

Prostate Cancer Research Consortium

On the 14 June 2004, the Irish Cancer Society, in conjunction with the DMMC, formally launched a Prostate Cancer Research Consortium. This involves clinicians and scientists from University College Dublin, Trinity College Dublin, and the hospitals Mater Misericordiae, St Vincent's, St James's and St Luke's in a concerted effort to improve the effectiveness of prostate cancer detection and guide more effective intervention strategies. There are on average 1,200 new cases and 500 deaths from prostate cancer every year in Ireland, and the disease incidence is increasing by 5% annually.

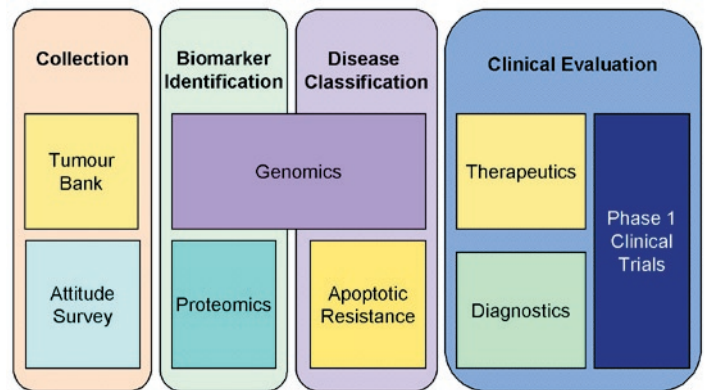
The Consortium will receive funding of €585,000 from the Irish Cancer Society over the next three years to investigate why some men develop cancerous prostate glands while others experience non-cancerous growths.



Prof Donal Hollywood and Dr Bill Watson hold a DNA microchip array.

Led by Dr Bill Watson (Conway Institute, UCD & Mater Misericordiae Hospital), Prof Donal Hollywood (TCD & St Luke's Hospital) and Prof Mark Lawler (TCD & St James's Hospital), the consortium has

four principal objectives: 1) build a biobank of tumour, blood and urine samples; 2) interrogate this bank to identify disease biomarkers; 3) use these markers to classify disease sub-groups; 4) evaluate new therapeutic and patient stratification approaches to improving disease treatment.



Over the next three years, approximately 300 samples will be collected from men who have been diagnosed with prostate cancer. Blood and urine will be collected from all patients, while tumour samples will be collected only from those patients undergoing surgical procedures (i.e. surgical resection or removal of the prostate gland). Ethical approval has been secured at the four participating hospitals and a common sampling protocol has been agreed. The collection is being held within local DMMC bioresource facilities and once the collection systems have been validated it is hoped to be able to expand to other surgical centres. Laser capture microscopy techniques have been developed that enable

DMMC News

DMMC News is a forum for the molecular medicine community in Dublin to present the latest developments of interest to a local and international audience. *DMMC News* is circulated widely in Dublin and to contacts further afield; it is also available to all from the DMMC website (www.dmmc.ie). It is an opportunity to present research, in the context of the developing cross-institutional collaborative environment, to fellow scientists and clinicians, funding agencies, government bodies, and the public. *DMMC News* contains listings of events (seminars, meetings, courses and workshops), and details of new arrivals. Contact info@dmmc.ie to contribute to future issues.

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researchers to sample tumour material free from contamination by adjacent benign tissue. Protein, DNA and RNA extracted from this tissue and from blood samples will be screened using SELDI-TOF, Protein & gene array chips and RT-PCR to identify characteristic 'biomarkers' for the disease state.

"The detection of Prostate Specific Antigen (PSA) is a 'biomarker' that is currently used to test for prostate cancer. While an increase in PSA level does not necessarily mean that a patient has prostate cancer, it does suggest the possibility that they have this disease. This new research will allow us to come up with better markers that will allow us to detect the disease earlier and with more certainty than currently possible and if we detect the disease earlier, we will have a better chance of successfully treating and curing it", said Dr Bill Watson.

The Prostate Cancer Research Consortium is also exploring the limitations of current treatments of prostate cancer. If prostate cancer is detected early when still localised to the prostate gland, it is curable by surgery or radiation therapy. The main problem is when it has progressed outside the gland. Hormone treatment can remove the chemical stimulus that tells the prostate and cancer cells to grow and survive. However, the cancer can adapt to this treatment and start to grow by another mechanism (androgen independent cancer) in which the body signals the cancer cells to resist natural cell death. When this happens clinicians can only hope to improve the quality of life of the patient with prostate cancer before they eventually succumb to the disease. Also speaking at the launch, Prof Donal Hollywood said "The Consortium is studying new therapies that will switch off this signal so that cancerous cells do not inappropriately avoid natural cell death. We are also examining the possibility of stimulating the signals that tell the cancer cells that they should be removed and we are examining the manipulation of cancer cells to make them more susceptible to current treatments."

Uniting surgeons, pathologists, oncologists, and epidemiologists from four hospitals with university fundamental researchers, the Prostate Cancer Research Consortium encapsulates the DMMC model. It demonstrates the power of collaborative research and leverages the technologies built across the city under the *Programme for Human Genomics* to tackle a disease of major significance.

DMMC Spring Symposium

Dublin Molecular Medicine Centre Research Symposia are currently held every six months, hosted alternately by our participant institutes. The most recent meeting was held on the 21 & 22 April 2004 at the Conway Institute of Biomolecular & Biomedical Research, UCD. Over 210 scientists and clinicians from across the DMMC and beyond attended a range of lectures and informal workshops.

The formal programme was structured with four themed sessions, each comprising a 1-hour plenary lecture by an invited guest and four 20-minute presentations by local speakers. Dr Ciaran Morrison (NUI, Galway) opened the session on *Apoptosis*



Participants in the Neurological Diseases workshop.

& *Cell Cycle* with a presentation of research suggesting that centrosome amplification, commonly seen in tumours, can act as a mechanism to ensure death of cells that might enter mitosis with extensive DNA damage. Dr Bruno Morgan (Leicester, UK) introduced the session on *Angiogenesis & Hypoxia* with a review of magnetic resonance imaging from a clinical perspective. He described the many technical challenges and explained how contrast agents have significantly enhanced the radiologist's ability to interrogate fine detail of human vasculature. Connecting molecular & cellular events to resultant thoughts & actions was a prevailing theme of the *CNS Development & Disease* session. This was particularly well illustrated by Prof Kevin Malone (St Vincent's University Hospital & UCD) who juxtaposed the molecular genetics and neurobiology of suicide with its societal impact. In the last of the formal sessions on *Resolution of Inflammation* Prof Alan Hall (London, UK) gave a fascinating insight into the pathways and signalling processes that regulate cell migration.

Four informal workshops were designed to bring fundamental academic researchers and clinician scientists together to discuss common themes:

- Signalling Pathways in Inflammation
- Experimental Cancer Therapies
- Studies on a range of Neurological Diseases
- Immunomodulation & Immunoregulation

The symposium workshops were very well attended with a total audience of approximately 130 scientists listening to 25 short presentations, including talks by junior researchers.

The DMMC Spring 2004 Symposium proved to be highly successful in advancing trans-institutional collaboration and translational interaction whilst showcasing the breadth and quality of research being conducted across the city. Our sincere thanks go to the many speakers, moderators, conference participants and those who helped with the meeting logistics. In particular we acknowledge the generous support of our conference sponsors (Servier, the Conway Institute Seminar Committee, HEA, HRB, Mason Technology and Medical Supply Company) who allowed us to present a highly informative and stimulating programme that was freely accessible to our research community.

Conway Institute Proteome Research Centre Opening Symposium

Stephen Pennington
Conway Institute, UCD

The opening of the Proteome Research Centre at the Conway Institute of Biomolecular & Biomedical Research, UCD was marked with a scientific symposium on 3 & 4 June 2004. The symposium attracted speakers of the highest international calibre and included a vibrant trade exhibition. The programme covered a range of important proteomics subjects including the application of proteomics to clinical research, methods for biomarker discovery, the role of various mass spectrometric approaches in diverse proteomic projects, new chemistries for protein expression profiling and the analysis of post-translational modifications.

At the opening reception, the Chief Executive of the Conway Institute Professor Pat Guiry welcomed all, and tours of the Proteome Research Centre gave visitors an opportunity to see the impressive instrumentation. Stephen Pennington, Professor of Proteomics, acknowledged support received from colleagues in establishing the Centre and the financial support of the commercial sponsors of the meeting.

The scientific sessions were very well received by the large audience of local, national and international visitors as evidenced by the questions and discussion

which followed each presentation and by the many comments received by e-mail after the event. The symposium was officially closed by the President of UCD, Professor Hugh Brady.



Back row (l-r): Dr Rosamonde Banks, Dr Robert Tonge, Prof David O'Connor, Prof Michael J. Dunn, Prof Darryl Pappin. **Front row (l-r):** Prof Stephen Pennington, Dr Scott Patterson, Prof Jonas Bergquist, Prof Muiris X. FitzGerald (Dean of Medicine, UCD), Dr Emer Cunningham (HEA).

Symposium Programme

Clinical proteomics

Prof. Denis Hochstrasser (Geneva University and University Hospital, Switzerland)

Cancer proteomics: biomarker & target discovery

Dr Rosamonde Banks (St James's University Hospital, Leeds, UK)

Markers of heart transplant rejection

Prof. Michael J. Dunn (Kings College London, UK)

Mass spectrometry for proteomics

Dr Scott Patterson (Amgen Inc., Thousand Oaks, CA, USA)

Liquid chromatography based expression profiling

Dr Gerard Cagney (RCSI)

Gel based protein expression profiling & its application in the pharmaceutical industry

Dr Robert Tonge (AstraZeneca Pharmaceuticals)

High throughput proteomics - FT ICR proteomics

Prof. Jonas Bergquist (Uppsala University, Sweden)

Expanding the proteomics space

Prof. David O'Connor (University of Southampton, UK)

Generation & recent applications of human protein arrays

Prof. Dolores Cahill (Centre for Human Proteomics, RCSI)

Integration and standardization: driving forces in protein informatics

Dr Rolf Apweiler (European Bioinformatics Institute, UK)

New protein chemistries

Prof. Darryl Pappin (Applied Biosystems)

For further information about the Proteome Research Centre contact Stephen Pennington (stephen.pennington@ucd.ie).

RESEARCH UPDATE: Connective Tissue Growth Factor & Diabetic Nephropathy

John Crean & Derek Brazil
Conway Institute, UCD

Diabetic nephropathy (DN) is a progressive fibrotic condition of the kidneys that affects approximately one third of diabetic patients. DN ultimately results in renal failure, requiring dialysis and kidney transplant, which, given the alarming increase in the incidence in diabetes worldwide, represents a major challenge for clinicians and scientists alike.

Connective tissue growth factor (CTGF) has recently risen to prominence as a key downstream mediator of TGF β 1 signaling, and has been implicated in the progression of fibrotic diseases such as atherosclerosis, pulmonary fibrosis and diabetic nephropathy (Murphy et al., 1999; Crean et al., 2001). However, clear signaling and regulatory insights for CTGF have remained elusive, while a specific cell surface receptor has yet to be identified. Recent developments in this field have gone some way towards addressing these issues, revealing divergent signaling pathways that respond to CTGF, controlling processes as diverse as extracellular matrix production, cell proliferation and cell polarization and migration (Crean et al., 2002; 2004).

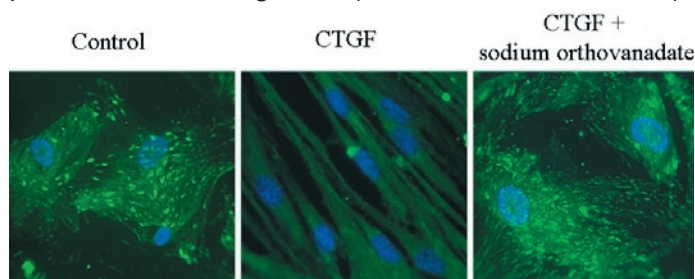


Fig. 1. CTGF mediated focal adhesion disassembly involves dephosphorylation of focal adhesion kinase.

The integrity of focal adhesion complexes is to a large degree dependent on the phosphorylation status of focal adhesion kinase. Given that cells treated with CTGF lost their focal adhesions, we investigated whether this was due to the action of phosphatases. Primary human mesangial cells were treated with CTGF and stained for focal adhesion kinase as described previously. Dissolution of mesangial cell focal adhesions in cells treated with CTGF was abrogated by pretreatment with the tyrosine phosphatase inhibitor sodium orthovanadate, indicating that phosphatase activity is necessary for loss of focal adhesion kinase.

Moreover, many of these signaling pathways have parallels in ontogenesis, raising the possibility that increased expression of CTGF and its downstream signaling cascades in fibrotic diseases represent a recapitulation of the developmental process (Sadlier

et al., 2004). In addition, CTGF has been identified as a potential early marker of diabetic nephropathy in a rat model of diabetes (Brazil et al., 2003). However, many of the fundamental questions concerning the mechanism of action of CTGF and the biological consequences of its upregulation in diabetic nephropathy remain unanswered.

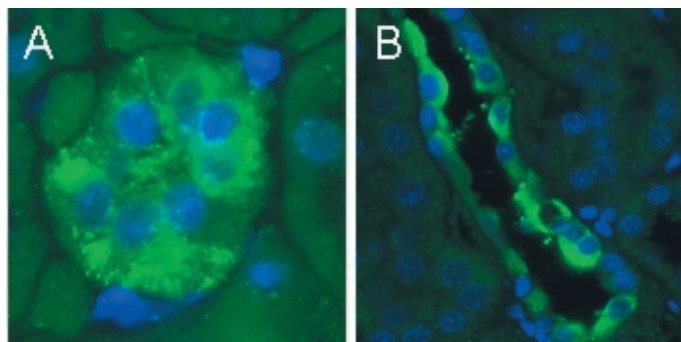


Fig. 2. Elevations in CTGF staining are observed in the kidneys of diabetic rats. Kidney sections were incubated with an anti-CTGF antibody. Elevated staining was observed in proximal tubule (A) and distal tubule (B) in diabetic rats compared to control (data not shown).

We are currently addressing the role of the various CTGF domains in terms of their biological activity and bioavailability, with a view to improving our understanding of the mechanism of action of CTGF, experiments that will facilitate and accelerate the therapeutic targeting of CTGF in molecular medicine.

Recent Key Publications

Murphy M, Godson C, Cannon S, Kato S, Mackenzie HS, Martin F, Brady HR. (1999). Suppression subtractive hybridization identifies high glucose levels as a stimulus for expression of connective tissue growth factor and other genes in human mesangial cells. *J Biol Chem.* 274, 5830-5834.

Crean JK, Lappin DWP, Godson C, Brady HR. (2001). Connective tissue growth factor: an attractive therapeutic target in fibrotic renal disease. *Expert Opin Ther Targets.* 5, 519-530.

Crean JK, Finlay D, Murphy M, Moss C, Godson C, Martin F, Brady HR. (2002). The role of p42/44 MAPK and protein kinase B in connective tissue growth factor induced extracellular matrix protein production, cell migration, and actin cytoskeletal rearrangement in human mesangial cells. *J Biol Chem.* 277, 44187-44194.

Crean JK, Finlay D, Furlong F, Mitchell D, Conway B, Brady HR, Godson C, Martin F. (2004). Connective Tissue Growth Factor [CTGF]/CCN2 stimulates mesangial cell migration through integrated dissolution of focal adhesion complexes and activation of cell polarization. *FASEB J.* 10.1096/fj.0-4-1546.fje. Published online 20 August 2004.

Sadlier DM, Connolly SB, Kieran NE, Roxburgh S, Brazil DP, Kairaitis L, Wang Y, Harris DC, Doran P, Brady HR. (2004). Sequential extracellular matrix-focused and baited-global cluster analysis of serial transcriptomic profiles identifies candidate modulators of renal tubulointerstitial fibrosis in murine adriamycin induced nephropathy. *J Biol Chem.* 279, 29670-29690.

Brazil DP, Kattla Jagunnathan J, Crehan F, Brady HR. and Godson CG. (2003). Analysis of Early Markers of Diabetic Nephropathy in the Goto-Kakizaki Rat Model of Type II Diabetes Mellitus. *J Am Soc Nephrol* 14, 366A-366A (Suppl).

Irish Autism Genetics Collaboration

Autism is a complex neurodevelopmental spectrum disorder that affects 1 in 1000 births with devastating social, behavioural and communication consequences. While the causes of autism are not yet understood, it is clear that there is a strong genetic component with the possibility of predisposition and heritability. Established in 1994, the National Alliance for Autism Research (NAAR) is a US parent-led organisation funding strategic research into autism and in the process attracting more than \$37 million of additional funds. The NAAR, in partnership with four US National Institutes, has created a large scale genetics collaboration (Autism Genome Project) designed to interrogate the human genome for susceptibility genes. This global initiative, with over 50 participating academic and research institutes, focuses on a collection of approximately 1,200 multiplex families (i.e. families containing two or more affected children).



The Irish Autism Genetics Collaborator Principal investigators with Mr Micheál Martin T.D.

Autism research within the DMMC includes collaborative investigations by scientists from both TCD's Department of Genetics and UCD's Department of Medical Genetics (Our Lady's Hospital for Sick Children, Crumlin). Principal investigators within this Irish Autism Genetics Collaboraton (IAGC) are Prof Michael Gill & Dr Louise Gallagher (TCD) and Prof Andrew Green & Dr Sean Ennis (UCD, Crumlin). It is a testament to their growing reputation in the field that IAGC have been invited to participate in the NAAR Autism Genome Project. The Minister for Health and Children, Mr Micheál Martin formally launched this participation on the 14 June 2004 at the National Centre for Medical Genetics, Crumlin. Recognising the importance of continued funding for both research and support services, the minister pledged his department's support for this initiative.

SFI Cancer Workshop

Science Foundation Ireland held a Cancer workshop at the Institute of Molecular Medicine, St James's Hospital on the 13 & 14 May 2004. Selected speakers representing the principal academic centres were invited to present brief overviews of each institution's cancer research strategy to an audience that included Prof Tomas Lindahl (Cancer Research, UK), Prof Arnold Levine (Institute for Advanced Study, Princeton) and representatives of various cancer research interest groups. The workshop was designed to assess areas of particular strength within the research community and to initiate discussions on how an internationally recognised Cancer Research Centre might be created in Ireland. The audience debated various models to seed such a centre and it was agreed that a small representative group should initiate a search to identify an appropriate centre director. This workshop represents the first tentative step towards building a virtual national organisation. The DMMC participants believe that to be successful this process must include all the best Irish research groups, engage the clinician scientists, and direct funding strategically.

Clinical Research Centre Beaumont Hospital

The establishment of dedicated resources for clinical research is a key component of the DMMC strategy to advance translational science. Through the *Programme for Human Genomics*, new facilities are being developed at St James's, St Vincent's and the Mater Misericordiae hospitals. Experienced personnel including epidemiologists, research nurses, technicians and data managers are being recruited as a shared resource under the direction of a tri-institutional bioresource co-ordinator. As this €15 million research infrastructure emerges across Dublin, *DMMC News* met with Prof Dermot Kenny, the Director of the only existing Clinical Research Centre (CRC) at Beaumont Hospital.

Opened in September 2001, this centre provides a fully integrated clinical research facility comprising 3 consultation rooms, 4 inpatient rooms and a day ward, state-of-the-art monitoring equipment, an integrated team of nurses, and administrative support. The clinical facilities are directly adjacent to 8,000 sq ft of basic research laboratories.

Prof Kenny has first-hand experience of conducting clinical research in Ireland and is well aware of the many obstacles that the DMMC needs to overcome if it is to achieve its translational science goal. "The Irish healthcare system is simply not constructed to allow research to take place", Prof Kenny notes. "Our system is, quite correctly, set-up for delivery of care and with the pressure on resources, it is inevitable that research activities get squeezed out. So even with the best will in the world, hospital consultants facing long waiting lists cannot justify the necessary investment in research". This is why facilities such as the CRC are so important since they bring together the many components essential for world-class research.



The Clinical Research Centre (CRC) at Beaumont Hospital.

So is the answer to build more dedicated research units such as the CRC? No, it is just part of the answer, Prof Kenny contends. "Our experience tells us that even with such a unit and long queues of patients, it can still be difficult to recruit the necessary numbers of patients". The next obstacle is the absence of academic consultant and research nurse positions. Prof Kenny explains how new consultant appointments have been traditionally made and how these understandably get slotted into vital frontline healthcare delivery positions. The DMMC needs to strongly advocate the importance of these academic clinicians and the value of clinical research in the context of ongoing healthcare reforms. Prof Kenny described how the Royal College of Surgeons in Ireland has developed a post-graduate course to address this particular nursing deficit that has led to the establishment of the Irish Research Nurses Association. This first cohort of research nurses will begin formal training in the autumn and Prof Kenny sees them as vital in advancing effective translational research.

Prof Kenny is first to admit that he has been surprised by some of the investigations that have been undertaken through the CRC and their outcomes. "When we first opened our doors, I would never have predicted that radiologists would be some of our most successful investigators or that their studies would have such an impact". He describes a recently published study of lung cancer screening using low dose computed tomography scanning. Despite recruiting a high-risk patient cohort, the prevalence of operable lung cancer detected was low. However, the study highlighted a significant incidence of other pulmonary illnesses.

This study demonstrates the challenge of taking a research-led approach to healthcare. A large number of patients are identified at a pre-symptomatic stage, increasing the burden on a system that is already stretched to capacity. We need to have confidence that these initial costs incurred represent a strategic investment that will control runaway spending through more effective healthcare. Investment in research is essential if we are to shift the healthcare dynamic from one of costly intervention & repair to one of prevention & maintenance. Dedicated clinical research facilities, such as the CRC, are a vital element to building an effective medical research capability. However, as Prof Kenny knows only too well, there are a series of constraints that prevent willing clinicians from undertaking more research. The bricks and mortar is the easy piece. Much more difficult is enabling healthcare professionals and hospitals to conduct this research through multi-disciplinary teams within dedicated clinical research units. Prof Kenny's experience shows how difficult but ultimately how successful translational medicine can be.

4-Year PhD Programmes at Trinity College Dublin

Trinity College has secured a €2 million award from the Health Research Board for two four-year PhD programmes. These awards aim to provide a broader and more collaborative education for young researchers embarking on a career in Health Research. The two successful proposals, chosen from 15 applications by an international panel, place an emphasis on translational research. Each programme will fund for four years up to seven doctoral students who will follow a structured training programme for the first year, with courses in research methods, ethics, commercialisation

and communications skills. The choice of research project will be made at the end of the first year. Each programme is described below.

Molecular Medicine – from genes to function

Dr Ross McManus, Institute of Molecular Medicine.

The Institute of Molecular Medicine TCD will host a flagship four year doctoral programme entitled 'Molecular Medicine – from genes to function'. This well-funded programme will take a multidisciplinary approach to the investigation of common diseases, with an emphasis on the interaction of genetic and environmental influences in disease development. The curriculum comprises a first year of taught modules and practical laboratory experience, with each student completing three mini-projects designed to give them a broad flavour of molecular and cellular biology research. Students will then progress to a full PhD to be completed in the following three years. The aim of the programme is to produce students of the highest standards internationally, exceptionally well-versed in molecular research at the interface of medicine. Information on the programme is available on the DMMC website or on the TCD Molecular Medicine Education website:

<http://oscar.gen.tcd.ie/molmed/phd>

From Basic Neuroscience to Clinical Application

Dr Maria Fitzgibbon, Trinity College Institute of Neuroscience.

Trinity College Institute of Neuroscience have built a 4-year integrated PhD research and training programme in neuroscience spanning from fundamental mechanisms to clinical applications. There has been strong interest in the programme allowing recruitment of a very high calibre of students. This flagship research and training programme aims to produce PhD graduates of the highest calibre, equipped with the appropriate range of expertise and skills for today's highly-competitive research. The programme will make full use of TCIN's new research facilities due to open this autumn to augment a curriculum of lecture, seminar and guided study. In addition to the academic facilities on the main campus, students will have access to excellent clinical research resource at the Mercer's Institute of Research into Ageing (St James's Hospital), at AMNCH (Tallaght), and at St Patrick's Hospital.

News In Brief...

Collaborations with Institut Pasteur

Following on from the November 2003 meeting in Dublin (reported in the last issue of DMMC News), Dr Aideen Long (RCSI) was invited to the Institut Pasteur, Paris to present on her current research. Her presentation was very well received and both institutions are exploring formal collaborations in the area of cell migration. Other individual investigator contacts are being developed in the areas of Toll-like receptors, nuclear transcription factors, and tuberculosis.

DMMC Scientific Advisory Committee

A meeting of the DMMC Scientific Advisory Committee (SAC) took place at Newman House on the 3 June 2004. There were a series of presentations by the directors of the participant institutions, the key disease area co-ordinators, and leaders of selected collaborative projects.

The SAC provides an excellent opportunity to peer review the activities of the DMMC in terms of both scientific and strategic impact. In their feedback report, the advisory committee highlighted areas of strength & deficiency and offered practical recommendations on future priorities for the DMMC. Further details of the SAC review can be obtained on our website.

Members of the Scientific Advisory Committee

Professor Martin Carey

Brigham and Women's Hospital, Harvard Medical School, Boston

Professor Garret FitzGerald

University of Pennsylvania School of Medicine, Pennsylvania

Professor Gordon Duff

Florey Professor of Molecular Medicine, University of Sheffield

Dr John Sims

Distinguished Fellow, Amgen Corporation, Seattle, Washington

Dr Peter Ghazal

Scottish Centre for Genomic Technology & Informatics, University of Edinburgh

Professor Stephen O'Rahilly

Dept of Medicine & Clinical Biochemistry, Addenbrooke's Hospital, Cambridge

Professor Hugh Brady

President, University College Dublin

Legal Agreements

Formal agreement has been reached by representatives of the Technology Transfer and Innovation Offices in RCSI, TCD and UCD on the treatment of jointly owned intellectual property arising from DMMC collaborations. This tripartite IP agreement should facilitate collaboration between individual investigators regardless of their university affiliation with the Technology Transfer Offices working in concert to guide the protection and exploitation of new knowledge.

The DMMC has helped to broker an agreement between UCD and the Mater Misericordiae Hospital addressing the treatment of intellectual property, ethical, and insurance liability issues that may arise from biomedical research conducted in the Genome Resource Unit (GRU) at the hospital.

Institute of Molecular Medicine Website

The TCD Institute of Molecular Medicine has launched a website. Visit <http://www.tcd.ie/IMM/> for information on research, education and events in the IMM.

Events

Please send details of forthcoming events to info@dmmc.ie

DATE	EVENT	LOCATION
6 September	Annual Scientific Meeting 2004 Irish Society of Human Genetics www.iol.ie/~ishg/	RCSI
9 September	Conway Institute Festival of Research www.ucd.ie/conway	Conway Institute, UCD
16 & 17 September	Irish Society for Immunology Meeting Contact: louise.mccormack@ucd.ie	NUI, Maynooth
9 - 13 October	World Congress of Psychiatric Genetics www.wcpg2004.ie	TCD
11 - 15 October	DMMC Course: Thermodynamics of Membrane Transport Physiology www.dmmc.ie/courses.htm	Education & Research Centre, Beaumont Hospital
18 - 19 October	DMMC Course: Introductory Coronary Artery Disease www.dmmc.ie/courses.htm	RCSI
21 October	Oxygen Sensing in Health & Disease www.ucd.ie/conway	Conway Institute, UCD
5 - 6 November	7th Annual Meeting of the TCD Institute of Molecular Medicine	St James's Hospital
16 - 19 November	DMMC Course: Advanced Coronary Artery Disease www.dmmc.ie/courses.htm	RCSI
15 - 16 March 2005	Molecular Mechanisms of Neurodegeneration Neurodegeneration Ireland www.ucd.ie/conway	UCD
31 March - 1 April 2005	Cancer 2005 Conference	St James's Hospital