*Galtonia candicans*

# The Galton Institute

## NEWSLETTER

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**Bob Edwards:  
The trail that led to  
The Nobel Prize  
by  
Martin H Johnson**

Robert Geoffrey 'Bob' Edwards was born into a working-class family on the 27<sup>th</sup> September 1925 in the small Yorkshire mill town of Batley. The family relocated to Manchester when Bob was about 5, where he was educated and gained a scholarship in 1937 to Manchester Central Boy's High School. The war then interrupted Bob's education, for when he left school he was conscripted into the British Army for almost four years. After discharge, in 1948, he returned home to Manchester, from where he applied to read agricultural sciences at the University College of North Wales at Bangor. Having gained a place and a grant to fund it, the course offered at Bangor was to disappoint. By that time he was an experienced 23 year old, and he found it unchallenging and unscientific, and so in his third year he transferred to the Zoology Department, led by the more intellectually challenging Rogers Brambell FRS. However, in 1951, aged 26 he gained a simple pass degree. Dismayed but not deterred, he applied to do a Diploma course in Animal Genetics at Edinburgh University under Conrad Waddington FRS, and, despite his pass degree, was accepted.

The intellectual spirit of scientific enquiry that Bob experienced in Edinburgh fitted his aptitudes, for Waddington rewarded his Diploma year with a funded 3-year PhD place. Bob chose to study the developmental genetics of the mouse under his supervisor, Alan Beatty. He generated aneuploid mouse embryos and studied their potential for normal development. To undertake these early attempts at 'genetic engineering' in mammals, he needed eggs, sperm and embryos in which to manipulate the chromosomal composition. Sperm were abundant, but eggs were not, leading him to two major discoveries that proved to be of later significance for his Nobel work. With his wife, Ruth Fowler, he devised ways to increase the numbers of synchronised eggs recoverable from adult female mice by use of exogenous hormones, overturning the conventional wisdom that super-ovulation of adult females was not possible. Second, working with Alan Gates, he described the remarkable timed sequence of egg chromoso-

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General Secretary:  
Mrs Betty Nixon

Newsletter Editor:  
Dr Geoffrey Vevers

mal maturation events that lead up to ovulation after injection of the ovulatory hormone (human chorionic gonadotrophin; hCG). It was also in Edinburgh that Bob's interest in ethics was first sparked by the interdisciplinary debates among scientists and theologians that Waddington organised. These resulted in Bob's life-long humanist ethical sympathies.

After a brief sojourn in the USA from 1957 to 1958, he returned to the UK at the invitation of Alan Parkes to join him at the MRC National Institute for Medical Research (NIMR), Mill Hill. His remit was to work on the development of new methods of fertility control, especially immuno-contraception. However, his time there between 1958 and 1962 was one of increasing intellectual conflict. Whilst enthusiastic about the science underlying immuno-contraception, his old interests in eggs, fertilisation and, in particular, the genetics of development were gradually reasserting themselves. His interest was re-awakened by the then recently published descriptions of the pathologies in man that resulted from chromosomal anomalies. The possible clinical relevance of his work on egg maturation and aneuploidy in the mouse was clear.

Bob resumed his experiments with mice, and found he was able to mimic *in vitro* the *in-vivo* maturation of eggs: the eggs matured spontaneously when released from their follicles. The possibility of studying the same phenomenon in humans was evident, as was *in-vitro* fertilisation and studies on the genetics of early human development. He then sourced human ovarian biopsies, with difficulty, from various clinical sources, to study human oocyte maturation. However, this quest for human eggs, and his dreams of IVF, reached the ears of the then Director of NIMR, Sir Charles Harington FRS, who banned any work there on human IVF. Bob left Mill Hill in 1962 for a year in Glasgow to work with John Paul. The year in Glasgow resulted in

two papers remarkable for their prescience. They describe the production of embryonic stem cells from rabbit embryos – capable of proliferating through over 100 generations and of differentiating into various cell types.

From Glasgow, Bob relocated to Cambridge in 1963, again at the invitation of Alan Parkes, now the Marshall/Walton professor there. He resumed his work on egg maturation, and showed that eggs of larger species, such as man, took longer to mature than those of smaller ones, human eggs taking some 36 hours rather than the 12 or so for mice. These cytogenetic studies were reported in two seminal papers in 1965. In each of these papers, the focus is on the study, detection and prevention of genetic disease, unsurprisingly given Bob's research interests. Indeed, within three years he had, with Richard Gardner, provided proof of principle for preimplantation genetic diagnosis (PGD), in a paper on rabbit embryo sexing published in 1968, another key paper.

Between 1965 and 1969, Bob struggled to achieve IVF in humans. Paradoxically, the problem he confronted was not with eggs, but with sperm. For fertilization to occur, the sperm had to be capacitated, a process that occurs physiologically in the uterus. The question was: how to achieve capacitation *in vitro*? The solution proved to lie in some experiments being undertaken by graduate student, Barry Bavister, who found that raising the pH of the medium yielded regular fertilisation of hamster eggs. Applying this medium to human sperm, did the trick, and, using eggs matured *in vitro*, fertilization *in vitro* was achieved in 1969.

In 1968, Bob had met Patrick Steptoe, and so began a fruitful partnership of equals: scientist and gynaecologist. Steptoe's deep concern for the infertile became shared by Bob. Patrick's clinical skills included his pioneering pre-eminence in the use of gynaecologi-

cal laparoscopy in the UK. These skills were critical for the success of the further IVF work, which used *in-vivo* matured eggs recovered just prior to ovulation, a change necessitated by concerns about the developmental potential of *in-vitro* matured eggs. In 1970 they described the collection of *in-vivo* matured eggs from follicles after mild hormonal stimulation, and by 1971 had achieved regular fertilisation of these eggs and their early development through cleavage to the blastocyst stage. The long haul to the birth of Louise Brown in 1978 was marked by struggles to get the endocrinological problems of implantation resolved. These struggles were not helped by fierce opposition from peers and press, nor by the rejection for funding of the work by the MRC, which they described as unethical.

Bob tackled this criticism head on. He chose to engage with the issues publically through the media, but incurred further criticism from peers for doing so. He is a pioneer in the public communication of science. He also engaged with professional ethicists and lawyers on the ethical and regulatory issues raised by his work, and published a Nature paper with Dave Sharpe in 1971, which surveys the scientific benefits and risks of the science of IVF, the legal and ethical issues raised by IVF, and the pros and cons of the various regulatory responses to them. It anticipates social responses that were some 13-19 years into the future.

To Bob's contributions to science, medicine, public communication and reproductive ethics should be added his pioneering work in building the community of modern scientific reproductive medicine that is called Assisted Reproductive Technologies (ART). He founded the European Society of Human Reproduction and Embryology as well as the journals Human Reproduction, Human Reproduction Update, Molecular Human Reproduction, and Reproductive BioMedicine Online. Justifiably called the father of ART, he is a worthy Nobel Laureate in Physiology

and Medicine (For more details of Nobel ceremony etc see <http://nobelprize.org/> and [Reproductive BioMedicine Online - Home](#) news button).

### Robert Edwards: some key papers:

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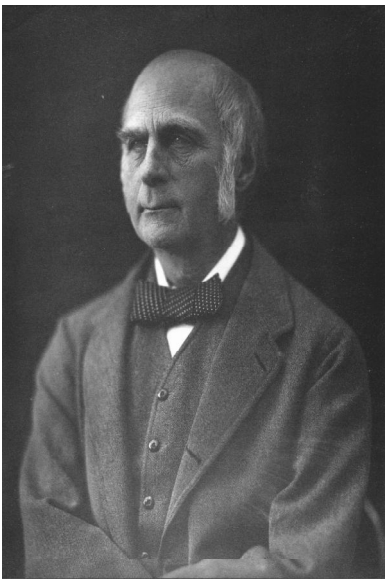
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**Martin Johnson** is Professor of Reproductive Sciences at The Anatomy School, Department of Physiology, Development and Neuroscience & the Centre for Trophoblast Research, Downing Street, Cambridge.

**Bob Edwards** has been a Fellow of the Galton Institute since 1965 and has served on our Council on three separate occasions. As well as delivering the Darwin Lecture in Human Biology in 1971, he also delivered the Galton Lecture at our annual conference in 1982. It was entitled *The Current Clinical and Ethical Situation of Human Conception In Vitro* and the full text can be found in *Twelve Galton Lectures: A Centenary Selection with Commentaries*, edited by Steve Jones and Milo Keynes and published by The Galton Institute in 2007.



### SIR FRANCIS GALTON 1822—1911

Victorian polymath: geographer, meteorologist, tropical explorer, founder of psychometrics, inventor of fingerprint identification, pioneer of statistical correlation and regression, eugenicist, cousin of Charles Darwin and best-selling author.

Sir Francis Galton died on 17 January, 1911 and was buried in his family grave, alongside his mother and father, in Claverdon churchyard in Warwickshire. Although Galton had lived for much of his life in London, his parents' family home was in Claverdon. To commemorate the centenary of Sir Francis' death, the Galton grave has been completely restored to its original state. Members of The Galton Institute will be interested to know that the Institute contributed, with others, towards this much needed restoration.

**The Galton Institute  
Annual Conference  
10 November, 2010  
at  
The Royal Society**

**Epigenetics: Where Life  
Meets the Genome**

Historically, the term "epigenetics" is attributed to Conrad Waddington (1905-1975) who in the late 1930s remarked "It is, surely, obvious that the fertilized egg contains constituents which have definite properties which allow only a certain limited number of reactions to occur; in so far as this is true, one may say that development proceeds on a basis of the "preformed" qualities of the fertilized egg. But equally it is clear that the interaction of these constituents gives rise to new types of tissue and organ which were not present originally, and in so far development must be considered as "epigenetic." The inherited *preformed* or *pre-determined* genetic program provides information about what is possible, but *regulation* of genetic expression involves interpretation. It is the latter that is epigenetic. Since then the term epigenetic has gone through many refinements and to reflect a broader biological focus than just development, and is now most commonly defined as "the study of mitotically and/or meiotically heritable changes in gene function that cannot be explained by changes in DNA sequence".

The establishment, maintenance and modulation of such gene transcriptional programmes is reliant on the inherent 'plasticity' of chromatin (the complexes that package DNA into chromosomes). Nucleosomes, the fundamental repeating unit of chromatin, are composed of a multi-subunit complex of histones, around which 147 base pairs of DNA is wrapped. The DNA molecule can be covalently modified at the 5 position

of cytosine bases (DNA methylation). While assembly of the genome into chromatin achieves the required DNA compaction to fit the genetic information into the cell nucleus, it inevitably affects every DNA based process including DNA repair, DNA replication and gene transcription. For such processes to access the DNA sequence, chromatin is a dynamic structure.

We now know that such processes and associated differential gene expression involve a complex interplay between transcription factors, chromatin regulators, histone modifications, histone variants, DNA methylation and non-coding RNA molecules. Furthermore, a number of diseases, most notably cancer, are characterized by altered epigenetic profiles; alterations in the epigenome may play a role in the susceptibility and pathogenesis of human disease.

The aim of this one-day symposium was to bring together a diverse range of recent research that has studied epigenetics in the context of the systems and areas outlined above. Six speakers from various disciplinary backgrounds gave talks to an audience of around 100 attendees.

Professor Adrian Bird (University of Edinburgh) opened the meeting with a discussion of epigenetics and chromatin. He proposed a refinement to the definition of epigenetics to convey more accurately the field in the 21<sup>st</sup> century; "the structural adaptation of chromosomal regions so as to register, signal or perpetuate altered activity states". The importance of these adaptations and altered activity states were highlighted in data presented concerning the neurological disorder Rett Syndrome and using a mouse model, demonstrated that Rett-like symptoms can be readily reversed by restoration of a functional gene MeCP2 that is a reader of epigenetic marks. This raised not only the prospect of a therapeutic approach to the treatment of Rett syndrome in humans but also highlighted the importance of epigenetics in disease.

Professor Azim Surani (University of Cambridge) delivered the Galton

Lecture. Prof Surani gave an overview of how early developmental switches of the type proposed by Conrad Waddington are controlled by epigenetic mechanisms. Specifically, how primordial germ cells undergo epigenetic changes during specification and movement to the genital ridge of the embryo. Furthermore, he presented recent data describing the reversal of this cellular differentiation process to generate pluripotent embryonic germ cells, which can be cultured and examined *in vitro*.

The afternoon session began with presentation of the Cedric Carter Medal by Professor Sir Walter Bodmer. The practice of awarding the Cedric Carter Memorial Medal was instituted in the 1980's after the death of Professor Cedric Carter, a long serving council member of the Eugenics Society, a past-president and a serving officer of the Society at the time of his death in 1984. The Institute awards the medal on a triennial basis to recipients who, in the opinion of Council, "have made outstanding contributions either to the work of the Institute or in the general field of eugenics". The 2010 recipient of the Cedric Carter Medal was Professor Anthony Edwards. Elected a fellow of the Eugenics Society in 1960, he has held numerous positions during his 50-year association with the Eugenics Society and the Galton Institute, including council member, vice president and in 1997 he gave the Galton Lecture.

Professor Bernhard Horsthemke (University of Duisburg-Essen) explained how genomic imprinting is an epigenetic process by which the male and the female germ line confer specific (marks) imprints onto certain gene regions, so that one allele of an imprinted gene is active and the other is silent. He demonstrated how the study of families with the Prader Willi syndrome and other disorders involving imprinted genes have revealed information about imprint erasure and the establishment of new imprints between generations.

Professor Peter Jones (USC/Norris Comprehensive Cancer Center) dis-

cussed new techniques for studying nucleosome positioning at the single-molecule level. Such a method allows each molecule to be viewed as an individual entity instead of an average population, single-molecule analysis confirmed nucleosome shifting at a number of genes therefore providing a potential mechanism for rapid silencing and reactivation of genes during the cell cycle.

Dr Vardhman Rakyan (Barts and The London School of Medicine and Dentistry) presented data on large-scale studies of human disease-associated epigenetic variation in

childhood-onset Type 1 Diabetes, specifically for DNA methylation. Such Epigenome-Wide Association Studies (EWAS) present novel opportunities but also create new challenges that are not encountered in genome-wide association studies (GWAS). He also discussed EWAS study design, cohort and sample selections, power and analytical approaches, confounding factors, follow-up studies, and how integration of EWAS with GWAS can help to dissect complex GWAS haplotypes for functional analysis.

The meeting concluded with an

overview of the days proceedings by Professor Marcus Pembrey (Visiting Professor, University of Bristol) and a discussion of what the future holds for epigenetics, including the potential for transgenerational inheritance of phenotypic traits mediated through epigenetic phenomena.

**Reported by: Paul J Hurd**, lecturer in Molecular Biology & Biochemistry, School of Biological and Chemical Sciences, Queen Mary, University of London as well as a trustee of The Galton Institute.

## Epigenetics and Epigenomics

### A Rough Guide

The two words in my title are seen more and more frequently nowadays. Historically epigenetic findings were first reported many years ago but were not readily accepted because "they did not conform to Mendel's laws" This observation provides, incidentally, an excellent type specimen supporting the thesis that neither laws nor dogma but rather principles should provide the framework for expounding biological knowledge. This short exposition arises because it appeared to me that general understanding of what the terms embrace and signify was perhaps less than it might be and is offered with the hope that readers will gain some benefit from it.

Casual observation tells us that the coat colour of cats is variable. However, the nature of this variability is different in the two sexes. Individual females may, for example, have patchy black and ginger coats but in males this is never seen. The reason for the difference is that the gene concerned with this colour difference is on the X chromosome and males, having only one X, show the coat colour phenotype determined by the single black or ginger variant of the gene they carry whilst in females, which have two X chromo-

somes and can therefore carry both black and orange genes, one of the two X chromosomes, with all of the genes it carries, is inactivated in each cell of the body. The inactivation is a largely random process which occurs early in foetal life and the descendants of each inactivated cell retain the inactivation through cell generations indefinitely. Thus, female cats carrying both gene variants display a mosaic pattern of black and ginger patches which reflects faithfully the original pattern of inactivation.

In this example we see a case of an epigenetic effect i.e. where the phenotype does not necessarily reflect the genotype and where inheritance (in this case from cell to cell) of the epigenetic (in this case inactivated) state is stable.

To give a satisfactory definition of epigenetics is not easy and so far as I am aware there is still no universally accepted definition. Why this is so is probably a consequence of the fact that epigenetic processes may have a variety of causal mechanisms. To illustrate the variation in terminology I give here two examples used in articles published in 2010. 1 "Epigenetics is the study of heritable alterations of gene expression that are not caused by changes in DNA sequence". 2 "Epigenetics is the study of inherited changes in phenotypic traits or genome function without changes in the underlying DNA sequence". For the writer and for general understanding the first state-

ment is to be preferred.

The principal mechanisms which are responsible for epigenetic phenomena can be regarded as switch gear turning genes on or off for long periods which may extend over generations although in the process of gamete formation an erasure process occurs which results in the removal of the majority of potentially heritable epigenetic effects. These mechanisms fall broadly into three classes. The first and probably both operationally and numerically most important is a process of methylation of DNA. Methylation *per se* is a part of the normal mechanism of control of gene activity but at an extreme level, by interfering with transcription of messenger RNA from the affected region, effectively shuts down activity of the gene concerned. The second mechanism is that of modification of the histone elements with which the DNA in chromosomes is intimately associated. Such modifications may include acetylation, methylation and phosphorylation and they appear to influence gene activity by changing the spatial organisation of the DNA-histone complex and as a consequence blocking transcription from the DNA. The third mechanism is less well understood and depends upon the existence of small (non-coding) molecules of RNA, which, by pairing with specific messenger RNA molecules, block production of the gene product concerned.

Finally there is another exceptional

epigenetic mechanism which depends not upon gene activity but upon protein state. Prions are protein molecules capable of existing in at least two conformational states and, in one of these forms (but not others) are responsible for the occurrence of ailments like mad cow disease and Kuru. The protein molecule has exactly the same amino acid sequence in all conformations but in one (disease causing) form has the additional property that it directs molecules in the course of synthesis to adopt the same conformation and hence to cause the disease to manifest in the offspring of affected individuals.

The example of prions noted above is a case of what may loosely be termed an epigenetic disease and evidence is accumulating that epigenetic effects may be involved fairly frequently in some diseases. Thus, for example, in the Netherlands the winter months of 1944-5 (*de hongerwinter*) were a period of severe shortage of food for many Dutch people, so severe in fact that thousands died. Studies of individuals

conceived during this period show an increased liability to diabetes and to schizophrenia suggestive of an epigenetic effect in which very low nutritional status of parents has produced an altered activity level of several, possibly many, genes passed on in this condition to offspring. Whilst this remains to be proven the fact that one gene involved in control of growth is under average methylated, another associated with schizophrenia is over average methylated and at least four other genes of unspecified function are also over average methylated in *hongerwinter* individuals is strongly suggestive. Similar findings have also been reported for Chinese and Swedish populations.

Possible epigenetic effects arising from a variety of experiences such as chronic exposure to drugs of abuse and stress in parents and of procedures required for IVF in the production of fertilised eggs have recently been announced and there seems little doubt that many more will emerge in future.

Turning now to epigenomics, defin-

ing this is simpler; it means simply the study *en masse* of those genes in the genome which are subject (or may be subject) to epigenetic effects. What then is the size of the epigenome? The human genome contains of the order of 20,000–25,000 genes but in any tissue at any time only a small fraction of this number is operative. Hard evidence exists to show that at least fifty individual genes on a number of different chromosomes show epigenetic effects and as the X chromosome, all of which is so involved, comprises about five percent of the genome it seems that possibly a few thousand (but may be many more) constitute the human epigenome.

Together epigenetics and epigenomics constitute a very active and exciting field of study which will surely generate results of great significance for both fundamental genetics and for the understanding of human development and diseases within the near future.

**John A Beardmore**  
Treasurer, The Galton Institute

## British Society for Population Studies

### Conference 2010

The 2010 Conference at the University of Exeter was again the highlight of the BSPS year, with over 180 participants over the three days of the Conference. From the feedback forms the consensus was that the meeting had been very successful, with particular plaudits for the two plenary sessions. Thus this report concentrates on those plenary sessions. It is hoped to have podcasts of the plenaries on the BSPS website.

Additionally, the ***Nothing new under the sun: a brief history of the Census in the UK*** special session, presented by Ian White from the Office for National Statistics, was reported as being hugely entertain-

ing by those attending. BSPS also added a couple of fringe meetings to the format in 2010.

### Plenary 1: Ties Boerma, World Health Organisation

Ties Boerma from the WHO presented his plenary session on the Demography and Monitoring and Evaluation of Health in Developing Countries.

He started with an overview of recent developments in world health relating his talk to Millennium Development Goals (MDG). The MDG6 is to *reduce the prevalence and death rates associated with malaria*. The burden of the disease, mostly in sub-Saharan Africa, is an estimated 243 million clinical episodes, and 800,000 deaths per year. He described a range of recent improvements in dealing with malaria, since about 2003, and noted in particular the large increase in funds to support prevention, testing and treatment. Ties presented charts showing the dramatic improvements in malaria prevalence across a range of coun-

tries and described some of the measurement issues for malaria, such as the use of verbal autopsy.

He described some recent developments in TB where the MDG is to reduce the prevalence and death rates. In 2008 there were an estimated 1.8 million deaths involving TB. He noted that interventions were mainly around treatment with multiple drugs and that there had been progress with case detection and treatment success, but that there was no evidence of a decline in prevalence. He looked at measurement issues, and mentioned the success of population based surveys to assess prevalence.

The biggest issue is HIV. The MDG is to halt and begin to reverse the spread of HIV by 2015. He noted that there were an estimated 33 million people living with Aids, with 2 million deaths in 2008. Ties showed a chart tracking the huge increase in funding for HIV/AIDS; from \$1.5 billion in 2000 to \$13 billion in 2008. He also showed the improvement in treatment, the slow decline

in new case rates and discussed issues with measurement.

The goals of MDG 4 and 5 are to reduce child mortality by  $\frac{2}{3}$  and maternal mortality by  $\frac{3}{4}$ , between 1990 and 2015. In 2009 there were about 8 million child deaths and 400,000 maternal deaths in 2008. 2010 is the year of maternal neonatal child health. Ties noted the gradual decline in child mortality but a slower decline in maternal mortality, and whilst recent estimates for maternal mortality were more upbeat, the MDG5 is unlikely to be met. In terms of measurement he noted the importance of household surveys as there is very limited clinical data.

Ties then discussed chronic diseases for which there are no MDGs, suggesting that this might be the next area to have goals. He noted that the burden is increasing due to a range of factors and that interventions were mainly focussed on prevention e.g. reducing risk factors such as tobacco. In 2011 there will be a United Nations General Assembly Special Session on chronic and non-communicable diseases which should present an important opportunity. He mentioned that there were crucial data gaps, for example lack of evidence on risk factors. Ties discussed using interview surveys to look at heart problems and schizophrenia, with some international comparisons. He also looked at the search for summary measures, including the BigMac Index!

He looked at monitoring and evaluation and the rôle of Demography and noted the need for regular monitoring of MDGs – especially to support performance based disbursement. He showed the 'epidemic' of indicators and targets, but noted that impact evaluation was a neglected topic. He set out two areas where there was a rôle for demography: these were data generation - through surveys, death registration and population based longitudinal surveys, and analysis and evaluation. In particular he noted that cause of death registration was a priority topic and it is estimated that 40 million babies are born but not registered each year, and 40 million people die unregistered each year. 77 countries, with two thirds of the world's population, do not have reliable cause of death statistics. IT

demography innovations, including conducting verbal autopsies via mobile 'phones, were showing progress.

## Plenary 2: Tomáš Sobotka, Vienna Institute of Demography

Tomáš Sobotka from the Vienna Institute of Demography (VID) presented the key trends in fertility in the developed world. As introduction, Tomáš noted that in the literature there were notions about fertility being too low and looming population decline; with populist writings, in sections of the media, on immigrants 'taking over'. Tomáš noted alarmist conclusions from 1906 on "Social suicide" in the UK as a result of declining fertility rates by Newsholm. Tomáš then compared this with recent quotes from demographers, showing that nothing changes, for example W. Lutz et al 2006, the "Low fertility trap" hypothesis. Tomáš also noted the European Commission Green Paper (2005) that said low birth rate is a "challenge for the public authorities"; and that "return to demographic growth" is one out of "three essential priorities". Tomáš, showed three examples from books "The Last Days of Europe: Epitaph for an Old Continent", "Decline and Fall: Europe's Slow Motion Suicide", and "PeopleQuake", and noted an alarmist video with bogus statistics on YouTube got 12.3 million views for the English version.

In terms of the micro-level theme he highlighted concerns that individual preferences are not fulfilled (but that this stands on "shaky ground") and concerns that people may "miss out" if they don't have a family they realise this too late (Kravdal 2010), though the argument can go the other way round, not realising the consequences of having children ...

Tomáš's talk then went on to look at four main areas:

- upturns in period fertility and their explanations
- the likely stabilisation in completed cohort fertility (in some regions)
- the effects of the recent recession and

- the evidence on convergence between 'native' and immigrant women.

Tomáš showed the increase in the number of countries with low fertility from 1970 to the early 2000's. Particularly striking is the rapid increase, from the middle of the 1990's, in the number of European countries with the lowest fertility rates (of below 1.3). However, since the early 2000's the number of countries with low fertility rates has remained roughly static, though the number with the lowest rates has dropped very sharply, back to zero in 2009.

Tomáš illustrated the big differences between regions in fertility trends, in particular very large declines in fertility in Southern Europe and Central-eastern Europe. A common feature however was towards an upturn in fertility starting about 2000 in almost all areas, though the amount of upturn still differs across regions, being very strong in some countries. This increase in fertility showed that areas can change rapidly from lowest low fertility to more normal low levels of 1.4 to 1.6, but still below replacement level. This upturn in fertility is remarkable as it is the first concerted rise of fertility across the whole developed world.

Tomáš looked at whether this increase is "real", with a large number of articles speculating that the lowest low rates are an artefact, caused by delayed childbearing, and that cohort rates may not ultimately show such low rates. Tomáš briefly looked at the Bongaarts-Feeney method that attempts to adjust for these effects, taking account of the tempo effect.

Tomáš then considered other possible explanations, in particular policy effects – the return of pronatalism and high levels of fertility of immigrants. He presented evidence showing that in some countries this effect was actually negative, and only small where it did occur.

It appears that fertility rates were

stabilising in Western, Southern, and Eastern Europe and the USA. He started by looking at cohort fertility rates, setting out the advantages of this method of measuring fertility, particularly in dealing with postponement issues. He noted that there was debate about whether it was period rather than cohort rates driving fertility. Some countries achieved low levels of cohort fertility 100 years ago and he showed that the decline in younger age cohort fertility had stabilised in several countries, with a small uptick in recent years in a few, suggesting that this marked the end of increasing postponement of child-bearing.

Tomáš suggested that there might be an increase in fertility with the recession in theory. In the OECD there was evidence since 1980 of a correlation between decreased fertility and decreasing GDP (lagged by a year). He also quoted research look-

ing at unemployment and fertility. However, he also pointed out studies that showed other factors were more important than the economic cycle. He concluded that some decline in fertility should be expected as a result of the recent recession, but looked at other complicating factors. The recession has slowed or stopped the increasing fertility rates in a number of countries, but not everywhere, and the effects of the recession on changing fertility rates were likely to be small and short-lived.

Tomáš stated that there was evidence of converging fertility rates amongst immigrants and second generation immigrants with the 'native born' population, showing the example of the Netherlands.

Finally Tomáš looked at the issue of whether there should be a desired or optimal fertility rate, looking at

the issues that might affect this discussion, such as environmental concerns and the impact of immigration.

Tomáš suggested that those that wanted to look further at this topic might like to look at the website [www.humanfertility.org](http://www.humanfertility.org)

All abstracts from the Conference can be found on the BPS website at <http://www2.lse.ac.uk/socialPolicy/BSPS/annualConference/2010/2010%20Exeter.aspx>

The above is a shortened version of the report submitted by The British Society of Population Studies.

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## The European Human Behaviour and Evolution Conference 2010

The 5th European Human Behaviour and Evolution Association Conference was held at the University of Wroclaw, Poland from Thursday 25 to Saturday 27 March 2010. The conference gathered over 160 attendees from 25 countries. There were 48 thought-provoking talks, including six plenary presentations, across the full spectrum of Evolutionary Psychology, Cultural Evolution and Human Behavioural Ecology. The continued emphasis on serial rather than parallel sessions, promoted the interchange of knowledge and ideas across discipline boundaries, during coffee breaks, and further still into the evening as delegates mingled and perused more than 60 poster presentations over wine.

The triumph of the 2010 conference is credit to the local organising committee. Special thanks are also extended to the Galton Institute, Lower Silesian Voivodship Marshal,

and the Faculty of Law, Administration and Economics from the University of Wroclaw for their generous financial support of the conference. A summary of the conference proceedings is provided below.

### Day 1

The opening ceremony, held in the exquisite surroundings of Wroclaw University's Aula Leopoldinum, was followed by the first of six engaging plenary talks. Daniel Fessler presented a captivating case for the utility of integrating phylogenetic and ultimate approaches in understanding the evolution of the mind, and outlined why emotions underpinning human notions of morality are likely rooted in evolved mechanisms of pathogen avoidance. In keeping with this theme, Lisa DeBruine reported that women's preference for male facial masculinity (an indicator of disease resistance) is inversely related to the health of a nation. The conference Scientific Committee judged Lisa DeBruine's abstract as the best of the conference.

John Lazarus discussed the benefits of 'cheap talk' in kick-starting the

evolution of cooperative behaviour, whilst Stephen Le presented data from Vietnam suggesting that patient people are not universally more cooperative. Gilbert Roberts used evolutionary simulation to investigate the role of reputation-based partner choice in unconditional cooperation, and the session was rounded off by Laurence Fiddick and colleagues who examined the effects of social status on perceptions of fairness in cooperative exchanges.

After lunch, Eckart Voland, delivering the second plenary talk of the day, outlined a thought provoking discussion of how cooperative breeding might have paved an evolutionary path to human conscientiousness and morality. Leslie Newson and colleagues followed with mathematical models used to explore the evolution of cooperative breeding. Shakti Lamba finished the session by questioning conventional group selection models of large-scale cooperation, using a combination of ecological and experimental data from 16 small scale societies.

The final part was split into two parallel sessions. Lewis Dean, Jamie



Tehrani and Anne Kandler addressed aspects of cultural evolution, covering areas as diverse as social cognition, phylogenetics and language shift, respectively. Meanwhile Paul Matthews, Charlotte Stormer, and Jenni Pettay took a behavioural ecology slant in addressing questions relating to fertility, life history and sexual selection.

## Day 2

The third plenary talk by Stephen Shennan examined the interesting relationship between the emergence of huge wealth and power inequalities in human societies and strategies associated with maximising reproductive success. Mathias Franz and Jeremy Kendal then described the use of modelling techniques to investigate the evolution of social learning.

After coffee, attention turned to reproductive decision making. Rebecca Sear presented a systematic review of reproductive decision making suggesting that kin influence fertility, but that the precise effects are dependent on kin category and ecology. Mirkka Lahdenpera reported findings of reproductive conflict between generations of pre-industrial Finns. Evelyne Heyer described a method that can be used to evaluate the cultural transmission of fertility with genetic data, whilst Martin Fieder presented data showing birth month effects on women's reproductive performance.

The first of the afternoon sessions began with Ernst Fehr's plenary, which examined the evolutionary foundations of strong reciprocity, employing experimental methods to distinguish between competing approaches among indigenous groups

in Papua New Guinea. This was followed by two presentations describing results obtained from public goods games: Tunde Paal discussed the effects of Machiavellian decision-making strategies whilst Ulrich Frey described a strategy that could facilitate success at climate conferences.

The last session again split into two streams. One track was devoted to behavioural adaptations, with presentations from Matt Grove on hominin behavioural plasticity, Gwenaël Kaminski on kinship detection, Diana Fleischman who discussed disgust sensitivity, and Ruth Mace on the evolution of political organisation. The other covered women's sexual strategies, with Katerina Klapilova discussing the effects of hormonal contraceptives, Bogusław Pawłowski examining prenatal investment, and Markus Rantala considering body hair preferences.

## Day 3

The penultimate plenary was by Joseph Call, who discussed the importance of temporal and non-temporal aspects of inhibitory control in evolving patience; Ben Jones examined the relationship between facial cues of dominance and gaze-following in humans and Zanna Clay ended the session with a talk on the strategic use of copulation calls to indicate social status in bonobos.

Attention then turned to hormones. Indriki Krams and Fhionna Moore presented experimental evidence examining the relationship between sex-hormones and male facial attractiveness. Meanwhile, Anna Ziomkiewicz explored the relationship between testosterone and female social dominance, whilst Michael Stirrat presented data on male

facial width and perceptions of untrustworthiness.

In the final plenary talk, Alexandra Alvergne provided a fascinating tour of her research addressing the proximate and ultimate factors shaping variation in paternal investment, presenting evidence from both human and non-human primate populations. This won her the EHBEA New Investigator Award.

This was followed by talks on parental loss and remarriage in the historical populations of Krummhoern and Quebec by Kai Willführ, and differential parental investment in child education by Annette Scheunpflug.

The final session again split into two parallel tracks. One covered sexual selection in humans (with presentations from Alex Courtiol, Gert Stulp, and Thomas Pollet), whilst Jeffery Stevens, Jenny Volstorff and Michele Belot discussed memory and cooperation.

The prize for the Best Student Talk from all conference attendees went to Shakti Lamba for the presentation entitled "Demography and ecology drive variation in cooperation across human populations", and the prize for the Best Poster to Anke Bullinger for poster entitled "Chimpanzees' Coordination in a "Stag Hunt" Game".

The above is a shortened version of the report which appears on The European Behaviour and Evolution website, written by Cara Evans (University College London).

**EHBEA** would like to thank **The Galton Institute** who helped support this conference with a grant of £1,000.

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## Morphometrics and Statistical Shape Analysis

Second UK one-day meeting held at the University of Kent, Canterbury, 7<sup>th</sup> June 2010

Morphometrics is becoming an increasingly important methodological and theoretical framework applied across the natural sciences, palaeontology, medical sciences and bioengineering. Francis Galton's statistical approach to quantifying and understanding morphological varia-

tion lies at the heart of the 'Biometric' school founded by Karl Pearson, Walter Weldon and Francis Galton. Indeed, the two-point shape coordinates system - rediscovered by Fred Bookstein and widely used for registering two-dimensional landmark configurations - was originally

developed by Francis Galton.

However, modern morphometrics and the statistical analysis of shape have developed far beyond the original Euclidean methods devised at the turn of the twentieth century. Today, morphometric methodologies are applied routinely by students across many disciplines, thanks to the aid of fast computer processors and user-friendly software. Due to the rapid expansion in the application of these techniques, it is important to maintain regular dialogue between the two communities of morphometric practitioners and the statisticians at the forefront of developing new analytical techniques.

The aim of this one-day meeting (funded by the Galton Institute and the Royal Statistical Society) was to bring together the diverse audience of morphometricians and statisticians with the view to stimulating discussion and debate across these communities. Six speakers, comprised of three applied morphometricians and three shape analysts, were invited to give 30 minute presentations to an audience of over 60 participants from the UK, Ireland, the Czech Republic, the Netherlands, Spain, the USA and Australia. In addition, registrants were encouraged to present their own research in the form of posters. A total of 11 posters were presented and the schedule allowed ample time for poster viewing and discussion.

The first speaker was Professor Kanti Mardia, a senior statistician from the University of Leeds, who spoke about the possible future directions of shape analysis from an analytical perspective. Some of the new methods being developed include the matching and alignment of shapes with different numbers of non-homologous landmarks, which has exciting potential applicability in the analysis of protein folding. Professor Mardia also urged the use of a pragmatic approach to statistical shape analysis and recognised the

importance of a common language for discussion between practitioners and statisticians. The second presentation was by Professor Chris Klingenberg, a biologist from the University of Manchester, on the quantitative genetics of shape variation. He illustrated with great effect the importance of an accurate morphometric protocol for capturing the fine-scale biological shape changes associated with microevolutionary phenomena such as short-term natural selection. The third talk by Dr Graham Horgan from Biomathematics and Statistics Scotland discussed a series of agriculture-related applications of various morphometric methods. For example, it is possible to morphometrically quantify the shape of pea stipules rather than relying on the bewildering array of qualitative descriptors currently used by horticulturalists. This presentation was particularly illuminating in terms of showing how statistical procedures are being applied to a new set of biological questions, previously divorced from morphometric protocol.

Professor Norman MacLeod, Keeper of Palaeontology at the British Natural History Museum gave a fascinating perspective on the utility of morphometrics within palaeontology, pointing out that taxonomic and systematic questions relating to extinct species must rely on accurate morphometric quantification in the absence of any genetic data. He presented data that showed that the analysis of morphometric variables was more likely to lead to accurate and repeatable conclusions as regards taxonomic affiliation of Foraminifera than human experts. Professor of Statistics at the University of Nottingham, Ian Dryden gave the last statistical talk of the day, focusing on the question of how to model curves in shape space. These methods are particularly useful for ontogenetic analyses in biology, where the question of interest is not how individuals vary from each other at a given point in time, but rather how the same individual changes shape

across time. By fitting a series of cubic and quadratic functions to the resultant shape curves it is possible to quantify differences in growth trajectories. He went on to discuss other new and innovative methods of shape analysis, such as geodesic curves and shape space splines. The last talk of the day was by Dr. Sarah Elton and Dr. Andrea Cardini from the Hull-York Medical School, which showed how geometric morphometrics techniques can be effectively employed to understand the eco-morphological variation of closely-related African primates. As well as illustrating how useful morphometric methodology is for capturing the fine-scale morphological variation related to ecological zones, the presentation also raised some interesting questions about future developments in the practical application of morphometrics to cranial material.

All six presentations stimulated many questions from the audience and sparked interesting debate throughout the day. One of the main outcomes of the meeting was the widespread recognition of the significance of having regular forums for discussion. It is important that biostatisticians communicate their complex mathematical models to practitioners of the methods, while those working with applied methods need to keep abreast of new and developing techniques which allow them to address shape-related questions in novel ways. It was agreed that these meetings should become a regular fixture within the UK and discussions are currently underway regarding the venue for a meeting in 2011.

**Noreen von Cramon-Taubadel**, lecturer in Biological Anthropology, University of Kent.

**The Galton Institute** helped support this conference with a grant of £1,000.

## THE TEACHING OF GENETICS IN SECONDARY SCHOOLS

I expect most of us first encountered the science of genetics in secondary school.

Maybe it was a fascinating experience and helped us to appreciate more of what's 'in the news'. But was it a solid foundation for undergraduate study and beyond? More importantly, is it any different today?

I have taught Biology in secondary school for 36 years, having studied genetics under Philip Sheppard, Arthur Cain, Cyril Clarke and Brian Charlesworth at the University of Liverpool. I was fortunate enough to have learnt from the best.

However, when I started teaching genetics as part of O-level (now GCSE) and A-level Biology syllabuses, I soon realised that what I was expected to deliver was a stylised and greatly over-simplified view of this most absorbing of subjects. Sadly, little has changed since I began all those years ago. To stimulate real interest, teachers must move beyond the boundaries set by the examination boards (and in turn set by QCDA and Ofqual) and dare to teach those areas which have real stimulus and relevance. I say dare because parents, understandably, want good examination results for their children as do head teachers and governors, since results determine league table positions, which determine intake which determine funding and so forth.

It's a brave teacher therefore, who ventures beyond what MUST be taught (to achieve the best grades) to study the complexities of the subject with those students who really appreciate them. With changes to university funding, such students are becoming increasingly rare. In my own school, Biology has always been a popular A-level choice, with a significant proportion of the students moving on to read Medicine, Dentistry, Pharmacy and Physiotherapy at university. Nonetheless, there has always been a nucleus of 'pure scientists' with no career immediately in mind, but who enjoy the subject and

the challenges it has to offer. I suppose I was once one of them.

Among these are the geneticists of tomorrow. They deserve the extra encouragement which the best teachers offer. However, will these top A-level students want to invest £27,000 in a degree which offers no guarantee of a job at the end while the medics and dentists have a clear career path? This is my main concern. If this small group shrinks much further, what is to be gained from working outside the stated curriculum? Teach the syllabus well, and let the results speak for themselves.

To help solve this problem of a lack of 'real' genetics in secondary schools, I would prefer to see the GCSE and A-level specifications move with the times.

There are plenty of 14-16 year olds who study only 'core science' at GCSE. The closest they come to studying genetics is a few lessons' worth of work on 'cloning, genetic engineering and GM crops'. However, they spend weeks on 'how humans affect the environment'. Surely, this cannot be the right balance.

Those students who are fortunate enough to have the opportunity to follow the three separate sciences at GCSE, cover the work of Mendel and some very basic monohybrid crosses but the role of DNA gets little more than a mention. Instead, they consider 'the ethical implications of recombinant DNA technology and stem cell research'. I'm reminded of a Physics colleague who says that at O-level, candidates would have been asked to describe the workings of an electric motor. Nowadays, at GCSE, they are more likely to be asked how 'they feel about the use of electricity'.

A-level Biology is starting to move in the right direction but the exam boards still live in the past, in a world of perfect data. There is no challenge to consider whether data fits expected ratios and certainly no expectation of schools to perform their own breeding experiments. Gone are the days of crossing *Drosophila* and considering the complex data such exercises yield. Even linkage studies are a thing of the past.

Genetics at this level is still considered to be a difficult area of study, so introducing greater complication might well inspire the best but equally may only serve to discourage their weaker brethren.

The teaching of molecular genetics is probably 25 years out of date. There is certainly no expectation of schools to consider DNA methylation and even 'introns and exons' get little more than a passing reference. Practical work in this field is also difficult because of cost implications and lack of technical expertise. I'm fortunate enough to have a very capable technician so that our A-level biologists can experience gel electrophoresis and PCR, but I expect we are in a minority.

Many university departments offer one-day courses in these advanced techniques, but places are limited and costs are often prohibitive. Some of the best sixth formers can apply to win Nuffield bursaries to spend one month of their summer holidays working alongside professional scientists but they cannot choose in which field they study and must take what they are given.

I am pleased to report, however, that population genetics has reappeared at A-level after an absence of almost 20 years. Students can once again study basic Hardy-Weinberg equilibrium which I always believed to be an excellent way to introduce the study of natural selection, an area which must play a crucial part in any A-level Biology syllabus, especially now that 'creationism' and 'intelligent design' are rearing their heads once more.

The examination boards and hence QCDA and Ofqual must move with the times. They are the driving forces which determine what must be taught in school laboratories. It is only the dedication of many teachers which enables our most talented students to experience the excitement and challenge offered by 'real' genetics. I believe that the Galton Institute has a role in driving these essential changes in GCSE and A-level curricula.

**By Bob Johnston**, Head of Science, St. Mary's College, Liverpool.

## EDITORIAL

The Editorship of this Newsletter has passed through several hands in the last four years which makes me wonder whether it is a position to be avoided. Nonetheless the sterling work of my predecessors in maintaining the standard of the Newsletter and even its existence at times when I am sure they would agree they had better things to do, is to be applauded. I am somewhat daunted but hope that I shall prove an adequate successor and intend to break the rapid turnover of Editors.

It is a special event for any institution when one of its members is awarded a Nobel Prize. Professor Bob Edwards is no ordinary member having served on the council for many years. His Galton Lecture of 1982 made a great impression upon me and I make no apology for placing Professor Martin Johnson's timely appreciation of Bob Edwards's Nobel winning career at the front of this issue.

I strongly recommend Bob Johnson's Teaching of Genetics in Secondary Schools and commend his conclusions. How are the best pupils to be encouraged into the fascination of genetics if they do not encounter the subject, except in a Bowdlerized fashion, before University? St Augustine believed in catching children by the age of 5-7 years; any able teenager can understand the essence of modern genetics if properly enthused.

The major event of the Institution's year is the annual conference and there is an excellent account of this most enjoyable and convivial event by Paul Hurd. Epigenetics and epigenomics mean different things to each person who uses the terms so Professor John Beardmore's elegant account is most welcome. Perhaps as a non-geneticist I may be allowed to

offer a different definition of epigenetics based upon the etymology: 'that which surrounds or is on the periphery of modern genetics', hence a changing field depending upon what is accepted as mainstream modern genetics.

One feature of the Institute is that grants are given to encourage meetings of other organizations and it is a pre-requisite that these meetings are reported on. In this issue we have three such reports; that of Noreen von Cramon-Taubadel is an excellent example of such a report and that of the British Society for Population Studies has details of its website where the abstracts of presentations can be found which is an ideal way of making more information available than is in the report. In terms of population growth in developed countries it will be interesting to watch the effect of the financial incentives being offered to young mothers by the Australian government. It is called 'Baby Bonus' and started in 2004.

The Newsletter is dependent upon the material available for publication and I encourage contributions which can be sent to Betty Nixon electronically and they should be signed and consistent with the aims of the Institute. We aim to produce three issues a year.

Every institution such as ours requires a pivotal person, but not all have someone of the skill and diplomacy of Betty Nixon. She has enormously eased my task and I am very grateful to her as I am sure are all the members who know her. Betty tells me that I should introduce myself. This I do with some reservation as I believe my role is a backroom one.

I was brought up in the London Zoo which engendered a great deal of friendly banter amongst my school friends; but they loved my birthday parties when they might be offered

an Indian Python to wind around their neck or to stroke a tiger, amongst more mundane things such as watching Archer Fish feed or having a chimpanzee join us at table. My father was Curator of the Aquarium and Invertebrates and ran the publications which included the journal of Zoology and we lived in A A Milne's 'Superintendants' House' until it was pulled down to make way for the Cotton Terraces. At the same time my grandfather, also Dr Geoffrey Vevers, was living in Whippsnade Zoo which he started with Sir Peter Chalmers Mitchell. I now realise what an excellent education I received and the qualities of the fascinating people by whom I was surrounded. The scientific world in London was smaller than it is now so a wide variety of people passed through my childhood home from Julian and Juliette Huxley, Wilfred le Gros Clark, Gavin de Beer, Solly Zuckerman, Peter Medawar and Desmond Morris to Frank Muir and Raymond Postgate. In the 1960's I was made a life member of the Galton Institute's predecessor the Eugenics Society as a Christmas present; later I served on the Council for one term but did not seek re-election as I did not consider I was able to make a contribution. After training at Guy's Hospital, London, I worked and taught there and at other hospitals until I joined a large urban general practice in Berkshire where I had a high proportion of rural patients.

In retirement I follow my non-clinical interests: I make items from silver and, very occasionally, gold; I am active in the Silver Society and the Bookplate Society of which I am Secretary and enjoy writing. I have a longstanding, longsuffering and supportive wife, Ingrid and two charming daughters Camilla and Alexandra.

**Geoffrey Vevers**

### THE GALTON INSTITUTE CONFERENCE 2011

To be held at The British Academy on Wednesday, 9th November, 2011

#### HUMAN AND PRIMATE EVOLUTION

Admission free but strictly by ticket