been administered to over three billion people throughout the world and is a well established part of the Expanded Programme on Immunisation in the developing world. When administered at birth, BCG confers consistent and reliable protection against disseminated disease in childhood. However, the protection conferred against pulmonary disease offered by BCG is much more variable and revaccination with BCG does not improve this protection.

It is important to understand the potential reasons for this variability in efficacy, as the University of Oxford develops a new vaccine attempting to overcome these issues called MVA85A. The vaccine candidate was awarded orphan drug status by the European

*Dr Helen McShane with Janenique Pienaar, the first baby vaccinated in the proof-of-concept efficacy trial of MVA85A.*

The vaccine candidate was awarded orphan drug status by the European Medicines Agency in 2008 and is the most clinically advanced of a new generation of tuberculosis candidates.

**The Oxford-Emergent Tuberculosis Consortium – a joint venture between the University of Oxford and Emergent BioSolutions Inc – was established to further develop MVA85A. For more on Emergent and OETC, see page 13.**

*Staff at the University of Cape Town using the new digital x-ray machine, bought on EuropeAid as part of phase IIa trials.*

Medicines Agency in 2008 and is the most clinically advanced of a new generation of tuberculosis candidates.

## Improving BCG with MVA85A

Exposure to non-tuberculous mycobacteria, which interfere with BCG, is one of the leading factors behind at least some of BCG's variability in efficacy. More recently, safety issues with BCG in HIV-infected infants have become apparent and there is an urgent need for a safer and more effective vaccine.

MVA85A is a recombinant strain of Modified Vaccinia Ankara (MVA) expressing antigen 85A, which has been developed by the University of Oxford as a booster vaccine for BCG. MVA85A first entered into clinical evaluation in 2002.

Twelve clinical trials with MVA85A have been completed and four more are ongoing. The early trials were all Phase I/IIa trials to evaluate the safety and immunogenicity of MVA85A in different populations. Safety and immunogenicity has been demonstrated in *Mycobacterium Tuberculosis (M.tb)* latently infected adults, HIV-infected adults and infants in trials conducted in the UK, The Gambia, South Africa and Senegal. Furthermore, MVA85A can improve BCG-induced protection in preclinical animal models.

At this stage, we do not yet know if the findings mean MVA85A will prevent the TB disease in humans. In the absence of an immunological correlate of protection – and validated preclinical animal models – the only method for determining how effective MVA85A is at preventing the TB disease is to continue with the large scale efficacy trial.

A proof-of-concept Phase IIb efficacy trial evaluating the protective efficacy of MVA85A in BCG-vaccinated infants is underway in South Africa. Another proof-of-concept Phase IIb efficacy trial evaluating the protective efficacy of MVA85A in HIV-infected adults will commence in early 2011.

## Trials essential in 21st Century

Significant progress has been made in the field of TB vaccines in the last 10 years. There are now 11 vaccines being evaluated in clinical trials, compared with none 10 years ago.

Two of these vaccine candidates are being evaluated in efficacy trials. To date there have been no significant safety concerns with any of these vaccines. However, the challenges for the next decade are clear.

The lack of an immunological correlate of protection, coupled with the lack of a validated preclinical animal model known to predict efficacy in humans means it is only

Safety issues with BCG in HIV-infected infants have become apparent and there is an urgent need for a safer and more effective vaccine.

*Infant at MVA85A vaccine trial visit in The Gambia.*

by conducting large, expensive and time consuming efficacy trials can we evaluate whether any of the new generation of vaccines prevent people developing TB.

Currently there is a very finite capacity to conduct such trials, both in terms of funding available and also regarding available field sites. It is only by conducting such trials can we begin to evaluate which immune responses and which animal models are useful in predicting which vaccine candidates are effective.

The importance of further research into possible new vaccines for TB is self-evident. Treatment of the disease currently takes a minimum of six months, while poor compliance is common and can lead to the emergence of drug resistance.

Strains of *M.tb* which are extensively and multi drug resistant can take up to two years to treat, compounding the global challenges in controlling this epidemic.

*Acknowledgements: Dr McShane would like to thank Wellcome Trust, Aeras Global TB Vaccine Foundation, EuropeAid and EDCTP for their financial assistance.*

The World Health Organisation's Global Plan to Stop TB, published in 2006, set some ambitious goals for the control of the epidemic.

Co-infection with HIV leads to a significantly increased susceptibility to TB disease and the geographical overlap between the TB and HIV epidemics further limit existing control strategies. One third of the global population is estimated to be latently infected with *M.tb,* at risk of reactivation of this latent infection, particularly if they become immuno-suppressed.

The World Health Organisation's Global Plan to Stop TB, published in 2006, set some ambitious goals for the control of the epidemic.

There was an important and explicit recognition that these targets would not be achieved without the development of new tools: new drugs, new diagnostic tests and new vaccines.

Ultimately, effective vaccination is the only efficient way to control any infectious disease epidemic and the only way any infectious disease has ever been eradicated.

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# Oxford-Emergent Tuberculosis Consortium Focus

A deeper insight into the partnership developing the world's leading TB vaccine candidate, by **Dr Adam Stoten, Deputy General Manager of OETC,** and **Dr Stephen Lockhart, Senior Vice President of Product Development at Emergent BioSolutions.**

The Oxford-Emergent Tuberculosis Consortium Ltd (OETC) was established in 2008 by Emergent BioSolutions Inc (Emergent) and the University of Oxford as a joint venture to further develop the most clinically advanced new vaccine for prevention of tuberculosis.

TB is one of the world's most damaging infectious diseases, with over nine million new cases and approximately two million deaths each year worldwide.

Current vaccines and drugs have failed to control the TB pandemic and – with increasing levels of drug resistance being seen in the clinic – new vaccines and drugs are desperately needed.

The joint venture structure represents a unique approach to commercialising new vaccines, combining academic and industrial expertise to address the myriad challenges inherent in TB vaccine development.

The vaccine being developed by OETC, MVA85A, was created by Dr Helen McShane, Professor Adrian Hill and colleagues at the University's Jenner Institute in 2000.

Clinical testing of the vaccine commenced in 2002 and by 2008 several relatively small clinical Phase I and Phase II trials had been conducted. These trials demonstrated that MVA85A was safe and well-tolerated by different populations and induced the type of immune response thought to be required for prevention of TB.

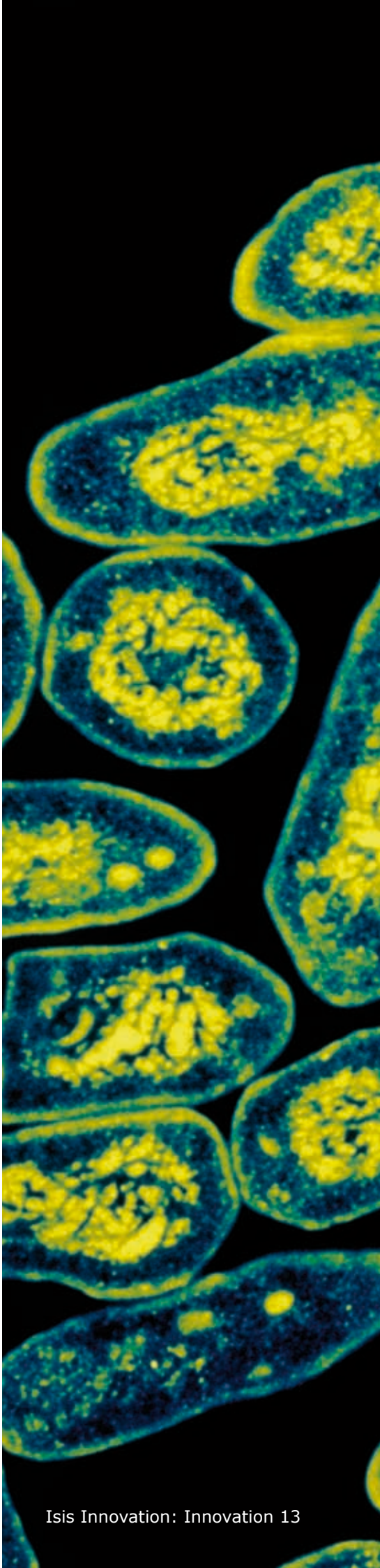
*OETC and Emergent BioSolutions delegation outside Brewelskloof Hospital, South Africa.*

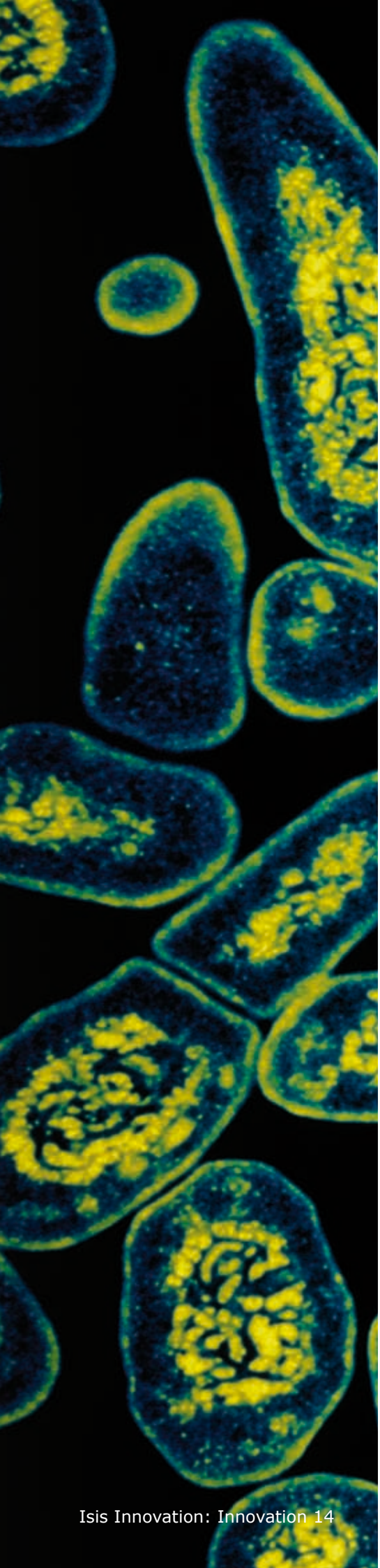
However, whilst data from the clinical trials were encouraging, major obstacles remained before MVA85A could be approved for use to prevent TB in vulnerable populations.

Firstly, a large clinical efficacy trial was needed to show whether the immune response induced by the vaccine would translate into protection from disease in infants.

Secondly, a new manufacturing process was required in order to ensure that the vaccine could be produced in sufficient volume to meet global demand.

A new, large scale, cost-effective manufacturing process was therefore needed, bringing together new technologies including continuous cell-lines for viral growth and disposable upstream/downstream processing.





## Emergent has a proprietary development programme using MVA and was already developing a commercially viable manufacturing process for MVA-based vaccines.

*Annie Brown Clinic in Ceres, near Cape Town, South Africa.*

The MVA85A used in clinical trials to date had been made using a process reliant on supply of eggs. While egg-based methods for vaccine production are not uncommon (e.g. in influenza vaccine manufacturing), this approach was unlikely to be suitable for a new TB vaccine for which demand could exceed 100 million doses each year.

A new, large scale, cost-effective manufacturing process was therefore needed, bringing together new technologies including continuous cell-lines for viral growth and disposable upstream/downstream processing. In addition to the manufacturing challenges, a large regulatory package would be required for global markets, including trials of MVA85A made using the new manufacturing process.

These activities are not typically undertaken within academic institutions, with the scale of required resources and expertise usually only found within biopharmaceutical companies.

This was recognised early on within the University and, in parallel with the scientific development of MVA85A, Dr McShane and colleagues were also working through Isis to identify potential commercial partners.

One such company was Emergent. Emergent is a US-based biopharmaceutical company which makes and sells BioThrax®, the only FDA licensed anthrax vaccine. On the basis of this profitable business, Emergent has acquired a development pipeline including vaccines and biotherapeutics focussed on infectious diseases, oncology and autoimmune disease, and has facilities in the USA, UK, Germany and Singapore.

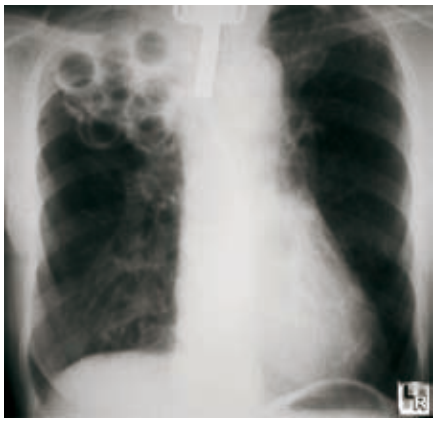
Emergent also has a proprietary development programme using MVA and was already developing a commercially viable manufacturing process for MVA-based vaccines.

While a potential licensing agreement was initially discussed with Isis – under which Emergent would take over development of the vaccine – it became clear that ongoing Oxford involvement would be of great benefit to the programme. Dr McShane is an international expert in TB vaccines, has a large network of expert colleagues and is well known to key funders of TB vaccine development.

Both parties concluded that a joint venture would be the optimal structure in which to combine their respective skills and talents, and in which to address both developing world and commercial market needs.

The joint venture benefits from University contributions of intellectual property, clinical expertise in TB vaccines and vaccine materials, and from Emergent contributions of funding, product development expertise, personnel and manufacturing capability.

The involvement of a commercial partner also enabled the University to secure funding for the infant efficacy study from the Wellcome Trust, a long-standing funder of the vaccine, and from the Aeras Global TB Foundation (Aeras). Consequently, Aeras and the Wellcome



*Plombage: pre-antibiotic treatment of inserting plastic balls into the chest cavity to squash the lung, stop air going into it and therefore killing TB.*

Trust, although not shareholders in the joint venture, remain important partners of OETC. Aeras has the distribution rights for the supply of the vaccine to developing world countries.

The process of OETC's formation and in particular the excellent working relationship built between Isis and Emergent also serves as evidence of the importance of a well-established and experienced technology transfer office, able to adapt and think creatively about the best route for commercialisation of a given technology.

OETC is a largely virtual company with day to day operations overseen by a General Manager and Deputy seconded from Emergent. They are supervised by a board of directors appointed by Emergent and the University.

Considerable investment is devoted by OETC to the management of multiple relationships between OETC and its partners, while regular communication takes place at the level of project teams and steering committees.

Significant progress has been made since OETC's formation. Enrolment in the infant efficacy study is almost complete and, after securing a grant from the European Developing World Clinical Trials Partnership, an efficacy study in HIV infected adults is to start shortly.

## OETC is able to apply Emergent's industrial experience to large scale manufacturing and product development while retaining the knowledge and expertise of University researchers.

Transfer of the new manufacturing process to a cGMP facility is progressing well and several regulatory agency meetings have been held to define the route forward. The experience with OETC has been very positive; so much so that Emergent recently initiated another joint venture, this time with an academic group in Singapore – Temasek Life Sciences – to create an MVA-based influenza vaccine and an H5N1 therapeutic.

In summary, the joint venture approach has been very successful. OETC is able to apply Emergent's industrial experience to large scale manufacturing and product development while retaining the knowledge and expertise of University researchers. OETC looks forward to continued success in developing what will hopefully be the first new TB vaccine to be marketed in more than 80 years.

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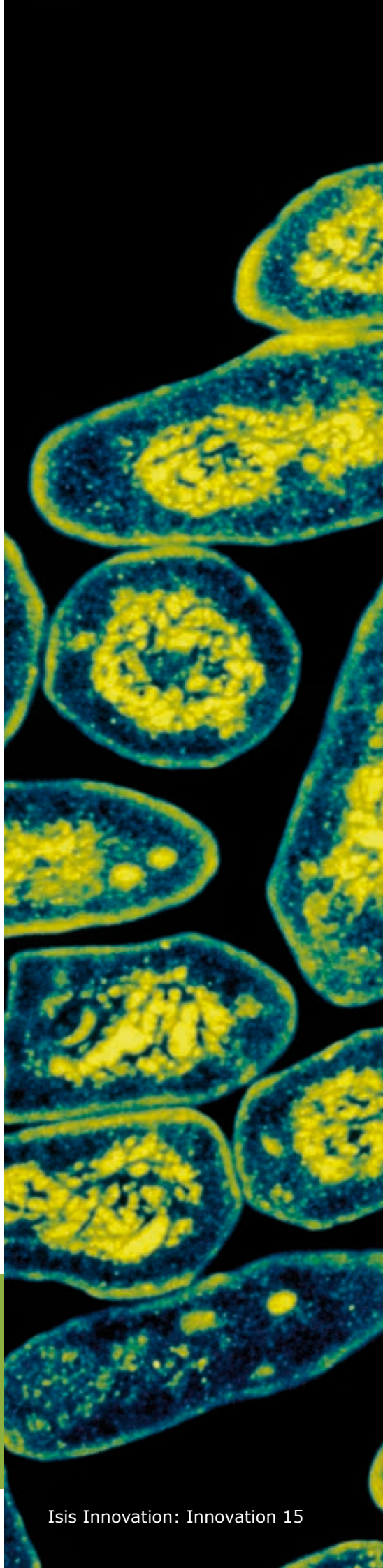

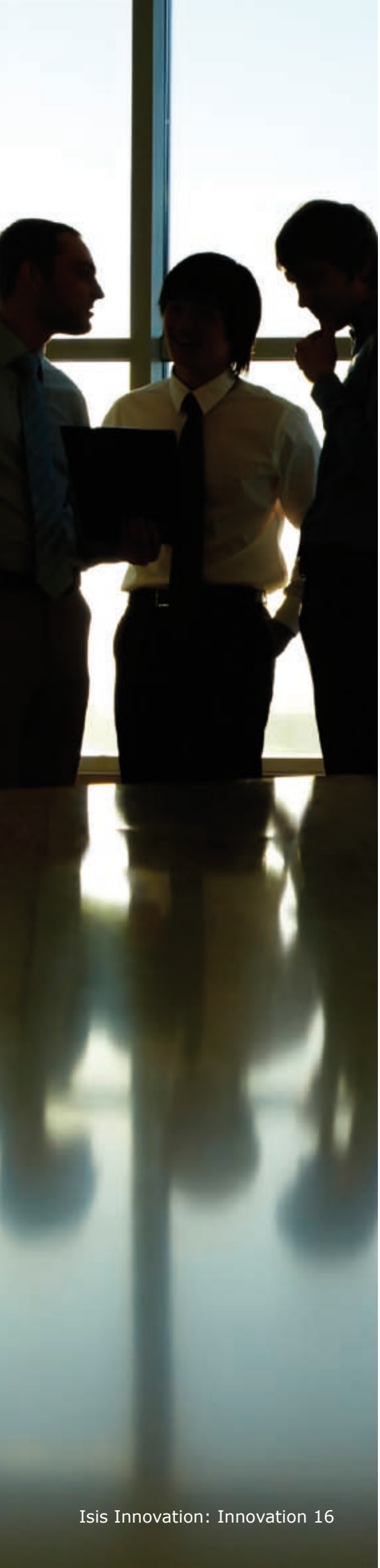

# Inside the Incubator

**Roy Azoulay** describes how an exciting new Isis initiative will offer IP advice and mentoring to emerging software ventures originating from the University of Oxford.

## Introducing the Isis Software Incubator

Isis Innovation has an outstanding record of commercialising Intellectual Property (IP) from the University of Oxford. A steady stream of spin-out companies benefit from the CEOs, management teams and supportive investors Isis is able to attract to exploit IP in a dedicated venture.

Software IP based on copyright is on the increase and Isis recognises that it is rarely weighed down by the usual expenses of patents or the need for research facilities, product design, validation and trials. Meanwhile, Isis understands that early stage software developers often benefit from opportunities to carry out some significant technical or commercial development, in order to create sustainable businesses. With this in mind, Isis has recently launched a new initiative called the Isis Software Incubator.

## Types of Ventures

The Incubator has been designed to offer appropriate support to emerging software ventures for development of products or services and to assist them with trading without external investment.

At the point of entry to the Incubator, the key characteristics of the candidate ventures are:

- **Oxford input copyrighted IP:** The venture should be based on non-patented copyrighted IP which originated at the University and can serve as a platform for the venture's product or service.
- **No investor needed:** The Incubator is targeted at ventures that do not need initial financial investment to achieve trade revenue to sustain the venture, to develop a product or service, or make it a viable trade-sale target.
- **Entrepreneurs / founders:** The Incubator targets entrepreneurs or founders that have a connection with the University of Oxford, who are willing and able to commit significant time and effort to the development of the venture instead of the usual professional management team. It welcomes in particular students and ex-students, as well as researchers. A typical individual may be coming towards the end of their time studying at the University, or reaching the end of a University post such as a post-doctoral position, and wishing to use the opportunity to develop their work into commercial reality.

## Stages of entry into the Incubator

Ventures that are accepted for support from the Incubator may be at three distinct stages of development:

Two companies have already been admitted into the Incubator, both of whom are commercialising deals in the UK and the US.

## Importantly, the Incubator offers assistance with identifying and reaching out to potential clients.

**Stage 1:** Pre-incorporation operation; the venture is not yet registered as a limited company and operates partly as an Isis project. The length of time spent in this mode will determine the University's equity holding in the venture.

**Stage 2:** Incorporated without external investment; the venture is registered as a limited company, has no initial need for external investment, but continues to enjoy the services of the Incubator.

**Stage 3:** Incorporated with external investment; the venture is registered as a limited company and has external investment.

### Advantages for new ventures

Incubator services include commercial mentoring through regular board meetings, IP advice and management and discussions that take place under Confidential Disclosure Agreements.

Ventures not yet established as limited companies also benefit from services such as accounting and insurance. The Incubator can also act as a shop window for new ventures, creating a web presence and handling business enquiries.

Importantly, the Incubator offers assistance with identifying and reaching out to potential clients, help with applications to the University Challenge Seed Fund for financial support, and support in the search for CEOs and investors where appropriate.

Advice on the creation of a limited company and help with necessary legal documents is also available.

An Isis project manager will help each venture with any existing obligations to the University and its funders and the use of existing University owned IP, allowing the entrepreneurs to concentrate on the development of their product and business.

All of these elements are of crucial importance to a newly created company emerging from the University of Oxford.

### Flying Start

Although only recently launched, the Incubator has already generated an overwhelmingly positive response.

Two companies have already been admitted into the Incubator, both of whom are commercialising deals in the UK and the US. Three additional companies are in the process of finalising admission into the Incubator.

The Incubator welcomes all enquiries or new applications. For an informal and confidential discussion please contact Roy Azoulay.

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# Transformers: magnets in disguise

**Dr Mark Gostock** reveals how ultra lightweight magnetic metamaterials developed at Oxford could transform electrical devices and power conversion.

## Heavyweight contenders

Ferromagnetic materials have traditionally been used in electrical power machinery such as transformers, motors, actuators and generators. Although relatively inexpensive, the iron cores of such devices are often bulky and very heavy, limiting their utility in certain applications. The Oxford invention uses metamaterials whose electromagnetic properties are structurally engineered from split-ring resonators as a low cost, lightweight alternative to conventional magnetic materials defined by their chemical composition.

Metamaterial technology allows construction of devices which mimic the effects of ferromagnetic materials as used in magnetic circuits. Being made from resonant electrical loop arrays in which the sum of the parts, not the parts themselves, define the overall behaviour, metamaterials are applicable to a range of systems whilst being very light, cheaper and more adaptable than traditional electromagnetic devices.

While the largest market share in 2007 was with electromagnetic materials, worth an estimated $102.5 million, recent reports suggest the global market for metamaterial applications may reach $2.6 billion by 2013.

## Next generation motors

Magnetic metamaterials exhibit a frequency dependent magnetic permeability which varies between positive (ferromagnetic) and negative (diamagnetic). This unique property could be utilised, for example, in highly sensitive equipment where it is desirable for the metamaterial core to filter unwanted frequencies from multiple systems drawing current from the same source, and therefore prevent coupling mechanisms. The flexibility of design offered by metamaterial technology also means many limits of operation can be addressed, particularly where weight is critical such as in the aerospace and automotive industries.

The major motivation for using metamaterial cored synthetic magnetic transformers over iron cored transformers is their ultra lightweight, convenient and portable nature, improving many design applications. Large radio amplifiers could see a significant reduction in weight, making transportation much easier. The metamaterial core is ideally suited in motors where very large electric systems, such as those needed in ships, often have their size limited by the inability of the craft to cope with such massive loads of iron. Furthermore, metamaterials provide a blueprint for new motor configurations, having faster responses that exploit repulsive as well as attractive forces, facilitated by easy switching of the driving signals.

Resonant behaviour of such structures also offers the possibility for construction of sound to RF transducers with greater response speeds than existing techniques. In such designs, sound waves causing

Metamaterials provide a blueprint for new motor configurations.

mechanical oscillations in stacks of resonators may add sidebands to an RF signal propagating through them by phase modulation. Such structures may be engineered for remote microphones, sound imaging surfaces and similar devices.

With the absence of large masses of magnetic material, power electronics will benefit from the use of metamaterials because of their lightness, zero saturation magnetisation and operation at much higher frequencies. In essence metamaterials offer the following advantages:

- Lightweight
- Frequency selective
- Non-magnetic, hence can be used in MRI machines
- High-frequency – 200 kHz
- Switchable magnetic properties

## Patent Status

Isis have an international patent application (PCT/GB2010/052039) for this research and would like to talk to companies or investors interested in commercialising this opportunity.

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# Testing, Testing

**Dr Weng Sie Wong** explains how a hydrophilic plug developed at the Dunn School of Pathology will enhance the reliability of test-tube drug research.

## Problematic proteins

Researchers investigating the relationship between abnormal proteins and human disease have made a discovery that has dramatic implications for a broad range of assays commonly used in research and drug development.

The research also has important implications for biologic therapeutics manufacturing processes in which protein aggregation is an unwanted by-product.

A fundamental understanding of the mechanism of action of any disease is key to developing effective new treatments. The long and expensive drug development process begins with *in vitro* (outside a living organism) studies.

These have the benefits of being cheap, reproducible and within a controlled environment, but often suffer from not being similar enough to the physiological environment to be predictive of the *in vivo* (whole organism) response.

*In vitro* screening assays are usually carried out in test-tubes, dishes, flasks and multiwell plates with liquid surfaces exposed to air.

This introduces a large flat hydrophobic surface into the assay affecting the conformation and partitioning of all assay components. Within the tissues of the body there are no such air-water interfaces and so these assay conditions are an inaccurate model of the physiological state.

Until now this issue was largely ignored. However, Oxford researchers have recently demonstrated that removal of the air-water interface completely changes the results of assays screening for modulators of protein aggregation[1].

The researchers' results have proved to be strongly predictive of *in vivo* results, underscoring the importance of the invention. This research also demonstrated that occlusion of the air-water interface dramatically reduces the rate of protein aggregation.

There has been a huge growth in the biologic therapeutics market in recent years, with a shift away from small molecules. A common problem that is encountered during the manufacture of biologic therapeutics is protein aggregation.

Protein aggregation is undesirable as these aggregates may cause an immunogenic response in the patient or other side effects resulting from administration of particulates of the drug.

Whilst insoluble aggregates may be simply removed by filtration, soluble aggregates are more difficult to remove and the processes to do so are costly.

Simple, cheap methodologies to prevent or minimise the formation of these aggregates are required to reduce the cost of manufacture.

## Physiological environment

The global, active pharmaceutical ingredients market was valued at $78 billion in 2008 with over 1,000 participating companies[2]. Patient demand for safer and more effective drug treatments continues to drive

There has been a huge growth in the biologic therapeutics market in recent years, with a shift away from small molecules.

## The global, active pharmaceutical ingredients market was valued at $78 billion in 2008 with over 1,000 participating companies.

market growth but there is also increasing pressure to lower the cost of new treatments.

Historically the high cost of drug development is due to the high attrition rate and increasing magnitude of cost at each step of the process. The lack of similarity between *in vitro* assays and the physiological environment is one of the factors that contributes to this high cost and can lead to the erroneous identification of new drug candidates, which subsequently fail in follow-on studies.

*In vivo* studies are also significantly more expensive than *in vitro* studies so the more research that can be conducted *in vitro*, the lower the overall cost.

## The method has been demonstrated in the field of protein aggregation using apparatus produced in a small laboratory workshop.

### Plugging the gap

The Oxford invention is an apparatus and method for removal of the air-water interface by using a hydrophilic plug to occlude the exposed liquid surface.

The technology is likely to be of interest to:

- researchers using *in vitro* assays, particularly those involving proteins
- manufacturers of laboratory consumables, particularly multiwell plates
- manufacturers of multiwell plate readers
- drug development and contract research companies
- manufacturers of biologic therapeutics

### Status

The Oxford method and apparatus is the subject of an international patent application. The method has been demonstrated in the field of protein aggregation using apparatus produced in a small laboratory workshop.

Isis is seeking commercial partners to explore the potentially large market of end-users across a broad range of research and drug development applications.


1. *FASEB J. 2010 Jan;24(1):309-17 Competing discrete interfacial effects are critical for amyloidogenesis*
2. *Frost & Sullivan, September 2009*



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# Spring Clean

Isis offers a diverse and growing portfolio of pioneering clean technologies to generate, store and manage energy, from carbon capture to solar energy. Isis's **Evert Guertsen** explains.

## Carbon capture and storage

Carbon capture and storage (CCS) is a very promising method for reducing the impact of carbon dioxide on the environment. This is of particular importance during the transition from fossil fuels to renewable energy.

According to the Department of Energy and Climate Change, "CCS has the potential to reduce the $CO_2$ emissions from power stations by around 90% and make a significant contribution towards the UK and international climate change goals." However, carbon capture and storage has remained extremely challenging due to the kinetically and thermodynamically unstable nature of $CO_2$. Oxford researchers have developed a novel, efficient process for the hydrogenation of $CO_2$, turning $CO_2$ into methanol. This innovative process stores $CO_2$ from the atmosphere and converts it into a usable chemical structure that is in high demand in the manufacture of certain chemicals and in the production of clean fuels. Value is therefore created at both ends of the market.

## Solar energy generation

Researchers from multiple departments in Oxford have made significant advances in increasing the efficiency of solar energy generation.

The Department of Chemistry has developed new transparent conducting oxide materials that offer comparable transparency and conductivity to indium tin oxide– the material currently used – but at significantly lower manufacturing costs. This innovation has the potential to lower the cost of manufacturing for all sorts of common products such as LCD displays, and one of the most promising applications is in the manufacture of solar cells. These materials have the potential to drastically increase the economic efficiency of generating energy from the sun.

## Energy data management

An important strategy for reducing the impact of carbon emissions on the environment is to empower consumers with detailed data about their current and projected energy consumption. Researchers from Oxford's Environmental Change Institute have developed novel data systems that incorporate weather patterns to help individuals and small businesses improve the management of their energy consumption.

The researchers have made their technology widely accessible to the public on the web through the IMeasure and SMEasure websites. With this data consumers have been able to lower their usage and reduce energy costs. The team has also begun to develop partnerships with utility companies and government agencies around the world to improve knowledge about local energy use.

## Spin-outs

Isis has facilitated the launch of several new clean technology spin-outs from the University. Four, in particular, are poised to redefine their market sectors. Yasa Motors is developing the next generation of high-torque electric motors for vehicles; its most recent prototype demonstrated a range of up to 200 miles and the ability to accelerate from 0-60 mph in less than six seconds. Navetas has developed innovative new smart meters that allow consumers to effectively manage their energy consumption

## The team has begun to develop partnerships with utility companies and government agencies around the world to improve knowledge about local energy use.

with a full product line of hardware and software applications. Kepler Energy has developed a novel tidal energy turbine design. Kepler is now in the process of building a scaled trial device for the next stage of design validation.

Most recently, Oxford Photovoltaics was formed to develop a revolutionary solar cell technology that is manufactured from cheap, abundant, non-toxic and non-corrosive materials and can be scaled to any volume. Harnessing the sun's energy, the solar cells are printed onto glass or other surfaces, are available in a range of colours and could be ideal for new buildings where solar cells are incorporated into glazing panels and walls.

Other innovations in clean technology managed by Isis include advancements in efficient heat conversion, production of alternative biofuels, hydrogen storage, and wind power generation.

### Weblinks

- www.imeasure.org.uk
- www.smeasure.org.uk
- www.isis-innovation.com /licensing/cleantech.html

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# Fluid Thinking

**Andy Self** explains how a new invention will help a cross section of society ranging from surgeons to engineers.

Researchers from the Institute of Biomedical Engineering (IBME) at the University of Oxford have developed a novel, scalable acoustic separator with many uses, but perhaps of particular relevance to those undergoing heart surgery.

## Unclogging the process

Particle separation is most commonly achieved by conventional membrane filtration, which presents the disadvantage that particles can only be separated on the basis of size and offers no solution to separating and manipulating different particles of similar size. Membrane filtration can also be slow and prone to clogging.

Centrifugation devices offer a density-based alternative, but these usually require a minimum initial volume to work and can only operate in batch mode, rather than in continuous flow.

Now, an acoustic separator has been created which enables the separation and manipulation of particles on the basis of their acoustic properties – density, compressibility and size.

## Riding the wave

The device uses a quarter ultrasonic standing wave, which enables particles to be separated from either pressure nodes or anti-nodes.

Through the clever use of radial flow, the device has been designed to be scalable, whereby the throughput can be increased merely by increasing the radius of the separator.

The device is also capable of continuous flow, a major time saving advantage over filtration and centrifugation techniques. Computational fluid dynamics have been used to develop and optimise a prototype device, which is being tested in a biomedical application.

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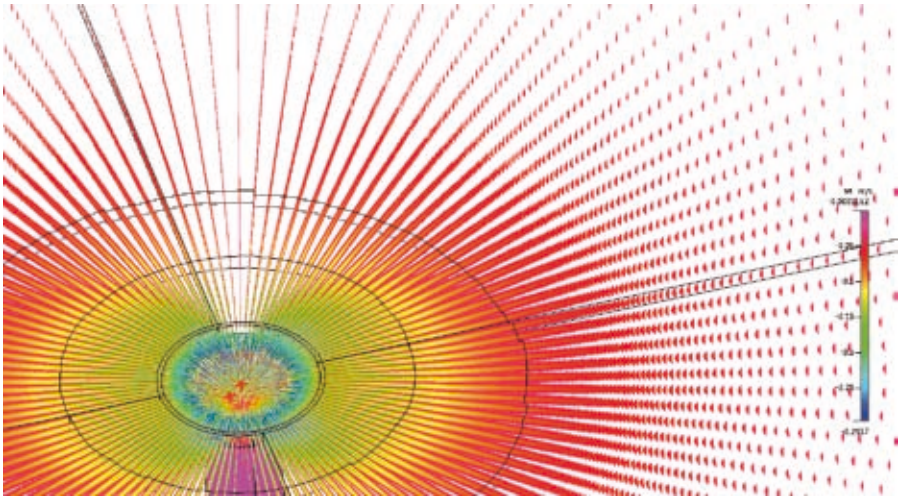

*Simulation of fluid flow through prototype device.*

## The acoustic separator could be of benefit to food and beverage industries amongst others.

### Heart of the matter

The current prototype has been designed for separating micron-sized particles in a biomedical context. It is specifically aimed at removing lipid microemboli (fat) from pericardial suction blood, for use during cardiac surgery, and is ultimately intended to replace cell-saver devices that are in current clinical usage.

The prototype has major advantages over the currently used cell-saver devices, which require minimum blood volumes and take tens of minutes to filter blood. The prototype has been tested with lipid emulsions and suspensions of polystyrene particles, and is soon to be tested with lipid suspensions in blood.

This technology is a platform technology with numerous possible applications. It can potentially separate any particles in suspension as long as they have different acoustic properties to the surrounding liquid.

It is envisaged that this technology could be of benefit to biomedical, chemical, engineering, food and beverage industries amongst others.

### Patent protection

This invention is the subject of an international patent application and Isis would like to talk to companies interested in developing the commercial opportunity.

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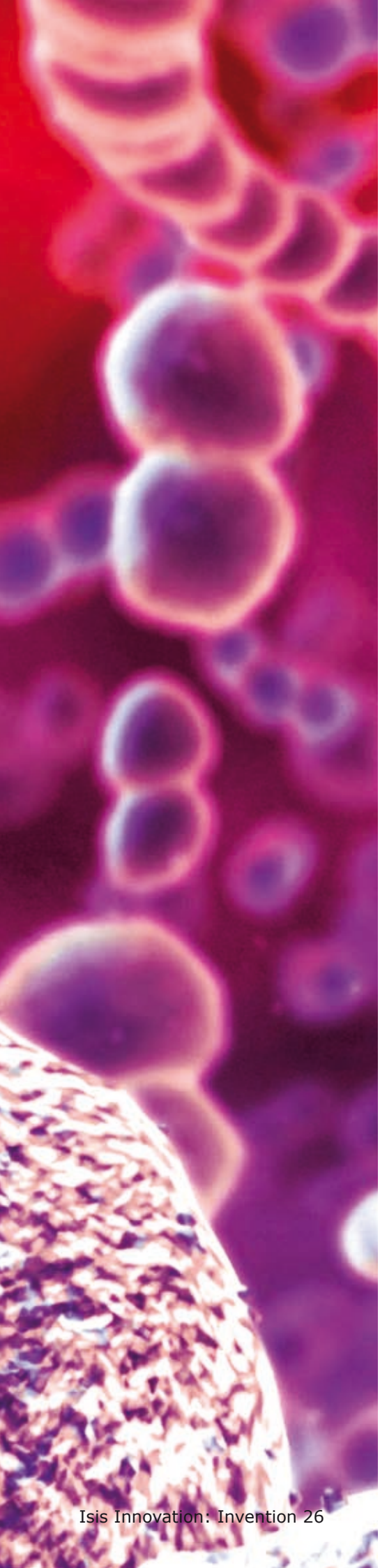

# From Flesh-eating Bacteria to Protein Superglue

**Dr Angela Oldacres** explains how an understanding of the structure of the hairs on a deadly bacterium can be used to find and identify proteins linked with diseases.

### Harnessing a lethal bug

Group A streptococci cause a range of human diseases, from the mild "strep throat" to the flesh-eating Necrotising Fasciitis. These bacteria use a number of special tricks to enable them to colonise the body and resist the immune system.

For example, thin hairs, called pili, extend from the bacterium, helping them to form strong attachments to human cells. Pili are chains of a protein called the major pilin.

The major pilin undergoes a spontaneous chemical reaction, locking two parts of the protein together irreversibly and making it one of the strongest proteins ever found.

Researchers at the University of Oxford have genetically dissected the major pilin to make a protein superglue, splitting it into a large protein partner and a short peptide partner.

As a result, rather than the chemical reaction locking the major pilin together, the protein partner locks covalently to the peptide partner. With this system, the peptide can now act as a tag, attached to other proteins *in vitro* or to proteins on living cells.

### Investigating proteins

Tagging with peptides is one of the most common ways to detect, purify or immobilise proteins in biotechnology.

Peptides are very useful but are often hard to control as required.

Peptides are very useful but are often hard to control as required. Previous ways to recognise these protein tags (most often HA, myc, FLAG, 6His varieties) were weak and in some cases required complicated chemical modification.

With this alternative approach the protein partner and peptide partner are easy to produce. They also react irreversibly simply upon mixing; no other component is required.

This reaction occurs through an amide bond, making it essentially irreversible and so the lock should be made stable over time, at high temperature, at high force and with harsh chemical treatment.

Peptide tags are used in immunoassays, nano-assembly,

The protein partner and peptide partner are easy to produce. They also react irreversibly simply upon mixing; no other component is required.

The Oxford team have recently demonstrated splitting an alternative protein scaffold, where the protein partner is smaller than the major pilin and the reaction to the peptide is 1,000-times faster.

protein purification, cellular imaging and protein arrays. However, the reversibility of binding often compromises sensitivity, life-time and purity.

### System highlights

- Composed of the 20 natural amino acids, so easy to express.
- Both partners genetically encodable, enabling targeting at a specific place or time.
- Reacts over a wide range of pH values (5-8) and temperatures (4-37ºC).
- No cysteines or requirement for specific buffer components.
- Specificity on human cells.

These features have the potential to overcome current peptide tag limitation.

### A family of protein superglues

Proteins containing internal locks are found in Group A streptococci but also in many other bacteria.

The Oxford team have recently demonstrated splitting an alternative protein scaffold, where the protein partner is smaller than the major pilin and the reaction to the peptide is 1,000-times faster. The same technology should therefore be applicable to create a family of different protein superglues, each of which lock on to their specific partner but not onto anything else.

This Oxford invention regarding peptide locks is the subject of a patent application. Isis would like to talk to companies interested in partnering to develop these covalent peptide tags and explore the commercial opportunities.

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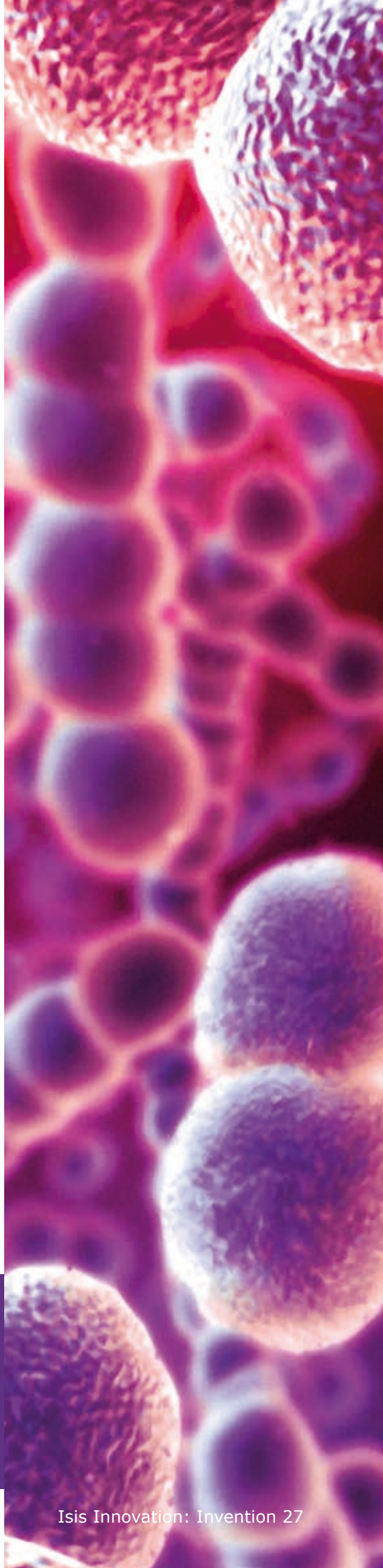

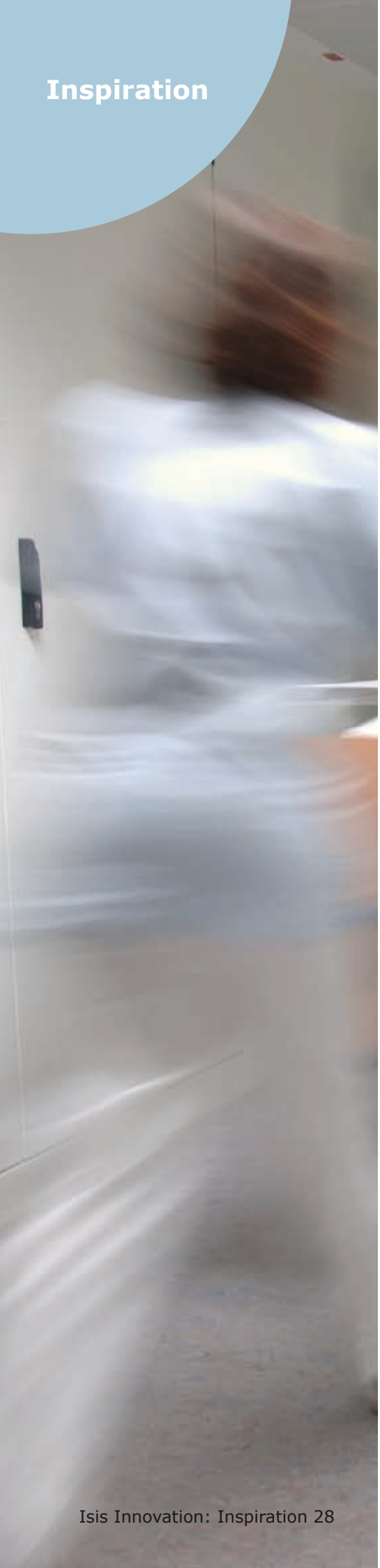

# The PROs of Academic Consultancy

**Andrew Goff, Oxford University Consulting,** discusses just a few of the ways that researchers at the University of Oxford can help the healthcare sector make the most of a range of PRO (Patient Reported Outcome) measures, available through Isis Outcomes.

An important feature of healthcare in the 21st century is the centrality of patients' views in providing quantifiable assessments of their own health and the quality of services. The patient experience is now recognised as a major indicator of healthcare quality and this has led to an expansion in the development and use of questionnaires, interview schedules and rating scales to measure states of health and illness from the patient's perspective.

Patient Reported Outcome (PRO) measures – health questionnaires completed by patients themselves – are increasingly being used to establish how patients perceive their health and how specific treatments or lifestyle changes impact their quality of life. The market for such PROs and PRO expertise is considerable. PROs are being adopted by pharmaceutical companies to assess the effectiveness of drugs from the patient's perspective, by healthcare providers to assess the outcomes of surgical or other interventions, and by academic researchers involved in measuring the benefits of healthcare provision.

## Oxford PROs

For orthopaedics, women's health and conditions of the central nervous system, Oxford researchers have developed some of the most respected and widely deployed condition-specific PROs in use today. For example, the *Oxford Hip and Knee Scores* are now the 'questionnaires of choice' for assessing surgery outcomes by healthcare providers, with recent adoption by national providers such as the NHS and the New Zealand Ministry of Health. Furthermore, the *Parkinson's Disease Questionnaire* (PDQ) is used in treatment trials throughout the world.

Recognising that the University of Oxford has renowned expertise in the development, optimisation and deployment of PROs, Isis launched the *Isis Outcomes* brand in April 2010. Apart from licensing the use of its PROs, Isis Outcomes also offers a range of related services supporting the Oxford PROs. These include the development of user manuals, assistance with translations and the provision of expert consultancy advice from world-class PRO developers.

Isis Outcomes' support services are managed through Oxford University Consulting (OUC), who are able to call upon expertise based at the University's Department of Public Health. Professors Crispin Jenkinson and Ray Fitzpatrick direct a multi-disciplinary team of researchers able to provide clients with authoritative guidance regarding the selection of appropriate PRO measures for use in clinical trials, clinical practice and population surveys.

## PRO support

Another important service that OUC arranges is the provision of PRO developer support to clients who wish to commission translations of

Oxford PROs into languages other than English. For instance, OUC recently arranged for PharmaQuest Ltd to receive developer support from Professor Jenkinson and another Oxford PRO expert, Dr Jill Dawson. PharmaQuest, a medical translation company that specialises in the translation and linguistic validation of PROs, has a robust process of quality assurance and, like OUC, is accredited to ISO9001:2008 standards of QA.

As part of the translation process, PharmaQuest asked OUC's consultants to undertake 'developer reviews' of back translations for each measure in each language. Developer reviews ensure that both semantic and conceptual equivalence are achieved and that cross-cultural issues and sensitivities are addressed. This, in turn, raises client confidence in the validity of comparing data collected from studies conducted around the world using the same PRO but in different languages.

PharmaQuest has a robust process of quality assurance and, like OUC, is accredited to ISO9001:2008 standards of QA.

By adopting a complementary approach to addressing the needs of clients, Isis Outcomes and Oxford University Consulting are now able to provide a comprehensive PRO service offering to the healthcare sector.

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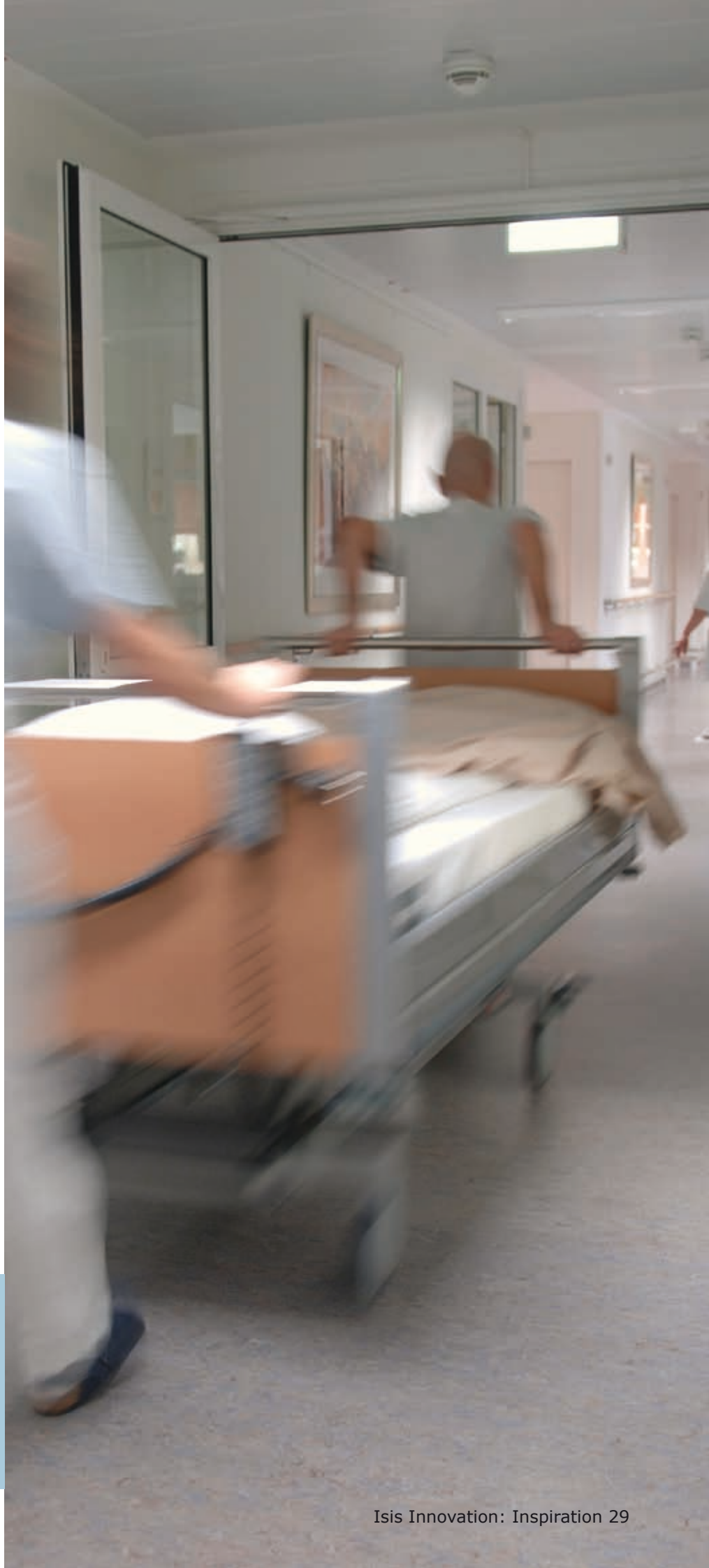


# Above Sea Level

**Dr Chris Moody of Isis Enterprise** explains how a technology once used to locate submarines has recently been redeveloped by scientists at the Science and Technology Centre in the Ukraine into a vital diagnostic tool, Cardiomox, for cardiac disorders such as arrhythmias and arterial blockages.

### Healthcare boosted by military technology

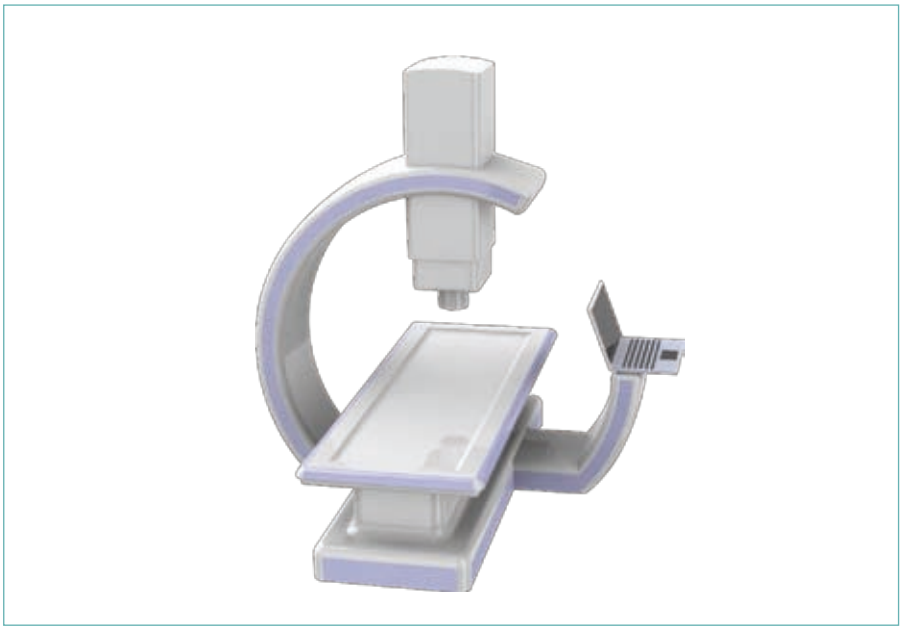
SQUIDs – superconducting quantum interference devices – were originally developed by two soviet weapons scientists for use in locating submarines deep in the ocean.

Dr Volodymyr Sosnytskyy and Dr Illya Chaykovskyy realised that this technology could have potential uses in the diagnosis of cardiac conditions once they began working under a scheme that aims to redirect former soviet defence projects into more commercially focussed ventures and research.

The scheme is part of a programme at the Ukranian Science and Technology Centre which is jointly run by several western governments. Isis has been working with the Ukrainian SQUID inventors at the centre for two years to advance the commercialisation of this uniquely valuable cardiac diagnostic technology, which is already in limited clinical use in the Ukraine.

Physicist Sosnytskyy and research cardiologist Chaykovskyy have been

This uniquely valuable cardiac diagnostic technology is already in limited clinical use in the Ukraine.



*Cardiomax: developing submarine detection technology for heart scanning.*

developing equipment to turn this scanning technique into a valuable and practical clinical tool for the last ten years.

Building on the basic SQUID detection science, they have developed sophisticated electromagnetic filtering hardware and software to allow the system to be used in an ordinary, unshielded hospital room.

They have also developed an equally important set of algorithms to process the scan data and transform it into useful information about electrical activity in the heart.

The result is a system that has proved extremely effective for first level screening of patients at risk of heart disease, artery blockages and subtle heart arrhythmias that are often missed with the standard electrocardiogram (ECG) procedure.

More recently, the technology has also been used to monitor the status and rate of recovery for patients in cardiac intensive care who have already had a heart attack.

## Improving on ECGs

ECGs measure only the total voltage of the heart's electrical impulses across and through the patient's chest wall, whereas this new technology, now called "Cardiomox" is capable of providing an image of the magnetic field generated from the heart's electric impulses.

The movement of electric charge through the heart can be mapped, showing the direction and intensity of the impulses at any point in time during the heart's cycle.

Abnormalities such as ischemia, arrhythmias and other defects can clearly be detected and characterised. The procedure is very fast, with the entire scan and image-processing taking approximately 12 minutes.

The system is completely non-invasive and involves no radioactive dyes or catheters. Patients are not subjected to any type of radiation or magnetic fields and the procedure is as stress free as possible.

This new technology is capable of providing an image of the magnetic field generated from the heart's electric impulses.

## Market experience and potential

An undercapitalised attempt at commercialisation last decade achieved the installation of a number of prototype systems followed by initial clinical trials, and gained regulatory approvals.

Some of these systems are still operating in routine clinical use for first-level cardiac screening in the Ukraine, China and South Korea. The current generation of equipment has been designed to be inexpensive to manufacture compared with magnetocardiography (MCG) equipment intended for research applications.

In addition to the cardiac screening and intensive care applications, MCG has been shown to be capable of detecting foetal heart problems in utero without any invasive risk to the foetus. This capability will be developed by the Cardiomox team in the future.

Isis Enterprise is currently seeking partners and investors to bring Cardiomox equipment to the market. The next step will be to secure funding for further clinical trials in the UK as well as equipment production.

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# Oxford Innovation Society

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

- Thursday 24 March 2011
- Thursday 22 September 2011
- Thursday 8 December 2011

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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