The Physiological Society
2015
Celebrating 100 years of women in The Society

Hodgkin Huxley House
30 Farringdon Lane
London EC1R 3AW
T +44 (0)20 7269 5718
www.physoc.org • journals.physoc.org

Women physiologists: Centenary celebrations and beyond

Women physiologists:
Centenary celebrations and beyond

The Physiological Society
2015
Celebrating 100 years of women in The Society

Women physiologists:

Centenary celebrations and beyond

Edited by

Susan Wray and Tilli Tansey

Forewords by

Dame Julia Higgins DBE FRS FREng and

Baroness Susan Greenfield CBE HonFRCP

Published in 2015 by The Physiological Society
At Hodgkin Huxley House, 30 Farringdon Lane, London EC1R 3AW

ISBN 978-0-9933410-0-7

Contents

Foreword

from Dame Julia Higgins DBE FRS FREng

It is my enormous pleasure to add some words of welcome and introduction to this book.

The anniversary that the book is commemorating and celebrating is a very significant one – 100 years since The Physiological Society formally admitted women to its membership (in 1915). This event marked another achievement in the progress of acceptance of female scientists into the mainstream of academic and public life.

We can of course debate how complete this process is, but it is certainly to the credit of The Society that they were in the vanguard of supporting and signalling the role of women in biomedical sciences.

That the process needs to continue is articulated in the first part of this book. The Physiological Society is no different from other learned bodies and grant awarding bodies in not yet having the expected gender representation throughout all its activities. It is commendable, however, that this issue is being faced head-on and discussed. As with the Athena SWAN process, with which I have a long-standing engagement, obtaining good data and reflecting on it, is a key vehicle for implementing actions and change www.ecu.ac.uk/equality-charters/athena-swan/.

The second half of the book is an uplifting celebration of all that is the best in current UK science. The engaging text from senior physiologists, who have undoubtedly reached through and crashed several glass ceilings, is a compelling read. I had the pleasure of speaking at The Society's reception in December 2013 for the launch of its Women Physiologists booklet. I know from speaking with Society members involved in that project just how well it was received, even by some who were initially sceptical. This 100-year anniversary book goes further and showcases even more wonderfully successful female physiologists. What I particularly enjoyed reading was the accounts provided by their selected junior colleagues, women they had trained or mentored. This demonstrated to me how strong and vibrant the discipline of physiology is, and how integrated it is with other disciplines. These early career stage women deserve our admiration and as a scientific community, our continued nurturing.

Congratulations to the editors of this book, Susan Wray and Tilli Tansey, for a thought provoking and fitting commemoration of this important event in The Physiological Society's history. I hope you enjoy reading the book, are impressed by what female physiologists have already achieved, and look forward to welcoming their continued contributions to science.

Foreword

from Baroness Susan Greenfield CBE HonFRCP

It is my great pleasure to add some background words of welcome and introduction to this 100-year anniversary book, published by The Physiological Society.

This is a particular pleasure for me, not only because I have been a member of The Society for over 30 years, but also because I contributed to the 75th-year anniversary book (Women Physiologists, edited by Lynn Bindman, Alison Brading and Tilli Tansey).

In the intervening 25 years, I am proud to say I have taken a lead in promoting the case and profile of women in science. I have done this through articles and pubic engagement events, as well as a recent speech in the House of Lords: Drawing attention to challenges facing women in science (5 March 2015).

With this book, The Physiological Society is both celebrating its members, past and present, and signposting its awareness of its need to serve all its members. Data in the first part of the book demonstrate some improvement in the percentage of female members and the positions they hold, compared with the case 25 years ago, but also make the case for continued effort, for example with chairs of its journals and its committees. The third part of the book clearly demonstrates there are plenty of female physiologists out there extremely well qualified to contribute to these roles. My message to them and to readers of the book is to step forward and grasp opportunities; don't wait for permission or until you are over-qualified.

Congratulations to the editors of this book, Susan Wray and Tilli Tansey, in paying respect to our history but also in being forward looking. This book is a fine commemoration of this important event in The Physiological Society's history.

I wish every success to The Society and this book and look forward to my own continued interactions with it.

Women physiologists: Centenary celebrations and beyond

Rule 36. Women shall be eligible for membership of The Society and have the same rights, duties and privileges as men.

This change was added to The Physiological Society's rules in January 1915, and the first six female members of The Society were duly elected at the Annual General Meeting later that year. Thus, 2015 marks the centenary of women's membership of The Society. To celebrate this milestone, The Physiological Society commissioned the publication of this book.

It has been our pleasure to engage wholeheartedly with this exciting project and we were keen to produce a publication that paid due respect to pioneering female physiologists past and present. We set out to celebrate the lives and achievements of these women and also to look to the future.

We have achieved this by using a brief history of The Society and the events leading to the election of women in 1915, published by one of us (TT) in 1993. That account was part of Women Physiologists: An Anniversary Celebration of Their Contributions to British Physiology, produced by Portland Press on behalf of The Society. The captivating piece entitled, 'To dine with ladies smelling of dog?' is reproduced in the first part of this book. This section lent itself to an appraisal of how auditable measures such as members by gender, female prize lecturers, the composition of editorial boards and committees, had changed or not, in the intervening 25 years. Lynn Bindman undertook that analysis with TT, both editors of the 75th anniversary book.

This article, entitled 'The landscape for women 25 years on', makes uncomfortable reading at times. Amidst some clear increases in the representation of women throughout The Society's activities, there are some disappointing lacunae. Acting as critical friends, Lynn and TT, working with Society staff, have given a new snapshot of where female physiologists have played prominent roles within the organisation. It is worth stating that we believe The Society isn't any different in gender equality from comparable associations of scientists. For example, The Royal Society elected their first two women fellows in 1945 (Kathleen Lonsdale, a crystallographer, and Marjory Stephenson, a biochemist), and has a current gender balance of just 6% female (see for example http://occamstypewriter.org/athenedonald/2015/02/27/why-cant-a-woman-be-more-like-a-man-2/).

In 2008, the Royal Society created an Equality and Diversity Advisory Network which monitors and advises on a range of activities within The Society https://royalsociety.org/~/media/about-us/edan-annual-report-2013.pdf. This network was initially chaired by Dame Julia Higgins, who has been generous enough to contribute a foreword to this book. Her credentials are impeccable and inspiring – she has also been instrumental in the success of the gender equality charter for universities, Athena SWAN. In 2015, the Equality Challenge Unit (ECU) is celebrating 10 years of the Athena

SWAN Charter. The charter was established to recognise institutional commitment to advancing the careers of women in science, technology, engineering, maths and medicine (STEMM) in higher education and research. The charter is currently being expanded to recognise focus on gender equality across higher education institutions.

Other organisations have similarly provided initiatives and monitoring schemes to investigate and address issues of equality and diversity. The Wellcome Trust, for example, the major funder of biomedical research in the UK, examined how PhD students make career choices and discovered some specific issues raised by women, including concerns about the lack of female role models. The lack of mentoring and career support, and concern that the competitiveness of science, especially during the early career stages, resulted in less weight being given to integrity and meritocracy than to self-promotion and competitiveness, making academia an unattractive career option (wtp053947.pdf). The Trust has recently announced that Baroness Eliza Manningham-Buller, Wellcome Trust Governor, will be the next Chair of the Trust, and she attended their recent workshop on Women in Science – Supporting and developing great talent, http://blog.wellcome.ac.uk/2015/03/12/women-in-science-2/.

The Physiological Society is also open to discussing these issues and has committed to the Science Council's declaration on diversity, equality and inclusion (http://www.sciencecouncil.org/content/declaration-diversity-equality-and-inclusion). The Society has appointed two Equality and Diversity Champions, Sue Deuchars and Rachel Tribe. They have contributed the afterword to this book detailing The Society's actions.

In 2013, The Society published the booklet Women in Physiology, which was launched at the International Union of Physiological Sciences (IUPS) meeting in Birmingham, and edited by Sue Wray and Chrissy Stokes from The Society's office. The idea for the booklet was the desire to have a handy source of inspirational biographies and stories from female physiologists. The lack of role models is repeatedly mentioned in studies of why women leave science; the (in)famous leaky pipeline. The booklet showcased female physiologists at a variety of career stages, providing role models appropriate for undergraduates onwards. This centenary publication adds to this, and we hope the sheer wealth of female talent portrayed will motivate all aspiring female scientists and young girls at school when considering the subjects they want to study at university. Together they complement an initiative by the Women's Committee of the American Physiological Society, Women Life Scientists: Past, Present, and Future, http://www.the-aps.org/mm/Education/K-12/Learning-Resources/Special-Teaching-Collections/Women-Life-Scientists-Units.
This innovative book is aimed at students and teachers of biology to provide updated biographies of typical female scientists, and to show how their work fits with modules of the typical biology

curriculum. The set of 20 life sciences modules is designed to increase students' exposure to female science role models by including both contemporary and historical women via brief biographies.

The second and third parts of the book feature women who we consider worthy of inclusion. The second part, edited by TT, is a collection of biographies of seven women. Four were chosen because they contributed to the 75th anniversary Women Physiologists book but sadly passed away since, including Alison Brading, who was the third editor of the book. The other three women, also deceased, were chosen because of their important and significant roles in physiology. These vignettes, edited from obituaries produced by friends and colleagues, are painted so well that both the woman and the scientific contribution resonate for a long time after reading them.

One of the original contributors to the 75-year anniversary book was Baroness Susan Greenfield. Although now extremely busy and well known for her public engagement work and championing of women in science, she was happy to support us connection the earlier book and this one, by writing a very supportive foreword for us. As recently as March 2015, Baroness Greenfield spoke in the House of Lords to champion the role of women in science and their contribution to wealth and empowerment. In this speech, she focused on the importance of science for women's economic empowerment in both private and public sectors. She noted that at a national level, graduates of both genders in STEM subjects – science, technology, engineering and maths – are perhaps unsurprisingly on higher starting salaries. However, there is a clear gender discrepancy. Just over 10% of science-based business owners are women, compared to 33% for other types of businesses. Of the FTSE 100 companies in STEM sectors, 13% of board directors are female, compared to 17% in non-science-based organisations, while fewer than 1 in 10 of STEM managers is female. It will be interesting to see how these figures change over the next decade. Her speech and that of other contributors can be read on the Parliament website:
http://www.publications.parliament.uk/pa/ld201415/ldhansrd/text/150305-0001.htm#15030536000284.

The third part of the book (edited by Sue Wray and Chrissy Stokes) presented us with the hard and troubling task of making choices – although by pairing physiologists we shared this burden. Our initial task was to select 25 women working in physiology, holding a chair and associated with other significant achievements. We did not want to replicate all the names that had featured in the 2013 booklet, but nor did we want to exclude them. After selecting some of these amazing women, we asked them to choose an early career scientist to feature on the page opposite their profile. All paired participants were asked a standard set of questions, after they had introduced themselves and their science. These were questions around challenges and aspirations. For the early career stage

contributors what this brought out was their passion and determination to have a career in science but also their worry about work–life balance and the future when it comes to obtaining funding to secure their work and groups. This last point is stark when one sees that these women have already excelled, obtaining fellowships, prizes and significant publications, for example. We suspect that this anxiety transcends gender and instead reflects the precarious and capricious nature of funding, perhaps particularly for 'standalone' physiology projects, rather than 'big/team' science. The Society can never be a major funder of researchers, but provides small research grants for early career physiologists on a yearly basis, as well as support through travel grants and techniques workshops.

The centenary of women being elected to The Society has been an excellent prompt for us celebrate and signpost the achievements of female physiologists. Reading the contributions of the early career researchers, it is enormously encouraging to see the talent associated with physiological research, irrespective of gender. Their words and passion convince us that when The Society celebrates the 125-year anniversary, the landscape will have changed significantly from how we find it today. We hope this book cheers them when they need it.

We are enormously grateful to all the contributors to this book. They have given their time and talents graciously. We would also like to sincerely thank The Society staff who have helped throughout the many months of this project, and done the hard work of turning our ideas and words into a good book. In particular, we would like to thank Jonathan Goodchild, Helga Groll, Sally Howells, Saranjit Sihota, Helen Burgess, Chrissy Stokes, and Philip Wright. Thanks are also recorded to Society Members Roger Lemon and David Miller for helpful input, and Candace Hassall of the Wellcome Trust for help with data.

Susan Wray and Tilli Tansey June 2015

Several contributors to the 75th anniversary publication Women Physiologists have sadly, since died. We would like to remember and celebrate our friends and colleagues, and pass on to those who did not know them these accounts of their lives and work. These portrayals are all adapted from obituaries written for learned societies, principally for publications of The Physiological Society, by fellow scientists.

The landscape for women 25 years on

In 1989 one of us (TT) alerted the then Committee Secretary of The Physiological Society, Reg Chapman, that 1990 would be the 75th anniversary of the first election of women to The Society. Reg subsequently asked the two women members of the Committee (LB and the late Alison Brading) to consider ways to mark that occasion. The immediate result was a joint communication to The Physiological Society entitled '"To dine with ladies smelling of dog"? – the election of women to The Physiological Society, 1915–1990' (*The Journal of Physiology*, 1990, vol. 430, p. 101P). This was expanded to become the first section of a more substantial volume, Women Physiologists, and is reproduced below. Women Physiologists, edited by the three of us, appeared in 1993 and it also included biographical accounts of many illustrious female physiologists who worked in the UK, all written by women members of The Society. Twenty-five years later, as the centenary beckoned, another celebratory volume was planned by Sue Wray, a contributor to that earlier book, and she approached us to reflect on Women Physiologists and the intervening years.

We were particularly intrigued to investigate whether Women Physiologists had had any impact on raising the visibility of women within The Society. LB undertook some basic statistical research using the membership records of The Society. When we assessed the membership for the 75th anniversary, only 10.8% of the ordinary members were female in the period 1988 to 1990. By 2006 the percentage had risen to 15.6%, and the most recent records in the Grey Book for 2013 show that the percentage of women in the membership has continued to rise, to 23% of the total.

Officers of The Society and its committees.

From 1990 women became slightly more prominent in running The Society – Joan Abbott, for example, was Chair of The Physiological Society Committee from 1997 to 2000. The Chair, however, is not considered an officer of The Society, and thus the first women officers of The Society were not elected until the 21st century: Bridget Lumb as Meetings Secretary (2002–2006) and recently (2013–2017) Anne King as Honorary Treasurer. On the 2013 Council of Trustees of The Physiological Society, Anne King as Honorary Treasurer and Mary Morrell as Chair of the Policy Committee (2012) are the two women out of the seven members of the Executive Committee. Among the other Trustees, 6 of the 12 are women. On committees, women are more visible. Of the Education and Outreach Committee, 5 out of 12 members are women; 2 out of 5 on the Finance Committee; 4 out of 7 on the History and Archives Committee; 2 out of 9 on the Meetings Committee; 2 out of 6 on the Membership and Grants Committee, 1 out of 4 on the Nominations Committee; 4 out of 8 on the Policy Committee; 2 out of 7 on the Publications Committee; and 1 out of 3 on the Remuneration Committee. Overall, this indicates just under 40% female participation

in committee work, which is considerably higher than the 23% of the membership who are female. The two Council members, Mary Morrell and Anne King, are the only two women Chairs of these committees.

Editorial Boards of the Society's publications

In contrast to the Committees, there are very few women scientists among the past officers of the Editorial Board of *The Journal of Physiology* as its Senior/Distributing editors, namely: Alison Brading (1984), Nancy Curtin (1989), Janice Marshall (1993), with Sue Wray (2000) as Press Editor/Press Secretary and Geraldine Clough (2003) as a Topical Reviews editor. That is only 5 women out of 94 past officers of The Journal. In 2015, three women from the USA are in senior Editorial Board positions: Kim Barrett as a Deputy Editor-in-Chief for The Americas (since 2011), Ingrid Sarelius as Senior Editor (since 2012) and Peying Fong as a Cross Talk Editor (since 2014) and Senior Editor (since 2015). That's 3 out of 15 people in a senior role. In 2015, 18 Reviewing Editors are female out of 73 (25%). Three out of 16 Consulting editors are women (Fran Ashcroft, Kay Davies and Carol Robinson). Experimental Physiology has had Ann Silver and Bridget Lumb as Press Editor and Press Secretary, respectively. In 2015, 6 out of 27 Editors on the Experimental Physiology Board are female (22%). Sue Wray is founding Editor-in-Chief of Physiology Reports, a new journal launched in 2013 and jointly owned by The Society and the American Physiological Society. The senior editorial team of Physiological Reports is 50% female.

Prize lecturers

A Society prize lecture, the Joan Mott prize, was endowed by Joan Mott in 1995 with the specific intention that the lecturer should preferably be a woman, and this has been the case every year to date. However it is notable that very few women have given any other prize lectures. Only four of the Annual Review Prize Lecturers since 1968 have been women: Olga Hudlická in 1990, Nancy Rothwell (elected FRS in 2004) in 1998, Fran Ashcroft (elected FRS in 1999) in 2003 and from the USA, Carla Schatz in 2011. The G.L. Brown Prize Lecture has since 1975 been presented by only two women, Annette Dolphin (elected FRS in 2015) in 1993 and Fran Ashcroft in 1996. The Hodgkin–Huxley lecture (established 2000) was given by Erin Schuman from the USA in 2103. In contrast, the Bayliss–Starling lecture (established 1963), the Paton lecture (established 1994) and the Sharpey-Schafer lecture have never been given by a woman. Interestingly, the Otto Hutter Teaching Prize established in 2010 has now been awarded five times, twice to a woman, Mary Cotter (2010) and Judy Harris (2015). In this centenary year it is gratifying to note that all 2015 Prize Lecturers are women. This is a direct consequence of the desire to celebrate the

centenary in a variety of ways and The Society's Council's commitment to continuing to redress the balance.

Further research by LB examined the number of female professors. We had the impression that women were more recognised intellectually in the early 2000s in being promoted to professor by title, but were aware that promotion in general had been eased in the past two decades. Partly this was to equate to the situation in the USA, and partly as compensation for poor increases in salaries. To check this impression LB estimated the percentage of women who were professors in 2006 and 2013, in comparison to men. This analysis had to omit some names where their gender was unclear from the name, and used a sample of 928, half the total membership in 2013. While 40% of the men were professors in 2006, only 18% of the women were professors in spite of the almost equal numbers of men and women postgraduates in 1990. By 2013, the figures were essentially unchanged, at 18% of the women and 41% of the men who were professors. Does this suggest that despite there being a greater recognition of the contribution that women can make to Physiology than 25 years ago, there is still reluctance to put them in positions of seniority, or for them to put themselves forward? The only comment we can make on the great preponderance of male editors on the Editorial Board and as Reviewing/Senior Editors of The Society's journals up to 2013 is that it has surprised and disappointed us. There are signs of improvement in time for our 100th anniversary!

Similarly, the low number of women giving Prize Lectures is disappointing, although it has been recognised by Council and is being acted on. But why is this? Our impression is that still women are welcomed to work on committees and act as referees and editors, and to excel at teaching, but we need to find ways of ensuring women are given the recognition they deserve. Of note, The Society's Council unanimously signed up as one of the founding signatories of the Science Council's Declaration on Diversity, Equality and Inclusion, and Council appointed two trustees, Sue Deuchars and Rachel Tribe, to lead on this, and they will be supported by a dedicated staff member and the CEO.

What has changed enormously in the past 25 years, however, is the broader climate in which these more local changes detailed above have taken place. The Equality Act 2006 introduced the Gender Equality Duty, which obliged public bodies to take action on gender equality, to address and eliminate unlawful sex discrimination and harassment, and to promote equality of opportunity between men and women. In universities and other places of higher education (where physiology is principally practised), Gender and Diversity issues are now addressed seriously. In 2005 the government's Equality Challenge Unit established the Athena SWAN Charter to encourage and recognise commitment to advancing the careers of women in science, technology, engineering, maths and

medicine (STEMM) employment in higher education and research. One of the pioneers in building up recognition for Athena SWAN, Dame Julia Higgins has written a foreword to this book.

In this centenary year of women first being elected to The Physiological Society, some of the figures above indicate that there is still plenty of work to be done, both within The Society and within the discipline more generally. The Council, with the leadership of Sue Deuchars and Rachel Tribe, are committed to continuing this agenda into the future, as noted above, and have contributed an afterword to the book.

By Lynn Bindman and Tilli Tansey

We are pleased to acknowledge the help of Sally Howells in connection with The Society's journals

"To dine with ladies smelling of dog"?

A brief history of women and The Physiological Society

E. M. Tansey

A historical account of women physiologists prior to the election in 1915, of the first six women to The Physiological Society.

The careers of these six pioneers are described, with most detail for Winifred Cullis who was the first woman to become Professor of Physiology and Head of a Department of Physiology. The situation of women in contemporary learned societies is also examined, as is the participation of women in The Physiological Society from 1915 to 1990.

'They were nearly all bearded, ... well several of those beards are preserved in photographs ... and another difference from now would be that I don't think, I don't know that there were any regulations about it, but I do not think there were any women members of The Society. I don't think it was because they could not produce beards, or whether the prevalence of beards kept them away, but they were very charming people.'

[C. S. Sherrington: transcript of an after dinner talk, to The Physiological Society, Trinity College, Cambridge, 1 October 1941].[1]

Sir Charles Sherrington's mischievous reminiscences of the early days of The Physiological Society emphasize an important point: from its foundation in 1876 until 1915, that is for almost 40 years, there were no women members. The role of women in the physiological sciences in Britain prior to 1915 will be specifically assessed in this chapter, which also examines the debates about their election to The Society, and will briefly summarize the activities of women within The Society, until 1990. It thus addresses several questions: was there ever an explicit bar to women becoming members?; were there many suitably qualified women prior to 1915 and were any refused membership?; how did they finally gain admission?; and how did The Physiological Society compare with other societies?[2]

Women in late 19th century science

The absence, or apparent absence, of women from the ranks of the newly emerging professional physiologists during the final decades of the 19th century was not unique, and scrutiny of several bibliographic dictionaries has provided little evidence of women in science or medicine during this period[3]. Recent works that have explored some of the historical inter-relationships between gender, science and society have accentuated some of the difficulties in locating women scientists, especially within the context of a shifting focus from the field to the laboratory, from the amateur to the professional. Additionally, underlying contemporary social and cultural assumptions, such as 'Nature'

as feminine and 'Science' as masculine, have further restricted the criteria by which women's participation in, and contributions to, scientific activities are assessed[4]. This chapter attempts to examine the situation within British physiology during the past century, as a case study of the role of women within one scientific specialty.

The history of British physiology, as it resolved during the final years of the 19th century into the structures and practices we are familiar with today, seems almost exclusively male-dominated. Occasionally women appear, although they do so on the periphery. In 1879, for example, the novelist Mary Ann Evans endowed the George Henry Lewes Studentship in Physiology, which was early recognition of the need to provide dedicated financial support for the development of a new professional science. The scholarship provided significant assistance for many eminent physiologists, and was, from its foundation, specifically open to both men and women. But even Mary Ann Evans felt obliged, for the sake of her 'reputation', to hide her sex behind the masculine nom de plume of 'George Eliot'[5].

By the close of the 19th century, there had been several disparate campaigns, with varying success rates, to improve the limited and restrictive educational and professional opportunities available to women. These included the founding of schools and colleges dedicated to the needs of women's education[6]. One such was Girton College, founded in Cambridge in 1873; here (as also happened in Oxford) female students were permitted, at the discretion of the academic staff, to join men in some classes. In Cambridge, agreement was reached in 1877 that women could attend the University courses in anatomy and physiology run by Professor Humphrys, while Michael Foster's physiology classes at Trinity College were also opened to women students[7]. Although they were further permitted to sit University examinations and their names were included in the Tripos Lists, it was to be many years before women were formally awarded the degrees they had duly earned – 1920 in Oxford and 1923 in Cambridge[8].

A few women managed to achieve medical qualifications, often in the face of much opposition, and frequently by routes that were immediately closed behind them[9]. Three educational institutes in London were of particular importance in providing early courses in either medicine or physiology from which women could obtain degrees. The London School of Medicine for Women opened in 1874, mainly as a result of the campaigning efforts of Sophia Jex-Blake, one of the first medically qualified women in Britain. It was not until 1876, however, that an Act of Parliament enabled all medical corporations to examine women, and the London School, later incorporated into the Royal Free Hospital Medical School, produced its first medical graduates in 1882. The second establishment under consideration, University College, London, first admitted women as full members in 1878 and the first of its own female students to graduate with a B.Sc. in physiology

was in 1891, just 5 years before one of the subjects in this book, Harriette Chick (q.v.). The first woman to obtain a degree in physiology was Florence Eves, a Cambridge student from Newnham College, who graduated in 1881[10]. Bedford College for Women, which opened in 1849, had included physiology classes from 1882 onwards[11].

The Physiological Society

What then was the situation in The Physiological Society? Founded in March 1876 by men of varied scientific backgrounds it was formulated as a dining society for 'mutual benefit and protection ... for promoting the advancement of Physiology and facilitating the intercourse of Physiologists'[12]. The first set of domestic rules restricted membership to 40 'working physiologists', although 'working' was never defined and the numerical limit was abolished in 1884. There was never any explicit limitation by sex. The interdependence of The Society and the subject have been analysed as 'inextricably linked; the history of the one reflects the history of the other'[13], and an examination of the role of women within The Society can be used with confidence as an indicator of their significance, or otherwise, within the discipline itself.

The regular meetings of The Society, which had from December 1880 included some scientific demonstrations and talks before the main business of The Society – the dinner – were vitally important in providing reinforcement and cohesion to the professional cadre of physiologists. Neither the first Minute Book of The Society nor the published Proceedings of its early meetings provide much evidence of the presence of women physiologists, although their identification has relied either on the use of a first name or title, or on personal knowledge that a contributor is female[14]. Miss Greenwood, of whom more later, was the first woman to publish a communication, although her observations on the gastric glands of the pig were presented to The Society, in March 1884, by J.N. Langley. Significantly, there is no evidence that she attended the meeting herself, although, ironically, the Minutes record the Secretary's rare complaint that members had not provided the names of all their guests. Five years later a Miss Brinck was the author of a communication on the nutrition of skeletal muscle, although it too was read to The Society by a male member, Augustus Waller, a procedure not employed for papers by male guests of The Society. The first explicit record in Sharpey-Schafer's History of The Physiological Society of a woman at a scientific meeting was Florence Buchanan's presence at the Oxford meeting in June 1896, although she was not at the dinner[15]. It was a further 10 years before five women were, for the first time, allowed to attend the dinner[16].

Women in British physiology, 1876-1915

Are these sparse reports of activities within The Society an accurate reflection of the numbers of women regularly working in physiological research? A systematic study of the early volumes of *The Journal of Physiology* provides an estimate of how many women prior to 1915, might have been eligible for Society membership, although one has to look carefully: for example, A.D. Waller is attributed with sole authorship of two communications to The Society, which on closer examination were collaborations with women – Helen Kemp and Mary Waller, respectively. Although The Journal was privately owned by Michael Foster from 1878 until 1893 and then by J.N. Langley until 1926, and its editorial policy did not necessarily reflect The Society's position, the two were intimately associated. There is no evidence that there was ever any question of excluding papers written by women, and its very first volume contained papers by Harriet V. Bills and Emily Nunn[17]. Significantly, perhaps, both were Americans. The only regular British contributor during the early years was Marion Greenwood[18], a Demonstrator in Physiology at Newnham College, Cambridge, whose communication to The Society had been read by Langley in 1884. University records show that she took the Natural Sciences Tripos from Girton College, passing Part I in 1882 and Part II the following year both with first class marks (the first woman to achieve this distinction in physiology). By 1890, she was a Lecturer at Girton and Newnham Colleges and her work, principally on digestive processes in invertebrates, was clearly identified as 'From the Physiological Laboratory, Cambridge'. She, together with a Newnham colleague Florence Eves who worked contemporaneously on hepatic and pancreatic function, was supported by Michael Foster and by J.N. Langley, the latter of whom Greenwood acknowledged for 'unwearied patience and constant help'. Greenwood never held a University position and, after marriage in 1899 to the marine biologist George Bidder, her independent research career ceased. She died in 1932 and never became a member of The Physiological Society[19].

"To dine with ladies smelling of dog"?

Physiologist	Papers	Communications	Member
Harriet Bills	1		
Miss Brinck		1	
A. Miriam Bruce[48]		1	
Florence Buchanan	2	10	1915
Elizabeth Cooke[49]	2		
Harriette Chicks[50]	4		1918
Winifred Cullis	8	1	1915
Dorothy Dales[51]	4	3	
Florence Durham[52]		4	1920
Elizabeth E. Eaves[53]	1		1918
Beatrice Edgell[54]		2	
Florence Eves	2		
Mabel Fitzgerald[55]	1		1973
Laura Forster[56]	1		
Marion Greenwood[57]	7		
Helen G. Grunbaum[58]		3	
Gladys Hartwell[59]		1	1922
Evelyn E. Hewer[60]	1		1918
A. Muriel Hill[61]	1	2	
Annie Homer[62]		3	
Lily H. Huie[63]		1	
Helen P. Kemp[64]		3	
Marie Krogh[65]	1		
Janet E. Lane-Claypon[66]	1	1	
Doris L. Mackinnon[67]		1	
Marion I. Newbiggin[68]	1	1	
Dorothy Norris[69]		1	
Helen Perkins[70]	1		
Myra E. Pollard[71]	1		
Agnes Ellen Porter[72]		1	
C.B. Sanders[73]		1	
Edith R. Saunders[74]	1		
Ida Smedley[75]	3	1	
Sarah C.M. Sowton	2		1915
Mary Christine Tebb[76]	8	6	
Florence D. Thompson[77]		1	
Enid M. Tribe[78]		1	1915
May Tweedy[79]	1		1956
Nora Tweedy[80]		1	1927
Mary D. Waller[81]		3	
Edith G. Willcock[82]	4	1	

Publications by women physiologists in *The Journal of Physiology* before 1915[47]

Until 1915, an increasing number of women gave communications and demonstrations to The Society and published papers in the journal, and a summary of their contributions is given in Table 1. Replotted in Figure 1, the data reveal two important features: that from 1901 onwards there was an increasing and constant female presence amongst the authors; and that some of these authors were consistently contributing more than one publication per year. How then did these productive women become members of The Society?

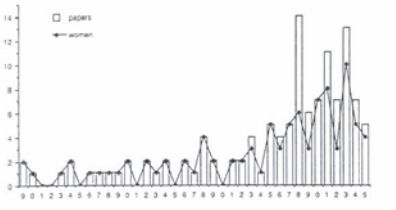


Figure 1

A histogram showing both the total numbers of papers and communications published by women in *The Journal of Physiology* between 1879 and 1915, and the numbers of women producing these papers

The debate to admit women to The Physiological Society, 1913–1915

According to the official History, it was at the AGM in January 1913 that it was first proposed, by J.S. Haldane, that women should be eligible for membership. This was approved by 16 votes to 13, and an amendment that all members should be canvassed on the question was defeated. Haldane's private correspondence, in a letter to Mabel Purefoy Fitzgerald, whose own election is described below, provides an account of the occasion:

'By the way there was a very lively debate at the January meeting over the question of admission of women to membership of The Society! I had moved a resolution in favour of this, & in the end it was only carried by a small majority. It all seems very absurd, considering that women are nearly always present at the meetings & often read papers.'[20]

Strangely, the issue was still under discussion later that year and, during a Society dinner in June, E.H. Starling, who opposed the motion (his brother-in-law William Bayliss supported the idea), stressed that The Society was primarily 'a dining society and it would be improper to dine with ladies smelling of dog –the men smelling of dog that is'[21]. The Society's Minute books (those of both the Scientific Meetings and those of the Committee Meetings) shed little further light on either Haldane's initial proposal or the response to it, the record merely noting: 'It was understood that further action should be left to the Committee'. At neither of the two subsequent Committee Meetings (17 May and 7 June 1913) was the matter raised, and it was at the third such meeting, in December 1913, that 'It was proposed by Prof. Cushny & seconded by Dr. Pembrey "That the Committee take no action in respect of the admission of women to membership of the Society"'. This was rejected by seven votes to two and J.N. Langley suggested that the question be

addressed to the entire membership, this proposal being passed by the same margin of seven votes to two[22]. Thus, it was at the AGM in January 1914, despite the previous year's vote, that Langley and Haldane proposed a postal ballot on the subject, and Starling recommended that the Committee draw up the terms of the referendum. Six months later the result was announced: 161 members, from a total of 272, voted on the matter. Of these 94 supported the admission of women, 36 voted for women as associates only, barring them from attending the dinners (a telling indication of how central the dining activities were to The Society's business!), and 31 wanted no alteration in the status quo. Accordingly, the proposal was made and carried that the Committee should formally recommend, at the next AGM, the admission of women. And so finally, in January 1915, 'approved by a majority', the following was added to The Society's rules:

Rule 36. Women shall be eligible for membership of The Society and have the same rights, duties and privileges as men.

The first six women members of The Physiological Society

Six months after this amendment, at the first available opportunity, Florence Buchanan, Winifred C. Cullis, Ruth C. Skelton, Sarah C.M. Sowton, Constance Leetham Terry and Enid M. Tribe were elected to The Society, along with two men, George Winfield and W.R. Thacker. In his Annual Report for 1915 the Secretary, William Bayliss, noted laconically: 'A new departure has been taken in the admission of women to membership of The Society on the same terms as men'.

These first women members seem to have pursued rather different careers, as assessed by an examination of their scientific publications. With the exception of Winifred Cullis it has been difficult to discover much detail of their lives, a problem that besets many biographical studies of scientists, who are extremely difficult to trace unless they achieve professional pre-eminence[23]. These problems are compounded when considering women who often changed their name upon marriage and who frequently never held officially recorded academic positions.

Florence Buchanan from Oxford was an immensely productive physiologist, and between 1899 and 1923 she published several papers and gave at least 12 communications to The Physiological Society. Her work included early studies of the electrical properties of resting and contracting skeletal muscle and an extensive comparative study of cardiovascular function, including assessments of the effects of hibernation. Prior to her election in 1915, she was introduced to The Society by J.S. Haldane, and it seems likely that it was his proposal of Miss Buchanan for membership that initiated the debate about women in The Physiological Society. Although there is no record in any of The Society's Minutes, close scrutiny of the early Candidates Books, small notebooks in which suggested names were jotted down somewhat casually (the inclusion of qualifications or addresses of candidates was erratic), shows that Haldane entered Buchanan's name in the lists sometime

around 1912. Despite considerable backing, indicated by 31 supporting signatures, she was not elected, although the candidates immediately before and after her in the Candidates Book, August Krogh and Casimir Funk, were elected with less support (25 and 20 signatures, respectively) in January 1913. This, of course, was the very meeting when Haldane formally proposed the election of women. Buchanan's name was transferred to the new Candidates Book at the beginning of 1915, where she attracted a further 18 supporters, her entry covering, uniquely, a total of three pages!

Of the other women elected in 1915, little is known. Sarah Sowton, for example, also had a productive, but varied, scientific career. During the final years of the 19th century, she was working on the effects of carbon dioxide on skeletal and cardiac muscle function at St Mary's Hospital Medical School in London with Augustus Waller. She was one of seven British women listed as delegates to the fourth International Physiological Congress in Cambridge in 1898 – the others being Miss J. Brinck (London), Miss M. Greenwood (Cambridge), Miss H.J. Hutchinson (Nottingham), Miss M.C. Tebb (London), Mrs A.D. Waller (London) and Miss F.A. Welby (London) – but was the only one to present a paper. Later she worked with Charles Sherrington in Liverpool, their particular interest being the effect of chloroform on spinal reflexes. Together, they compiled several reports for the special Chloroform Committee of the British Medical Association, all published in the British Medical Journal. By 1915 she had an impressive list of publications, and A.D. Waller, describing her as 'engaged in research', proposed her for Membership of The Society, although where she was then working is not indicated. During the following year, however, she was clearly employed in Leeds, and produced a paper on anaphylaxis with the husband and wife team of A.S. and H.G. Leyton (formerly Grunbaum), and in 1928 she was the co-author of a report, for the Industrial Fatigue Research Board, on an experimental study of the effects of menstruation on mental and physical efficiency[24].

There is a similar paucity of detailed information about the careers of the other women elected in 1915. Ruth Skelton was a Demonstrator in Ernest Starling's department at University College London, and published work on cardiovascular physiology[25]. She was nominated for Society membership by Joseph Barcroft, as was Constance Leetham Terry who was then a Demonstrator in Physiology at the London School of Medicine for Women. Terry was the first woman to be awarded the University of London's University Studentship in Physiology in 1913, the same year that saw her first publication on in vitro effects of drugs on ventricular muscle[26]. Enid Tribe was a Lecturer in Histology at the London School of Medicine for Women and the author of papers on cardiac and pulmonary innervation[27]. She, too, was proposed by Barcroft, with whom she later worked, and continued to be listed in the Grey Book in her married name (Mrs Oppenheimer) after moving to

New York. One of her earliest papers[28] was in collaboration with the sixth woman elected in 1915, Winifred Clara Cullis, who can be regarded almost as the stereotypic 'pioneer' woman physiologist. Her achievements deserve further examination.

Winifred Cullis (1875-1956)

Winifred Cullis[29], born in June 1875 in Gloucester, was educated at the King Edward's High School for Girls in Birmingham, whence she was sent at her own request for additional biology tuition at the local Mason College (precursor of the University of Birmingham). This aroused some controversy, with threats of staff resignations, it being considered indecent for a girl to study so much biology. She entered Newnham College, Cambridge, with a Sidgwick Scholarship, to read Natural Sciences, and she too came under the influence of J.N. Langley. She was awarded second class marks in both parts of the Tripos (1899 and 1900), and, after a brief period teaching biology in a private girls school, was appointed a Demonstrator in Physiology at the London School of Medicine for Women in 1901. Two years later, she became a lecturer in the same department, in 1908 she earned a University of London D.Sc.[30], and in 1912 she was named as Reader and Head of Department, in succession to T.G. Brodie, with whom she had worked closely for several years. Seven years later the University of London granted her the title and status of a full Professor, when she was appointed as the first incumbent of the Jex-Blake Chair of Physiology. She was subsequently the first woman to serve on The Physiological Society's Committee, from 1918 to 1925, and the first woman to preside at a Meeting of The Society in 1920[31].

During the early years of her career, either alone or in collaboration, she produced quality work on a number of subjects: she produced several papers with T.G. Brodie on urine secretion, gut gas metabolism, and coronary vessel innervation; with W.E. Dixon she investigated the function of the atrio-ventricular bundle; with Enid Tribe she published observations on cardiac innervation; she produced further papers on cardiovascular physiology with Ellen Dahl, Olive Rendel and Eleanor Scarborough; and her final communication to The Society in 1936 was on the action of acetylcholine on the denervated heart of the chick.

As a teacher, she inspired generations of students at the London School for Women (later the Royal Free Hospital Medical School) and she was an early proponent of using films in the teaching of physiology. One pupil recalled her lectures as '... a model, their spontaneity coming from a mastery of the subject and of words, and also, one suspects, from the most careful forethought. They were amusing, indeed on occasions uproariously funny. Everyone was grateful for the stimulus ...'[32].

Her role was much greater than indicated by this bald listing of academic achievements. She was an indefatigable public lecturer, especially on health education, addressing audiences as diverse as those of the BBC Schools programmes and British troops in wartime, and she wrote books on general

human physiology and health for the layman[33]. She was a founder member of the Federation of University Women, serving as its President from 1925–1929, and later was instrumental in establishing the International Federation of University Women. She believed that both bodies were vital in promoting the co-operation of professional women in achieving and maintaining equal opportunities and status with men. During the Second World War, she travelled extensively in America, the Far East and Australasia on behalf of the Ministry of Information, and her internationalism is appropriately commemorated in an eponymous Lecture Fellowship of the British-American Association. Several addenda to her obituary in the Times testify to her influential roles in other spheres: in the English-Speaking Union; on the governing body of Chelsea Polytechnic; and as a governor of the Royal Academy of Dancing[34]. The latter tribute, by Dame Margot Fonteyn, shows that Winifred Cullis' personal involvement extended to providing special courses in physiology and anatomy for the dancers, and chairing the Academy's Overseas Committee, no sinecure: apparently, she attended two or three meetings per week. Her obituaries not only laud her extensive professional and public achievements, but also praise her warm personality, sound common sense and her abiding concern for the advancement of women. One obituary notice concluded warmly that 'her memory will long be cherished' – sadly, an over-optimistic expectation.

Women in contemporary learned societies

To return to 1915 and the election of those first women into The Physiological Society – was the situation in contemporary, learned societies any different? A random survey reveals that medical women had been members of the Medico-Psychological Association since 1895 and were admitted to The Royal Physical Society of Edinburgh in 1909; however, that was the same year that saw a particularly acrimonious correspondence in the pages of Nature over the Chemical Society's refusal to permit women members[35].

In America, the Societies of Zoologists and of Naturalists had already elected women members by the turn of the century, and during this period women were Founder Members of at least two American scientific societies: the American Society of Biological Chemists (1906) and the American Institute of Nutrition (1933)[36]. All assessment of the American Physiological Society is slightly blurred by the existence, although not concurrently, of two such-named bodies. The earlier society, founded in 1837, was principally for the promulgation of ideas on health and hygiene. Women formed over a quarter of its original membership, and local 'Ladies Physiological Societies' were promoted and established across the country, although the movement does not seem to have flourished[37]. What survives today as the American Physiological Society (APS) was founded in 1887 as an academic society closely analogous to the British Society. Although they elected their

first woman member in 1902, ironically the first person ever rejected, in 1895, was also a woman. This was Frances Emily White, who was refused because her publications were in popular magazines and not therefore considered to fulfil the original research criteria used by The Society. The reasons for her failure were carefully publicised by The Society, apparently anxious to avoid the charge of discrimination on the grounds of sex[38].

In 1902, however, an eminently suitable candidate, Ida Hyde, was presented. The APS Council (like their British colleagues later), notwithstanding the lack of any constitutional prohibition, decided to refer the matter to the whole membership, and one cannot but wonder if the evident unsuitability of the previous woman candidate had in fact been welcome. After 'a full discussion' Dr Hyde was elected[39], but she remained the sole woman for 11 years, until Mabel Purefoy Fitzgerald joined her[40].

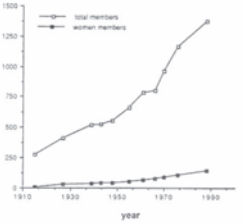
Miss Fitzgerald provides a poignant footnote to the history of women in British physiology. Born in 1872, she was trained by J.S. Haldane in Oxford and is chiefly remembered, if at all, for her work on high altitude acclimatization, carried out in conjunction with the Pike's Peak expedition in 1911. Around about 1912, she appears to have been resident in the United States, although she moved to Edinburgh to work as a clinical pathologist during the First World War, and she finally returned to Oxford in 1930. There she remained, in apparent obscurity, until at the age of 100 she was elected to membership of The Physiological Society[41].

Some societies founded in Britain after The Physiological Society adopted an even harsher attitude to the question of women's membership, at least initially. The Biochemical Society, established in 1911 by several members of The Physiological Society and closely modelled on the older society, had a formal rule from its initiation that only men were eligible. This regulation, passed after 'prolonged and vigorous discussion' and described by The Society's own historian as 'bizarre', was soon challenged and overturned: the first three women, Ida Smedley, Harriette Chick (q.v.) and Muriel Wheldale, were elected the following year[42]. More strangely perhaps, the Pharmacological Society, which was formed as late as 1931, another 'daughter society' of The Physiological Society, also explicitly excluded women. However, Mary Pickford (q.v.) became the first woman member four years later, with no dissent being recorded in their Minutes, and she was followed in successive years by Edith Bulbring (q.v.) and Marthe Vogt (q.v.)[43]. These positive prohibitions against women, however short-lived, clearly raise important questions, worthy of more detailed analysis than possible here, about the increasing perception of science as a male-orientated profession, and the evolution and promotion of that perception.

In the broader reaches of national science, women were not elected to the Royal Society until 1945, during the Presidency of the physiologist H.H. Dale[44]. These were Kathleen Lonsdale (Section A, Physical Sciences) and Marjory Stephenson (Section B, Biological Sciences), and their election also

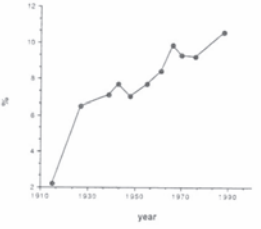
had encountered resistance, although Dale himself in his Presidential Address noted 'I find myself again with the majority, in believing this change involves no more than a perfectly normal adjustment of our practice, perhaps rather belated, to the growth in extent and distinction of women's contribution to the advancement of science by research'.[45]

Figure 2



A graph showing both the total numbers of members and the numbers of women members of The Physiological Society between 1915 and 1990

Figure 3



A graph, calculated from the data in Figure 2, showing the numbers of women members as a percentage of the total of The Physiological Society between 1915 and 1990

Women in The Physiological Society, 1915–1990

After 1915 women were, and have been, regularly elected to membership of The Physiological Society. Signatures in the early Candidates' Books show that three men – J. Barcroft, W.M. Bayliss and H.H. Dale – and Winifred Cullis regularly and consistently proposed and supported the election of early women members. It was not until 1967 that the first female Honorary Member was elected, when Dame Harriette Chick (q.v.) was so honoured after almost 50 years of membership (see Figures 2 and 3).

Gradually women followed Winifred Cullis onto The Society's Committee and, many years later, also reached the Editorial Boards of The Society's journals, Margaret Murray (q.v.) being elected to the board of *The Journal of Physiology* in 1949, and Catherine Hebb (q.v.) onto the board of the Quarterly *Journal of Experimental Physiology* (now *Experimental Physiology*) in 1951. These are all significant stages in the attainment by women physiologists of status and acceptance as professional scientists. But important as they are, they are only a part of the process of achieving adequate recognition and opportunity: access to permanent positions and subsequent promotion, as well as to research grants and academic resources, are also necessary, and the difficulties in

tracing the lives and careers of some of these early women physiologists testify to the ephemeral nature of many of their positions.

In 1982, the distinguished biochemist Dorothy Needham F.R.S., reviewed her own career:

'Looking back over my 45 years in research I find it remarkable, especially from the point of view of contemporary practice, that although a fully-qualified and full-time investigator I never received, or even applied for, any substantive post. I simply existed on one research grant after another, devoid of position, rank or assured emolument. In other words, I belong to the generation for whom it was calmly assumed that married women would be supported financially by their husbands, and if they chose to work in the laboratory all day and half the night, it was their own concern. Moral support I also received consistently from Joseph [Joseph Needham F.R.S., her husband], but it was never in his power to give me the self-respect which comes from a recognised and established position. I am glad that the young women in science today are not expected to observe this discouraging system of dependence'.[46]

I thank Professor W.E. Bynum, and Dr A. Silver for their help in providing information or for criticizing earlier drafts of the manuscript; and the Committee of The Physiological Society for allowing access to, and quotation from, The Society Archives. I am grateful to the Wellcome Trust for financial support.

Notes

1. Archives of The Physiological Society.

2. A preliminary communication was given to The Physiological Society on the occasion of the 75th anniversary; see Bindman, Brading and Tansey (1990).

3. For example, Rosenberg and Bergstrom (1975) provide 85 entries for 'Women in medicine', although 110 for 'Women in psychology'. Chaff et al. (1977) include just two entries under 'physiology'. In a slightly later work, Henifin (1979) includes 'Women in the scientific workforce and structure of the scientific workforce'; see pp. 213–268, especially pp. 227–231. Other useful bibliographies are given in Chaff et al. (1977) and Ritchie (1980), especially 'Science', p. 79.

4. This is a rapidly growing field of study; see e.g. Mason (1992a). The essays in Abir-Am and Outram (1987) explore several factors affecting the representation of women in various fields of science; see especially M.W. Rossiter (1982), 'Introduction', pp. xi— xii. Work on American medicine has extended our understanding of some of the pressures and limitations that confronted medical women [see e.g. Morantz et al. (1982) and Morantz-Sanchez (1985)], although there is no explicit account of women physiologists.

5. George Eliot to John Blackwood, Feb 1857, quoted in Haight (1968), p. 219. She was associated with some quite remarkable women, including Barbara Bodichon (Florence Nightingale's cousin) and Emily Davies, both active educational reformers and founders of Girton College. Bodichon was particularly persuasive, when the Studentship was inaugurated, that it should be specifically open to women, although the first, Winifred Parsons, did not apply until 1919; see Tansey (1988, 1990, 1992).

6. Hollis (1979) provides a useful spread of material that embraces several aspects of the 'woman question'. More readily accessible and interpretive accounts of several key issues are offered in Forster (1984), and Phillips (1990) gives an account of women's access to education in parallel with a discussion of their interests and activities in scientific endeavours.

7. See e.g. 'University intelligence: Cambridge' Nature (1879) 20, 74.

8. See Bennett (1990) pp. 184–185.

9. See e.g. Blake (1990), and also Jex-Blake (1886) and

Blackwell (1895), for eye-witness accounts of these pioneering days.

10. The histories by Harte (1979; 1986, pp. 132–134), and the University of London Historical Record provide further details. I thank Mr J. Arterton, Registrar of University College London and Professor N. Harte for assistance.

11. Tuke (1939) and Harte (1986) p. 112–113.

12. Details of the early members of The Physiological Society are in Sharpey-Schafer (1927) pp. 12–40, and O'Connor (1988) passim.

13. Bynum (1976), quote on p. 24.

14. Reports of the scientific sessions were included in *The Journal of Physiology* from December 1883; prior to that they are detailed in Sharpey-Schafer (1927).

15. It must be noted that at least two portions of the first Minute Book have been excised: from 18 May to 12 Dec 1878, and from 13 Nov 1886 to 12 Feb 1887. However, it is extremely unlikely that any women attended meetings in these periods.

16. Mrs Chalmers Watson and Mrs Thompson, and the Misses Mitchell, Eaves and Sowton; the last two later joined The Society.

17. Nunn became well known in America as a Professor of Zoology; see Rossiter (1982), pp. 323n30, 334n53, 345n29.

18. She was no relation to the medical statistician Major Greenwood who published in *The Journal of Physiology* during the same period, and who was elected to The Physiological Society in 1906.

19. I am most grateful to Dr Anna Bidder for information about her mother.

20. J.S. Haldane to Mabel Purefoy Fitzgerald, 4 Mar 1913; the original is in the Mabel Purefoy Fitzgerald Papers in the Bodleian Library, Oxford. I am indebted to Dr R.W. Torrance for this information.

21. Evans (1964) recounts the anecdote; it is not mentioned in either the Minutes of the Meeting or in Sharpey-Schafer's History.

22. The ten Committee members present were: Leonard Hill (in the Chair), F.A. Bainbridge, W.M. Bayliss, A.R. Cushny, E.P. Cathcart, A.R. Harden, J.N. Langley, J. Mellanby, M. Pembrey and H.E. Rom".

23. Compared with say a medically-qualified person whose entries in the Medical Register, or more usually the Medical Directory, provide basic details of qualifications, positions and addresses.

24. Sowton and Myers (1928) and Welch and Myers (1932) p. 44 claim that she was a member of the Board, but corroborative evidence has not been found in the Board's Annual Reports.

25. E.g. Skelton, R. (1921) The relation of pulse pressure to the output of the heart. J. Physiol. (London) 55, 319–321.

26. University of London Historical Register (1926) p. 286. See also Leetham Terry, C. Action of certain drugs on isolated strips of ventricle. J. Physiol. (London) (1913) 46, 151–158.

27. E.g. Tribe, E. (1914) Vasomotor nerves in the lung. J. Physiol. (London) (1913) 48, 154–170.

28. Tribe, E. and Cullis, W.C. (1913) Distribution of nerves in the heart. J. Physiol. (London) 46, 141–150.

29. Details of Winifred Cullis are taken from her entry in Who was Who, the Dictionary of National Biography (by Ruth Bowden), and obituaries in The Times (15 Nov 1956), The Daily Telegraph (15 Nov 1956), The Lancet (24 Nov 1956) and the British Medical Journal (24 Nov 1956). I am grateful to Professor Ruth Bowden for additional information.

30. Cullis (1908).

31. The meeting, at the London School of Medicine for Women, was held on 10 July 1920 and had been arranged at very short notice (less than three weeks) because the scheduled meeting in Oxford was cancelled.

32. Bowden, R. (1956) Dr. Winifred Canis. The Times, 3 Dec.

33. Cullis and Bond (1935) and Cullis (1949).

34. The Times, 20 Nov 1956.

35. See e.g. Nature (1908–1909) 79, 399, 429–431, 488; and Moore and Philip (1947) pp. 96–97, 116–117. Creese (1991) provides an interesting study of the numbers of women engaged in chemical research at the turn of the century, and Dr Joan Mason is currently completing a detailed analysis of women and the Chemical Society.

36. See the articles by various authors in Reynolds (1987).

37. Morantz-Sanchez (1985) p. 35; Hoff and Fulton (1937). Women were involved in similar organizations in Britain; e.g. Mrs Florence Fenwick-Miller, the editor of The Woman's Signal wrote books on health, physiology and anatomy (see Arsdel, 1981).

38. Howell (1938) pp. 1–89.

39. See Appel (1987) pp. 31–62, especially p. 33.

Rossiter (1982) pp. 89–90, 331, also discusses Ida Hyde's election and lists some of her publications.

40. Appel, Cassidy and Tidball (1987) pp. 381–390. This provides a succinct analysis of women's roles within the management and organization structure of The Society, and teaching and research commitments are implicit and are not therefore elaborated on separately.

I41. am most grateful to Dr R.W. Torrance for allowing me to use material from an unpublished manuscript.

42. Goodwin (1987), pp. 14–15. See also Mason (1992b).

43. Bynum (1981), especially pp. 24–27.

44. A brief summary of the limitations of the Royal Society's Charter and the effect of the Sex Disqualifications Removal Act can be found in Hill (1962), pp. 321–336; see also Mason (1991, 1992c).

45. Dale (1945), especially p. 130.

46. Needham (1982), pp. 158–163. Might such a 'discouraging system of dependence' also affect the likelihood of a woman joining, even when eligible, and subscribing to a professional society?

47. The titles of papers will be provided in the following notes, as indicators of the wide range of scientific activities undertaken by these pioneer women.

48. The cerebellar tracts of the spinal cord. J. Physiol. (London) (1907) 35, xlix (with E.A. Schafer),

49. Action of the inorganic salts of serum, milk, gastric juice, etc., upon the isolated working heart, with remarks upon the causation of the heart-beat. J. Physiol. (London) (1893) 14, 198–220 (with W.H. Howell); Experiments upon osmotic properties of the living frog's muscle. J. Physiol. (London) (1898) 23, 137–149.

50. On the "heat coagulation" of proteins. J. Physiol. (London) (1910) 40, 404–430; On the "heat-coagulation" of proteins. Part II. The action of hot water upon egg-albumen and the influence of acids and salts upon reaction velocity. J. Physiol. (London) (1911), 43, 1–27; On the "heat-coagulation" of proteins Part III. The influence of alkali upon the reaction. J. Physiol. (London) (1911) 45, 61–69; On the "heat-coagulation" of proteins. Part IV. The conditions controlling the agglutination of proteins already acted upon by hot water. J. Physiol. (London) (1911) 45, 261–295 (all with C.J. Martin).

51. The action of acids on skeletal muscle. J. Physiol. (London) (1911) 42, xxix–moc; Observations on the physiological action of D- and L-tetrahydroquinaldine. J. Physiol. (London) (1911) 42, xxxi–xiocii; The influence of nerve stimulation on the electrocardiogram. J. Physiol. (London) (1913) 46, 319–336; The influence of vagus and sympathetic nerves on the electrical and mechanical responses of the frog's heart. J. Physiol. (London) (1913) 46, xxviii (all with G.R. Mines); On the action of electrolytes on Paramecium. J. Physiol. (London) (1913) 47, 130–140; Hydrogen ion concentrations limiting automaticity in different regions of the frog's heart. J. Physiol. (London) (1914) 47, 493–508; Hydrogen ion concentrations limiting automaticity in different regions of the frog's heart. J. Physiol. (London) (1914) 47, i (last two with C.R. Thacker).

52. On frog-heart-tracings. J. Physiol. (London) (1903) 30, xxvii–xxix (with H.E. Durham); Auricular and ventricular tracings from frog's hearts. J. Physiol. (London) (1903) 30, xxxi; On tracings from the auricle, ventricle, and sinus of the frog's heart. J. Physiol. (London) (1905) 33, xxiv–xxvii; Note on melanins. J. Physiol. (London) (1907) 35, xlvii–xlviii.

53. The transformations in the fats in the hen's egg during development. J. Physiol. (London) (1910) 40, 451-453.

54. Time judgement. J. Physiol. (London) (1902) 28, xxxi–xxxii; Experiments on association. J. Physiol. (London) (1905) 32, lxiv–lxv.

55. The normal alveolar carbonic acid pressure in man. J. Physiol. (London) (1905) 32, 486–494 (with J.S. Haldane); The breathing and haemoglobin content in persons acclimatized at various high altitudes. Unpublished demonstration, Physiological Society 17 May, 1913.

56. Note of foetal muscle spindles. J. Physiol. (London) (1902) 28, 201–203.

57. Observations on the gastric glands of the pig. J. Physiol. (London) (1884) 5, 195–208; On the digestive process in some Rhizopods. J. Physiol. (London) (1886) 7, 253–273; On the gastric glands of the pig idem vii–ix (communicated by J.N. Langley); On the digestive process in some Rhizopods Part Two. J. Physiol. (London) (1887) 8, 263–287; On digestion in Hydra, with some observations on the structure of the endoderm. J. Physiol. (London) (1888) 9, 317–344; On the action of nicotin upon some invertebrates. J. Physiol. (London) (1890) 11, 573–605; On retractile cilia in the intestine of Lumbricus terrestris. J. Physiol. (London) (1892) 13, 239–259.

58. On some changes in normal tissues produced by the action of radium. J. Physiol. (London) (1910) 41, xviii–xviv; Some points concerning the structure and function of the pituitary gland in man. J. Physiol. (London) (1911)

42, xxviii (both with A.S. Grunbaum); On certain chemical differences of the serum of old and young rats. J. Physiol. (London) (1915) 49, xxviii (with A.S. Grunbaum and H.S. Raper).

59. Some effects of muscular exercise on women. J. Physiol. (London) (1913) 46, ix–x (with N. Tweedy).

60. The effect of thymus feeding on the activity of the reproductive organs in the rat. J. Physiol. (London) (1914) 47, 479–490.

61. Calorimetrical experiments on warm-blooded animals. J. Physiol. (London) (1913) 46, 81–103; A self-recording calorimeter for large animals. J. Physiol. (London) (1914) 48, xiii–xiv (both with A.V. Hill); The effects of high external temperatures on the metabolism of rats. J. Physiol. (London) (1913) 46, xxxi. Muriel, sister of A.V. Hill, married the physiologist T.S. Hele; her niece Margaret Hill, A. V.'s daughter, became a member of The Society in 1931.

62. A note on the constitution of kynurenic acid. J. Physiol. (London) (1913) 46, xviii; A correction, rbitilxii; A note on a new method of estimating tryptophane in proteins. J. Physiol. (London) (1914) 48, iv.

63. Preliminary note on changes in the gland cells of Drosera produced by various food materials. J. Physiol. (London) (1898) 23, vi–vii, communicated by Gustav Mann.

64. Demonstration of the 'contractility' of nerve, of fiddle-strings and of other strings. J. Physiol. (London) (1908) 37, xviii–xxi; The action of alcohol upon electrically inexcitable muscle. J. Physiol. (London) (1908) 37, xliii–xlvi (both with A.D. Waller, who is listed as sole author of the first communication, a subtitle indicating experiments by H. Kemp and A.D. Waller); The physiological effects of (1) primary and secondary propyl alcohol, (2) normal primary and tertiary butyl alcohol. J. Physiol. (London) (1908) 37, xlix–li.

65. The diffusion of gases through the lungs of man. J. Physiol. (London) (1915) 49,271-300.

66. Some researches on the autolytic degradation of tissues. J. Physiol. (London) (1904) 31, 169–187 (with S.B. Schryver); On the post-natal formation of primordial ova. J. Physiol. (London) (1905) 32, Ai–A(14i.

67. The optical properties of the contractile elements in heliozoa. J. Physiol. (London) (1909) 38, 254–258.

68. The pigments of the decapod Crustacea. J. Physiol. (London) (1897) 21, 237–257; The pigments of the muscle and ovaries [of the freshwater salmon]. J. Physiol. (London) (1898) 22, 356.

69. The diaceryl reactions for proteins. J. Physiol. (London) (1911) 42, 332–336 (with A. Hadden).

70. A contribution to the study of geotaxis in the higher animals. J. Physiol. (London) (1879) 2, 99–110 (with C.B. Davenport).

71. On the relations of diaphragmatic and costal respiration, with particular reference to phonation. J. Physiol. (London) (1890) 11, 159–178 (with H. Sewall).

72. On the question of the identity of pepsin and rennet. J. Physiol. (London) (1911) 42, 389–401.

73. Electrical conditions in active arum spadices. J. Physiol. (London) (1907) 36, xvii–xviii.

74. On the role of acid in protozoan digestion. J. Physiol. (London) (1894) 16, 441–467 (with Marion Greenwood). Edith Saunders became a well-known botanist, working in the Cambridge Botanical Gardens (see Walters, 1981, pp. 90–91).

75. The utilisation of different sugars by the normal heart. J. Physiol. (London) (1912) 45, 462–469; The behaviour of the diabetic heart towards sugar. J. Physiol. (London) (1912) 45, 470–472 (both with H. MacLean); The action of the liver on the simpler sugars. J. Physiol. (London) (1912) 44, 203–205; The biochemical synthesis of fatty acids from carbohydrates. J. Physiol. (London) (1912) 45, x:cv–xxvii.

76. On the transformation of maltose to dextrose. J. Physiol. (London) (1892) 13, xix—loc (with L.E. Shore); On the transformation of maltose to dextrose. J. Physiol. (London) (1894) 15, 421–432; Hydrolysis of glycogen. J. Physiol. (London) (1898) 22, 423–432; Chemistry of reticular tissue. J. Physiol. (London) (1899) 24, x–xi; Reticulin and collagen. J. Physiol. (London) (1902) 27, 463–472; The precipitation of proteins by alcohol and certain other reagents. J. Physiol. (London) (1903) 30, 25–38; The cholesterin of the brain. J. Physiol. (London) (1906) 34, 106–110. The following all in collaboration with O. Rosenheim, whom she later married: The non-existence of 'protagon' as a definite chemical compound. J. Physiol. (London) (1907) 36, 1–16; The optical activity of so-called 'protagon'. J. Physiol. (London) (1908) 37, 341–347; On a new physical phenomenon observed in connection with the optical activity of so-called 'protagon'. J. Physiol. (London) (1908) 37, 348–354; Further proofs of the non-existence of 'Protagon' as a definite chemical compound. J. Physiol. (London) (1908) 37, i–iv; The lipoids of the brain. Part 1. Sphingomyelin. J. Physiol. (London) (1909) 38, On the lipoids of the adrenals. J. Physiol. (London) (1909) 38,

liv–lvi; The lipoids of the brain. Part II. A new method for the preparation of the galactosides and of sphingomylein. J. Physiol. (London) (1910) 41, i–ii.

77. The islets of Langerhans in the elasmobranch fishes. J. Physiol. (London) (1907) 35, xlv–xlvi (with Swale Vincent).

78. Effect of adrenaline on pulmonary circulation. J. Physiol. (London) (1912) 45, xx–xxii; see also Note 28 above.

79. The natural channels of absorption evoking the chemical mechanism of gastric secretion. J. Physiol. (London) (1909) 38, 263–267 (with J.S. Edkins). May Tweedy later married Edward Mellanby and was a distinguished nutritional physiologist in her own right; see Dale (1955).

80. See Note 59 above.

81. Note on the relation between the electrolyte concentration of some neutral perfusion liquids and the frequency of beat of the frog's heart. J. Physiol. (London) (1914) 48, xlvi–xlvii; A.D. Waller (with the assistance of M.D. Waller): Calculation of the axial angle. J. Physiol. (London) (1915) 49, xxxiii–xxxv; The condenser effect of platinum electrodes. J. Physiol. (London) (1915) 49, xliii–xlv.

82. The action of the rays from radium upon some simple forms of animal life. J. Physiol. (London) (1904) 30, 449–454; The action of radium rays on ryrosinase. J. Physiol. (London) 34, 207–209; The importance of individual amino-acids in metabolism. J. Physiol. (London) (1906) 35, 88–102; Crystalline egg-albumin. J. Physiol. (London) (1908) 37, 27–36 (both with F.G. Hopkins); W.B. Hardy and Mrs Stanley Gardiner [E.G. Wilkock]: Proteins of blood plasma. J. Physiol. (London) (1910) 40, lxviii–boci.

References

Abir-Am, P.G. and Outram, D. (eds) (1987) Uneasy Careers and Intimate Lives: Women in Science 1789–1979. Rutgers University Press, New Brunswick, New Jersey

Appel, T. (1987) First quarter century, 1887–1912. In History of the American Physiological Society. The First Century, 1887–1987 (Brobeck, J.R., Reynolds, O.E. and Appel, T.A., eds.), pp. 31–52, Am. Physiol. Soc., Bethesda

Appel, TA, Cassidy, M.M. and Tidball, M.E. (1987) Women in physiology. In History of the American Physiological Society. The First Century, 1887–1987 (Brobeck, J.R., Reynolds, O.E. and Appel, T.A., eds.), pp. 381–390, Am. Physiol. Soc., Bethesda

Arsdel, R.T. (1981) Mrs Florence Fenwick-Miller and The Woman's Signal, 1895–1899. Vict. Per. Rev. 14, 107–118

Bennett, D. (1990) Emily Davies and the Liberation of Women. Andre Deutsch, London

Bindman, L.J., Brading A.F. and Tansey, E.M. (1990) To dine with ladies smelling of dog? Women and The Physiological Society 1915–1990. J. Physiol. (London) 430, 101P

Blackwell, E. (1895) Pioneer Work in Opening the Medical Profession to Women. Longmans, Green and Co., London

Blake, C. (1990) The Charge of the Parasols: Woman's Entry to the Medical Profession. The Women's Press, London

Brobeck, J.R., Reynolds, O.E. and Appel, T.A. (eds.) (1987) History of the American Physiological Society. The First Century, 1887–1987. Am. Physiol. Soc., Bethesda

Bynum, W.F. (1976) A short history of The Physiological Society 1926–1976. J. Physiol. (London) 263, 23–72
Bynum, W.F. (1981) An Early History of the Pharmacological Society. The British Pharmacological Society

Chaff, S.L., Haimbach, R., Fenichel, C. and Woodside, N.B. (1977) Women in Medicine: a Bibliography of the Literature on Women Physicians. Scarecrow Press, New Jersey

Creese, M.R.S. (1991) British Women of the Nineteenth and Early Twentieth Centuries who Contributed to Research in the Chemical Sciences. Brit. J. Hist. Sci. 24, 275–305

Cullis, W.C. (1908) Experiments Upon the Isolated Mammalian Heart, Especially with Regard to the Action of Defibrinated Blood Upon it. Women's Printing Press, London

Cullis, W.C. and Bond, M. (1935) The Body and its Health. Ivor Nicholson and Watson, London

Cullis, W.C. (1949) Your Body and the Way it Works. Understanding the Modern World Series. George Allen and Unwin, London

Dale, H.H. (1945) Address of the President, Anniversary Meeting. Proc. R. Soc. London 133B, 123–139 Dale, H.H. (1955) Edward Mellanby, 1884–1955. Biog. Merns. F.R.S. 1, 193–222

Evans, C.L. (1964) Reminiscences of Bayliss and Starling. The Physiological Society, University Press, Cambridge

Forster, M. (1984) Significant Sisters: the Grassroots of Active Feminism, 1839–1939. Seeker and Warburg, London

Goodwin, T.W. (1987) History of the Biochemical Society, 1911–1986. The Biochemical Society, London Haight, G.S. (1968) George Eliot: a Biography. Clarendon Press, Oxford

Harte, N. (1979) The Admission of Women to University College London. A Centenary Lecture. University College, London

Harte, N. (1986) The University of London 1836–1986. Athlone Press, London

Henifin, M.S. (1979) Bibliography: women, science and health. In Women Looking at Biology Looking at Women: a Collection of Feminist Critiques (Hubbard, R., Henifin, M.S. and Fried, B., eds.), pp. 213–268, G.K. Hall and Co, Boston, MA

Hill, A.V. (1962) The Royal Society. In The Ethical Dilemma of Science and Other Writings. The Scientific Book Guild, London

Hoff, H.E, and Fulton, J.F. (1937) The centenary of the first American Physiological Society founded at Boston by William A. Alcoa and Sylvester Graham. Bull. Hist. Med. 5, 687–734

Hollis, P. (1979) Women in Public 1850–1900. Documents of the Victorian Women's Movement. George Allen and Unwin, London

Howell, W.H. (1938) The American Physiological Society during in first twenty-five years. In History of the American Physiological Society Semicentennial, 1887–1937, pp. 1–89. Am. Physiol. Soc., Baltimore

Jex-Blake, S. (1886) Medical Women: a Thesis and a History. Oliphant, Anderson and Ferrier, Edinburgh

Mason, J. (1991) Hertha Ayrton (1854–1927) and the Admission of Women to the Royal Society of London. Notes & Records R. Soc. London 45, 201–220

Mason, J. (1992a) Women in Science: Breaking out of the Circle. Essay Review. Notes & Records R. Soc. London 46, 177–182

Mason, J. (1992b) Towards Equal Opportunities. The Biochemist Oct/Nov, pp. 1–4

Mason, J. (1992c) The Admission of the First Women to the Royal Society of London. Notes & Records R. Soc. Lond. 46, 279–300

Moore, T.S. and Philip, J.C. (1947) The Chemical Society, 1841–1941. The Chemical Society, London Moranrz, R.M., Pomerlau, C.S. and Fenichel, C.H. (1982) In Her Own Words: Oral Histories of Women Physicians. Greenwood Press, Westport, CT

Morantz-Sanchez, R.M. (1985) Sympathy and Science: Women Physicians in American Medicine. University Press, Oxford

Needham, D. (1982) Women biochemists in Cambridge. In Women Scientists: the Road to Liberation (Richter, D., ed.), pp. 158–163, Macmillan Press, London

O'Connor, W.J. (1988) Founders of British Physiology: a Biographical Dictionary. University Press, Manchester

Phillips, P. (1990) The Scientific Lady: a Social History of Woman's Scientific Interests 1520–1918. Weidenfeld, London

Reynolds, O. (1987) Origins of FASEB and its Member Societies. Fed. Proc. 46, 223–250

Ritchie, M. (1980) Women's Studies. A Checklist of Bibliographies. Mansell, London

Rosenberg, M.B. and Bergstrom, L.V. (1975) Women in Society: a Critical Review of the Literature with a Selected Annotated Bibliography. Sage Publications, London

Rossiter, M.W. (1982) Women Scientists in America: Struggles and Strategies to 1940. Johns Hopkins University Press, Baltimore

Sharpey-Schafer, E.A. (1927) History of The Physiological Society, 1876–1926. University Press, Cambridge

Sowton, S.C.M. and Myers, C.S. (1928) Two contributions to the experimental study of the menstrual cycle. 1. Its influence on mental and muscular efficiency. Ind. Fat. Res. Bd. Rep. 45

Tansey, E.M. (1988) George Eliot's gift to medicine. Trans. Med. Soc. London 104, 15–24

Tansey, E.M. (1990) The George Henry Lewes Trust for the support of students of physiology. Notes & Records R. Soc. London 44, 221–240

Tansey, E.M. (1992) The science least adequately studied in England: physiology and the George Henry Lewes Studentship, 1879–1939. J. Hist. Med. 47, 163–185

Tuke, M.J. (1939) A history of Bedford College for Women 1849–1937, Oxford University Press, London University of London (1926) The Historical Record (1836–1926). University of London Press, London Walters, S.M. (1981) The Shaping of Cambridge Botany. University Press, Cambridge

Welch, H.J. and Myers, C.S. (1932) Ten Years of Industrial Psychology. Sir Isaac Pitman and Sons Ltd., London

Alison Brading

(1939-2011)

Alison Brading was a truly remarkable and inspirational woman, who coped with debilitating disease to establish herself as one of the leading female scientists of her generation. She profoundly shaped our understanding of the physiology of smooth muscle and, towards the later stages of her career, helped pioneer the clinical understanding of incontinence.

During a visit to Nigeria in 1957, just after her A levels (Advanced level school exams for English pupils, usually take at 18 years of age), Alison acquired a polio infection which left her disabled. After flying home in one of the queen's planes (apparently a spare left in Lagos when she went out to open the hospital in Ibadan which Alison's father, Brigadier Brading, had been in charge of building), Alison spent the next year and a half in the Wingfield Hospital (Oxford; now Nuffield Orthopaedic Centre). She never recovered, and was reliant on crutches for mobility for the next 40 years and then, as her skeletal muscles weakened further, she was largely confined to a wheelchair. Following her extended recuperation in the Wingfield, and with her irrepressible optimism for life and enthusiasm for learning, she read Zoology at the University of Bristol and graduated with a first class honours degree in 1962.

During her undergraduate studies, she developed a passion for animal physiology, and this led her to remain in Bristol to conduct her PhD with Peter Caldwell, FRS. With Caldwell, she carried out an electrophysiological analysis of the membrane potential in Ascaris lumbricoides, which kindled her career-long interest in the properties of muscle.

Whereas most research was devoted to understanding the physiology of cardiac and skeletal muscle, Alison decided to focus her efforts on the less tractable and largely ignored field of smooth muscle. Smooth muscle lines the walls of hollow internal structures such as blood vessels, bronchi, gut and urinary

bladder, and aberrant smooth muscle function is linked to an alarming number of disparate human diseases.

Her burgeoning interest in muscle led her, in 1965, to the research laboratory of Professor Edith Bülbring, FRS, based in the Pharmacology department at Oxford. Bülbring's group was the international centre of excellence in the field, and a magnet for both established and aspiring smooth muscle physiologists. It was here that Alison, with another gifted young scientist, Tadao Tomita, discovered fundamental mechanisms underlying smooth muscle excitability. They showed that calcium ions carry the spikes of electrical activity that often drive smooth muscle contraction, compared to skeletal muscle.

Alison elegantly established the importance of membrane pumps in modulating excitability, particularly sodium–calcium exchange. This was important work: it showed that smooth muscle function was sculpted by a subtle interplay between ion channels and the largely overlooked ionic pumps. She also showed that different types of smooth muscle had different electrical and mechanical properties. This ran counter to the prevailing ideas of a homogeneous population of smooth muscle and led to a growing appreciation of the need to study each organ system in isolation. Much of this work was published in *The Journal of Physiology*. Her subsequent work identified mechanisms through which drugs affected muscle function, which is being exploited by pharmaceutical companies to manage blood pressure, incontinence and gastro-intestinal problems.

On Bülbring's retirement, Alison headed the Smooth Muscle Research Group and continued its international dominance. Along with Tom Bolton, another acolyte of Bülbring's and based at St George's Hospital Medical School, Alison ensured Britain remained at the forefront of smooth muscle research. Her laboratory was open to all: any visitor, regardless of standing or nationality, was always welcomed and often put up in her charming cottage in Thrupp, overlooking the Oxford Canal. Her list of international collaborators was impressive: graduates, postdoctoral fellows and clinicians, many of whom occupy leading positions not only in the UK and Europe but also in North America, Japan, Taiwan and Australia.

In the late 1980s, Alison redirected her research programme to tackle clinically related problems and focused on therapeutic management of the involuntary smooth muscle contraction that engenders incontinence. Her shift pre-empted the current trend for translational research by two decades and served as a beacon for the rewards awaiting the marriage of mechanistic physiology with human disease. During this time, she set up the Oxford Incontinence Group, involving basic scientists and clinicians, which she headed until her retirement in 2005.

Alison Brading

(1939-2011)

In addition to her science (recorded in more than 160 papers and several books), Alison was an energetic and committed member of The Physiological Society, serving on the editorial board of *The Journal of Physiology* for several years. She was also an Editor of the British Journal of Pharmacology along with several clinical journals on Urology.

Alison was also a remarkable educator, an Oxford icon: a true polymath who excelled both in her scientific research and in her teaching at both university and college levels. A dedicated tutor, she taught generations of Oxford medical students, physiologists and psychologists, opening up the life sciences and instilling in them a scientific curiosity that would serve them well as their own careers unfolded. In the present climate of extreme specialisation, she was probably the last of the great Oxford post-war medical tutors: able to teach the entire breadth of her discipline from the single molecule to the whole animal, and link disparate areas together with remarkable insight and clarity.

But this is only part of the story. It was her personal touch, her sensitivity, her deeply entrenched belief (no doubt stemming from her own disability) that all her students were capable of accomplishing anything they put their minds to, her sense of fairness and equality, her moral strength and probity, her unflinching commitment to higher education, and her ineffable courage and fortitude (which drove her on in spite of the cruel hand that fate had dealt her) that inspired her colleagues and students alike, and enriched the lives of all those fortunate to be around her.

Thomas Huxley once wrote, 'The known is finite and the unknown infinite. Intellectually, we stand on an islet surrounded by the vast ocean of the unknown. The business of each generation is to reclaim some of the land' (Huxley, 1888). That Alison reclaimed some of that land is clear from her scientific endeavours and success. What is perhaps more remarkable is the way she did it. She will be missed for many years to come.

Adapted from the original contribution of Anant B. Parekh, published in Parekh, AB (2011), Alison F. Brading (1939–2011). *The Journal of Physiology*, 589: 1871–1872. doi: 10.1113/jphysiol.2011.207589

Gertrude Falk

(1925–2008)

Gertrude came on a Guggenheim Fellowship from a position at the University of Washington in Seattle to work with Paul Fatt in the Biophysics Department at UCL in 1961. Although her PhD work at Rochester was on diuresis in the rat, she later became one of the early microelectrode electrophysiologists.

Gertrude had worked as a post-doc with Gerrard in Chicago and studied a wide range of smooth and striated muscle types.

She and Paul Fatt tackled the question of the puzzlingly high capacitance of muscle – this was before it was established that the membranes of the transverse tubules were continuous with the surface membrane. They used two electrode recording techniques that required an in-depth understanding of the electrical properties involved ('real' biophysics). They reached the conclusion that the 'internal' membranes accounted for the high capacitance about the same time as the electron microscopy revealed the structure.

Gertrude continued to collaborate with Paul for some years, turning their techniques to electrical studies of rod outer segments (chosen as a tissue that did not move). It is worth remembering that when they started to work on retina very little was known about phototransduction. They were among the first to look at the cellular biophysics of the problem.

Gertrude's interests in the synaptic connections and function of the retina started with a theoretical paper (as well as two extensive and scholarly Handbook chapters) that she and Paul wrote in 1974. Jonathan Ashmore began working with her as a post-doc at that time and claims that he only got the job because he could solve cable equations analytically – which must have struck a chord, as Gertrude recounted that in her

Gertrude Falk

(1925–2008)

student days in the USA she was well-nigh a national champion at doing integrations in her head. The joint work became a lively collaboration and produced a small clutch of Nature papers. This was then carried forward over many years by Gertrude and Richard Shiells. Shortly before she retired, they discovered that the rod ON-bipolar cell synapse depended upon a metabotropic glutamate (mGLUR6) receptor cascade. It was a critical scientific combination, with Richard's experimental skills complementing Gertrude's encyclopaedic knowledge of the literature, old and new.

She continued to teach occasionally for many years beyond her retirement, and to come to the Starling Room to indulge her great conversational skills and challenging opinions until just a couple of months ago. Her great sense of humour and ready amusement at the oddities of life and people was always tempered by her warm and generous spirit.

Gertrude had a fierce sense of justice and ready sympathy for the underdog. She was a loyal and kind friend to anyone in need; typically this was shown not in mere words of protest, but was translated into action. Her indifference to conventions is well illustrated by the occasion when, drinking coffee in the men's staff common room – at that time still segregated – she responded calmly to the Beadle summoned to escort her out, 'well, I am certainly going to finish my coffee first', and did so at her leisure.

Gertrude and Paul Fatt were married for a period, and had one daughter. Although they later divorced, their relationship remained amicable. Her illness was sudden and perhaps mercifully quite short, since the thing that saddened her most during this, aside from the prospect of not seeing her two grandchildren grow up, was the likely loss of her memory and her intellect.

Adapted from the original contribution of Jonathan Ashmore, Lynn Bindman, Tony Gardner-Medwin and Sally Page published in Ashmore J, Bindman L, Gardner-Medwin T & Page S (2008), *Physiology News*, Summer 2008, Issue 71, pp. 57–58

Marianne Fillenz

(1924–2012)

Marianne Fillenz died at the age of 88 from cancer. Those of us in Oxford will miss her especially. After 60 years here, she seemed to be a permanent fixture. We will miss her exceptional friendliness, her interest in everything from local gossip to the place of humanity in the universe, her positive outlook and her quizzical responses to incautious remarks. Generations of colleagues and students have cause to be grateful for her great patience and deeply conscientious attention to making sure that she understood their problems and that they understood what she was trying to tell them.

Marianne was born in 1924 in Timisoara, Romania, to a Viennese mother and a Hungarian Jewish father. Correctly predicting the march of Nazism into Romania in 1939, they left for New Zealand. The choice of New Zealand was completely accidental: Jewish friends had a spare entry form for New Zealand and passed it on to them. But what a fortunate accident!

In New Zealand, she met two of the most important influences in her life, the philosopher Karl Popper and the new Professor of Physiology at Otago, Jack Eccles, who had just arrived in New Zealand from working with Charles Sherrington in Oxford. Both were inspirational to her, and Marianne maintained their friendships, bound by her deep interest in philosophy and in physiology, throughout her life.

Jack Eccles inspired her life choice of research physiology during her preclinical medical studies at the University of Otago and she never looked back. Her first paper was published in 1946 in the Journal of Neurophysiology on the acetylcholine endplate potential in skeletal muscle. Such was her talent that Eccles persuaded her to interrupt or abandon her medical studies to undertake a DPhil in Physiology at Oxford. She remained intensely loyal to Jack. Her last paper published in 2012 was on his life and work.

Marianne Fillenz

(1924–2012)

In 1950 she arrived, at Somerville College, in Oxford where she remained for the rest of her life. She did her DPhil with Sybil Cooper and David Whitteridge, studying receptors responding to stretch of the eye muscles. Her paper on this, published with Sybil in *The Journal of Physiology* in 1955, is a classic.

How we know where our eyes are pointing remains contentious and the question of what sensory endings supply the brain with information about eye muscle length is still unsettled to this day, since typical muscle spindles are not found in these muscles. But Marianne's work showed clearly that an eye muscle length signal is indeed supplied to the brain in the cat, and this was much later confirmed in humans. Marianne became skilled in recording from single nerve fibres in peripheral nerves and from single nerve cells in the brain stem. Later, she had moved her main interests from eye muscles and vision to her subsequent lifelong study of the autonomic nervous system and its control, and for the next 30 years, she became the local expert on the anatomy and physiology of the autonomic nervous system.

Marianne was not content simply to use techniques she had already learnt; she eagerly sought out new methods that she thought might help her to better understand the control of the autonomic nervous system. Therefore, she was one of the first people to use and develop the technique of voltammetry to measure catecholamine release deep in the brain. Her paper on linear sweep voltammetry to measure dopamine release in the rat striatum is another classic, and her technique is still widely used today. With John Albery, she developed voltammetry electrodes for conveniently measuring many other substances, such as glucose, alcohol, Marianne Fillenz amino acids, oxygen, CO_2 and N_2O.

As well as being a highly productive research scientist, Marianne was a devoted and much loved teacher. After her DPhil, she spent nine years as a college lecturer at St Hilda's and as a University 'Demonstrator' in the Department of Physiology, and won a Tutorial Fellowship at St Anne's College in 1963. She was a loyal member of St Anne's for the rest of her life. With her wide interests spanning philosophy, social policy, politics and the arts (she was an excellent pianist, and regular concert goer), she was an extremely popular member of the SCR.

Teaching mainly female undergraduate and graduate medical and physiology students, she was particularly keen to encourage her female students not to feel that family commitments would inevitably reduce their scientific productivity, and she revelled in their successes when they came.

She was a tenacious rationalist, so that both students and colleagues had to be on their toes. Her favourite phrase was, 'Really, you believe that!' after which you knew you were in for some

hard defending. Her helpfulness, humanity and breadth of interests captivated her pupils and colleagues alike.

In addition to being a productive scientist and teaching full-time, she also successfully raised three children with the minimum of outside help, but an unusual amount of support by her husband, John Clarke (who sadly predeceased her by two years). John was a strikingly tall and handsome Rhodes Scholar from Western Australia, studying hypothalamic control of the reproductive system, which he continued throughout his – also highly productive – life. They met during their first term at Oxford and married a year later. John was an amazingly 'modern' father, who put every other man to shame; for instance he would seldom go to lunch in College as most donnish fathers did, but insisted on returning home to help Marianne give their children their lunch – he was meticulous in shouldering his half of all their childcare responsibilities.

Marianne was also a keen Member of The Physiological Society and most of her early publications were originally in the form of Physiological Society Proceedings. Many Members will remember her unfailing reasonableness and courtesy when she was chairing the often heated discussions following a presentation. We will all miss her greatly.

Adapted from the original contribution of John Stein in Stein J (2013), *Physiology News*, Winter 2013, Issue 93, p. 53

Olga Hudlická

(1926–2014)

Olga Hudlická was uncompromisingly honest in all she did and said. She was also a person of considerable courage and this was obvious on the first occasion that we met. We were introduced by Gene Renkin in 1968 during the International Congress of Physiological Sciences in Washington. This was of course the time of the Cold War when communications between Eastern European countries and the West were very limited, but I had heard of Olga's work largely through the proceedings of a conference on muscle blood flow that she had organised a few years earlier.

I was surprised to be able to meet her because of recent events in Czechoslovakia. She explained that she had travelled from Prague to the USA a few weeks before the Congress to spend six months sabbatical leave working in Gene Renkin's laboratory in Durham, NC. This was the year of 'the Prague Spring' when the Czechoslovak Communist Party, led by Alexander Dubcek , introduced a series a liberalising reforms that appeared to give the country greater freedom from Soviet control. But a few days before the Washington Conference (about a week before she and I met) Soviet tanks had rolled into Prague and taken control of the Government to rein in these reforms.

Temporally, communications between Czechoslovakia and the outside World had been cut off or at least very severely restricted. Olga had not been able to contact her husband, a Prague physician, or her children since this had happened. She had no idea what to expect when she returned. But she discussed this calmly as something that had to be faced. Communications with Prague appeared to improve and Olga remained in the US for another three and a half months, returning to Prague shortly before Christmas.

Surprisingly, Olga was able to make a brief visit to England the following summer. At the invitation of Professor Henry Barcroft, she presented a paper at the Oxford meeting of The Physiological Society, where we met for a second time. What I have only recently learned is that this trip enabled her to activate the plans that she and her husband had made to evacuate their family from Czechoslovakia. Just how effectively these plans were executed reveals how cool-headed both Olga and her husband must have been and how bravely their children behaved.

Within days of her return to Prague, their young son flew to London to stay with the Barcrofts and their daughter took a train to Colmer in France to stay with friends for two months, ostensibly to improve her French. After a short interim, one weekend Olga and her husband drove their car out of Prague into the country and over the border to visit good friends in Hungary. When they left Prague, the only possessions they carried with them were contained in a small suitcase, which had been hidden in the car several days before their departure. From Hungary, they drove through Austria and Italy to Menton in France where they met their daughter. They then travelled to Paris to meet their son off the train from London.

It was only at this point that their children learned that they were not returning to Czechoslovakia. After driving to Zurich to meet Olga's mother and put her on a plane to stay with her son in the US, they drove on to Frankfurt where Olga's husband was employed for a few months as a physician and Olga worked in the Max Planck Institute. They had left Czechoslovakia just in time. The Czechoslovakian borders were sealed on the 15th September 1969.

Olga and her children moved to England at the end of the year and spent Christmas in London. They were joined in February 1970 by Olga's husband and her mother and moved to Birmingham, where Olga became a member of Sidney Hilton's research group in the Physiology Department of Birmingham University. Her husband worked as a physician in a Birmingham hospital. Within a few years, Olga had moved on to the academic staff of the department, initially as a lecturer but soon to be promoted. Then tragically, just as her research on angiogenesis in muscle was being recognised internationally and her family were growing up and going to university, her physician husband died suddenly.

Driven initially by grief, within a short time Olga was working at a pace few could maintain - a pace she sustained into her eighties. But far from being a boring workaholic, Olga was delightful company. Her 'no-nonsense' persona hid a warm personality, a sensitivity to the feelings of others,

Olga Hudlická

(1926–2014)

a delightful sense of humour and of course a critical view of life. I have to smile as I recall several of our discussions about politics and society where she would attack my arguments that she thought were based on too romantic a view of life. She was a person everyone respected and she was a very good friend – someone I feel very privileged to have known.

Adapted from the original contribution of Charles Michel (additional details provided by Professor Hudlická's daughter) published by the British Microcirculation Society in Michel C (2014) A tribute. British Microcirculation Society. http://www.microcirculation.org.uk/assets/Professor-Olga-Hudlick-tributes.....pdf

Born in Prelouc, Czechoslovakia, Olga received her MD from Prague's Charles University in 1950, then her PhD (1954) and DSc (1968) in the Institute of Physiology, Czechoslovak Academy of Sciences working on muscle blood flow and its regulation under different conditions. She was inspired by the pioneering work of Ernest Gutmann working in his laboratory alongside another important figure in UK Physiology, her lifelong friend Gerta Vrbová. In 1969, the political situation forced her to leave her beloved country and emigrate to England, where she remained in the Department of Physiology at the University of Birmingham until retirement in 1993. She continued to work as Professor Emeritus and it took her many years before her activity slowed down, so we often joked that it was only her salary that had retired! Her main interest was on the role of various factors connected with increased blood flow (the monograph Muscle Blood Flow was published in 1973), and capillary growth in normal and ischaemic skeletal and cardiac muscle (the hugely influential Angiogenesis appeared in 1968). She published over 200 papers, chapters and reviews (the last one in 2011), and three edited monographs.

Before she came to Britain, Olga was Honorary Secretary of the Czechoslovak Physiological Society (1960–1969), and played important roles in the British Microcirculation Society as Honorary Secretary (1985–1992) and President (1996–1999). At BMS meetings she could always be relied upon to ask some penetrating questions; she greatly enjoyed attending the MCS meetings in the USA, especially interacting with Brian Duling there. It is a great shock to lose both these highly respected members of the microcirculation community within a matter of months. Her influence on this field was recognised as a Visiting Professor at universities in Frankfurt/Main, California (Davis), and Caracas (Venezuela). She also received several prestigious awards including The Zweifach Award (Microcirculatory Society USA, 1996) and the Malpighi Award (European Society for Microcirculation, 2008), and was Annual Review Lecturer of The Physiological Society in 1990.

Her enthusiasm for the subject never waned, and well into her retirement, she could be seen at seminars interested to find out where the new trends were leading. For those in her lab her breadth of knowledge was inspiring, while her uncanny ability to remember bibliographic details of papers she had read years earlier was rather intimidating – woe betide anyone with a vague recollection of 'something'! Although teaching across many aspects of physiology for many years, with a traditional style that didn't tolerate lazy students, her passion was always research. She lived life at a pace, whether it was tiring out younger visitors as she acted as tour guide around Prague, or stints in surgery that would daunt anyone half her age. When we last met, she was still active in research, this time testing out recipes and writing a cookbook, and content with the knowledge that her scientific legacy was being continued. I personally owe her a tremendous amount, and consider it a privilege to have known and worked with her.

Adapted from the original contribution of Stuart Egginton published by the British Microcirculation Society in Egginton S (2014) A tribute. British Microcirculation Society.
http://www.microcirculation.org.uk/assets/Professor-Olga-Hudlick-tributes.....pdf

Shelagh Morrissey

(1916–1990)

Shelagh Morrissey was born in London and after a convent education there, she joined the Women's Land Army during the Second World War. Immediately after the war, she worked in Kew Gardens, where no doubt she had her first contact with hothouse plant life. She remained an enthusiastic gardener all her life. After Kew, Shelagh trained as secondary school teacher and following a brief spell of teaching, she entered Bedford College, London University in 1951. She gained a first degree in Botany. A keen oarswoman, she was awarded full Rowing Colours by London University. Continuing an interest first generated at Kew, she began postgraduate research under DF Cheesman at Bedford into the digestive processes of the pitcher plant, and was able to demonstrate several similarities in the control of digestion in both animals and plants. She gained her PhD in 1962.

Image credit: Martin Rosenberg, Mill Hill, 1979

'The Physiological Society Archives'

In 1956, Shelagh was appointed to an Assistant Lectureship in the Department of Physiology, Queen Elizabeth College, London University, and subsequently became a Lecturer in the same department. She was elected to The Physiological Society in 1972, and was always an active contributor to Meetings. She continued her work on gastric secretion, and became particularly interested in the pathophysiology of gastric mucosa associated with cystic fibrosis. A particular interest involved the histochemical analysis of mucosubtances in the human stomach and duodenum and the application of this to studies of peptic ulceration and the effects of smoking. In this work, she was supported by many enthusiastic students, all of whom were inspired by her interest and energy.

Despite her late entry into the academic world, and the handicap of being a woman in a profession dominated by men, her research progressed rapidly. She was invited to spend a

year's sabbatical at Mount Holyoke College in the USA and made visits all over the world to present her work. The Cystic Fibrosis Research Trust was a major supporter of her research work. In the 1970s, she developed research links with the University of Malta, and this island became a haven of peace for her over many years at Christmas and Easter. She never really retired from her work, and attended scientific meetings of The Society up until a few months before her death.

She was very fond of music and sang in the local choir of her church in Chelsea. Gardening and the accumulation of property and limousines were other major interests. The limousines were employed in many different ways; they included one famous white Mercedes, which travelled overland to the IUPS meeting in Budapest in 1981, carrying most of her research team and their posters with it. During her later years, Shelagh devoted much effort to increasing the awareness of cystic fibrosis in Malta and personally identified a number of cystic fibrosis families. It was her intention to improve the quality of medical management of the disease in Malta to match that in other parts of Europe.

She was certainly one of the most distinctive Members of The Society and her recognition of the contribution of women to it and to biomedical research generally was marked by an appreciation of Harriet Chick of the Lister Institute in Women Physiologists: An Anniversary Celebration (eds Lynn Bindman, Alison Brading and Tilli Tansey, Portland Press, 1993), an account completed only a few weeks before her death. Her own contribution will be sadly missed.

Adapted from the original contribution of Roger Lemon published in Lemon R (1990), The Physiological Society Annual Report 1990, pp. 23–24

Anne Warner

(1940–2012)

Anne Warner, who has died aged 71 of a cerebral haemorrhage after a long illness, combined many careers as cell electrophysiologist, science politician and founder of the UCL centre CoMPLEX (the Centre for Mathematics, Physics and the Life Sciences). Born Anne Brooks and educated in the West Country, she became a student at University College London where she graduated with a degree in physiology.

Working for her PhD with Otto Hutter at the National Institute for Medical Research, Anne was appointed at the early age of 23 to a staff position there, where she carried out some of the classic studies on the pH dependence of the chloride conductance in skeletal muscle. Her research subsequently turned towards understanding the role of gap junctions for intercellular communication in vertebrate embryonic development.

Image source: http://www.theguardian.com/science/2012/jun/10/anne-warner

Anne was at the right place to benefit from the improved electrophysiological techniques, which had been developing during the 1960s, and she used these to study many of the electrical events occurring in amphibian and mouse embryogenesis. Her collaborators included some of the major developmental biologists of the 70s and 80s. With her students and colleagues Christine Slack, Susanna Blackshaw, Luca Turin and Sarah Guthrie, her laboratory published a series of papers in *The Journal of Physiology*, Nature and Cell, which mapped out the early electrical events occurring during normal embryo development.

This was a period before effective calcium signalling, imaging and molecular methods became sufficiently powerful to study development. Although Anne had worked with Peter Baker on some of the earliest projects, which made the link between calcium and cell organisation, she only published a brief Letter to

Nature, co-authored with Roger Tsien and Tim Rink, which gave a hint of the subsequent momentous developments in the field of calcium sensing.

Appointed first at the Middlesex Hospital in Lewis Wolpert's Department and then as a Lecturer at the Royal Free Hospital School of Medicine when it was still in Hunter Street in Bloomsbury, Anne took up an appointment at UCL in 1976. Rising to the position of Reader in Geoff Burnstock's Department of Anatomy and Developmental Biology, she became the Royal Society Foulerton Professor in 1986 at UCL in succession to Ricardo Miledi, a position that she held for 15 years. She had been elected a Fellow of the Royal Society the previous year. Although her scientific work on the role of gap junctions in the developing embryo continued for the rest of her working life, there can be little doubt that much of her subsequent energy went into committee work and scientific policy.

The number of councils on which Anne sat is remarkable: they included the NERC, the MBA, the Lister Institute and the Roslin Institute as well as several MRC boards and policy committees. She was clearly much in demand; many can remember the speed that, after an apparently brief glance, she could deal with any grant or job application. She was also a member of the editorial board of *The Journal of Physiology* from 1979 and of the Committee of The Physiological Society from 1975 to 1979. During the last decade of her career, she was Director of CoMPLEX at UCL.

The inspiration came from the realisation that biology emerging in the postgenomic era required collaborations of scientists from the physical sciences, computer sciences and biomedical sciences. This centre, ahead of its time in the UK, focused on multiple aspects of systems biology and became a model for many other centres in the country. Through Anne's tireless efforts, it attracted excellent funding to start up a multidisciplinary and novel graduate programme, and also attracted grants to study the systems biology of the liver, along the lines of the Physiome Project organised by Denis Noble to model the heart.

Anne was never fully equipped with the mathematical tools to really develop the systems biology ideas fully, but she always listened and was responsible for encouraging many others to dip their toes in the deeper waters outside their own specialities. Anne was a strong supporter of the Marine Biological Association (MBA) in Plymouth. She sat on the council of the MBA and as a Vice President of the Council she undoubtedly steered the MBA through particularly difficult financial times in the 1990s when even its future fell into doubt. She had strong views on the role of the MBA and many of her ideas were taken up over the years. With David Ogden and Colin Brownlee

Anne Warner

(1940–2012)

she started the Cell Physiology workshop in 1984 (originally known as the Microelectrode Techniques workshop), a course that has created many cohorts of cell physiologists in the UK and abroad. She clearly saw this course as a major part of her legacy. And it is thanks to likes of Anne that the MBA still survives as an organisation.

Anne had a penchant for academic gossip, whisky and cigarettes, probably in that order. She very much saw herself as part of a UCL family and was extremely loyal to it, to her department and to her friends. When not to be seen engaging in conversation with her academic colleagues in UCL's senior common room, often with a bottle of white wine on the table, she could usually be spotted in the UCL quad pacing up and down in deep in thought with a cigarette held jauntily in one hand. A friend recalls that as a student he made the mistake of joining her in the bar after a Physiological Society dinner and offered to buy her a drink, thinking that she'd settle for a half of beer. 'I'll have a Laphroig,' said Anne, somewhat to the detriment of his budget.

Anne was formidable and, once her gaze fixed on you through her carriage-lamp spectacles, it was quite hard to refuse to do what she asked. Anne's illness started with a heart valve replacement that did not resolve well and led to her premature disengagement from COMPLEX. She also never smoked again, seeming to give it up remarkably easily. None of this really stopped her firing off emails of advice and requests for information, often on an hourly basis, but physically her ability to be involved was impaired. Her husband, Michael, a marine engineer whom she met when both were students in the UCL Dramatic Society, predeceased her by several months.

Adapted from the original contribution of Jonathan Ashmore published in Ashmore J (2012) In-depth Obituary, The Physiological Society.
https://www.physoc.org/sites/default/files/page/Obit_Warner_PhySoc_0512.pdf

Maureen Young

(1915–2013)

Maureen Young was born on 16 October 1915 in Southwold, Suffolk, England. During her early childhood she lived in London where her father was a pathologist at Guy's Hospital after the war. When she was ten, her parents moved to a posting in Singapore and she was sent to boarding school, Northwood Girls School, where practical lessons in chemistry and biology awakened her interest in science.

Her father was keen for girls to be educated and financially secure so he was happy to pay the fees for Maureen to attend Bedford College for women (from 1932 to 1938) when she finished school. This was a relatively long period as an undergraduate by today's standards but Maureen needed to take an intermediate year in chemistry, physics, botany and zoology as she had not taken higher qualification examinations at school. When she failed physics at the end of the first year, she had to repeat the year. She then proceeded to a three-year general degree in physiology, chemistry and zoology, followed by a one-year special degree in physiology, graduating with second-class BSc (Special) in 1938. During the summer vacations in 1937 and 1938, Maureen went to Germany to learn German, an essential language for scientists then, and witnessed first-hand the Nazi preparations for war. During WWII, Maureen worked with the Blood Transfusion Service, based partly in at St Thomas' Hospital, where she helped to develop an acid-citrate glucose solution for storage of whole blood. These studies led to her first publication in 1940. By 1942, she was back at Bedford College as a demonstrator in physiology, although the College had been evacuated to Cambridge by then. From 1942 to 1945, she worked in the Physiological Laboratory in Cambridge, teaching Bedford College students and carrying out research with Professor Joseph Barcroft. He had been Head of

Courtesy of Wellcome Images

Maureen Young

(1915–2013)

Department of Physiology, but by 1942, was in his 70s with failing eyesight. He recruited Maureen to take blood samples from the tiny carotid arteries of fetal rabbits to measure developmental changes in the oxygen content of fetal blood. This initiated Maureen's life-long interest in fetal physiology.

After the war, Maureen moved to St Thomas' Hospital as a demonstrator in physiology when medical schools started to appoint women as teaching staff, with a new compulsory intake of 15% female students. However, despite her previous research experience, it was not considered suitable for her to teach medical students reproductive physiology for several years after her appointment! During her career at St Thomas', she taught many aspects of physiology to Second MB medical students and ran an intercalated BSc course, first in the Physiology Department and then in the University Department of Obstetrics and Gynaecology, where she had transferred as a senior lecturer on its formation in 1964. For 18 years, she ran a research unit and became Professor of Perinatal Physiology before her retirement to a village near Cambridge in 1982. During her career, she worked abroad for several periods: at Yale, UCLA, Northwestern University Chicago and in the Department of Obstetrics in Perth, Australia, which established life-long international collaborations and friendships.

Even after retirement, she continued with research and academic work as a visitor at the Babraham Institute and an associate editor of Placenta. At St Thomas', her initial research focused on the placental transfer of curare and other drugs using rabbits and guinea pigs and later on the adaptations to the newborn circulation, in collaboration with clinical colleagues. Finally, her interests moved onto fetal growth and nutrition with particular emphasis on placental transfer of amino acids and the role of insulin in fetal protein turnover in a wide range of species including guinea pigs, rabbits, and sheep and horses. During a publishing career that spanned 63 years (from 1940 to 2003, the final one appearing when she was 88) she published well over 100 peer-reviewed original papers, many in *The Journal of Physiology,* as well as reviews and chapters in books. She was an enthusiastic member of several physiological and paediatric societies, and was elected to The Physiological Society in 1944. She was a founder member of the Neonatal Society and its President from 1984 to 1987. She regularly attended national and international meetings well into her 80s. Maureen was a pioneer in many ways. She was one of the first women to secure a teaching position in a medical school. She championed the professional recognition of women in an era when female academics were rare. She was an active advocate of fetal physiology and the need for basic research to underpin advances in medicine. She was a role model for active retirement, enjoying the freedom

from teaching and administrative work to continue pursuing scientific questions through her extensive network of collaborators and colleagues. She was also an inveterate traveller, visiting places like Iran, Hong Kong, Russia and Latin America, often alone, long before travel to these places was easy or entirely safe for Western Europeans. She will be remembered for her many kindnesses to younger academics and clinicians and for her infectious enthusiasm for placental and fetal physiology.

Adapted from the original contribution of Abigail Fowden in Fowden A (2013), Physiology News, Winter 2013, Issue 93, p. 54

Women physiologists

In this final section of the book we have addressed our title, specifically the 'and beyond' part.

We had great pleasure in interacting with all the women in the following pages. We chose women working in the broad field of physiology, who have made significant contributions to their research areas and also brought other insights due to the jobs and activities they had undertaken. Note bene, they are all brilliant scientists who happen to be women, and there are many more out there – we just didn't have space for all of them.

When in our invitations we described the scope of the book, how the project had arisen from wanting to mark this important 100-year anniversary, and what the book wished to accomplish, we quickly realised that our letters had conveyed the excitement of the project as the replies came rolling in fast. In addition we also learnt that these very busy women also considered the centenary book a worthwhile endeavour and one they wanted to engage with. These contributors made our job easier by turning in their prose and pictures over the succeeding weeks, and giving us such interesting, inspiring and personal accounts of their lives, scientific and beyond.

Following each distinguished woman is an earlier stage researcher. They are all stars and were chosen by the scientist featured before them. Again when we approached these women, they all agreed to contribute. These younger scientists are what make us sure there is an excellent future for physiology, and that female scientists will be playing a large part in it. The 'beyond' looks very attractive, and we want to see these women playing their full part in The Society, as committee members and chairs, journal editors and presidents.

The generosity of all these contributors, in sharing details of their lives and careers, reminds us that no one got to the position they have obtained because it was handed to them, and that all lives have their ups and downs. For those battling health problems we wish you well, and to all those struggling for that next grant, best wishes for it. And never give up on yourself. We know you will all enjoy reading each other's stories and we know readers of this book will take much from these accounts.

Chrissy Stokes and Susan Wray.

June 2015.

Professor Dame Frances Mary Ashcroft DBE

photo by Robert Taylor
www.taylor-photo.co.uk

Research career

I started out as a naturalist. I had never heard of physiology at school and I chose Cambridge as a University because you could defer your choice of a specialist science subject for longer. I 'fell into' my career rather than chose it, simply focusing on what I found interesting at the time. It has been a somewhat random walk. I did a PhD in Zoology in Cambridge and then a post-doc (with Peter Stanfield) in Physiology at Leicester. After a brief flirtation with the US (at UCLA), I moved to Oxford where I have been – very happily – ever since.

What research finding(s) and publications are you most proud of?

1. The first paper from my own lab, which showed that glucose closed the KATP channel and thereby stimulated electrical activity (and insulin secretion).
2. Cloning the KATP channel Kir6.2 subunit – simultaneously with Prof. Susumu Seino's group in Japan.
3. Finding that deletion of part of the C-terminus of Kir6.2 allowed it to traffic to the membrane by itself, enabling us to sort out which properties of the KATP channel were intrinsic to Kir6.2 and which were conferred by its accessory subunit SUR.
4. A study with Prof. Andrew Hattersley showing that gain-of-function mutations in the KATP channel cause neonatal diabetes (a rare monogenic type of diabetes).
5. This was the start of a wonderful and productive collaboration with Andrew that eventually led to patients with these mutations being able to swap their insulin injections for oral (sulphonylurea) drugs, which close the open KATP channels and so stimulate insulin release.

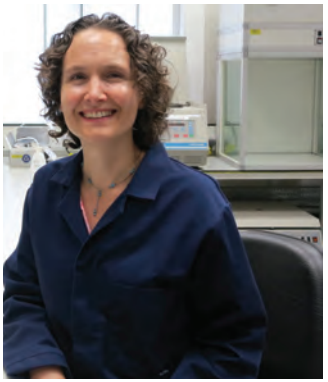
What significant challenges have you overcome?

I've mostly ignored the setbacks and just got on with it. Being told by an Oxford don that he would not vote for my appointment as he 'wouldn't be comfortable with women in the college' was a shock, but one I could do nothing about. Being turned down about six times in succession for a lectureship in Physiology at Oxford was galling, but beneficial in retrospect as I was able to focus on research. Being told I would 'never make a scientist' was hurtful, but made me determined to prove the speaker wrong. The lab being deluged with excrement from the animal house above us was unbelievably ghastly, and on the third occasion (!) led to Health and Safety shutting the lab down immediately so we could not do experiments for 3 months, but now makes for an amusing anecdote. Then there are the usual woes of a scientific life: venomous reviewers, difficult competitors (who may make malicious comments), and that sinking feeling when you open a journal and find someone has published your latest story before you.

What advice would you give your younger self?

Stay calm and focused and just carry on. Most bad things that happen have a positive side even if you cannot see it at the time, and most things are resurrectable. Have faith in yourself. Try to be confident – and pretend to be confident if you are not (you'll find it does help). Collaborate – it is rewarding in so many ways and has been a great joy to me: in September, Prof. Patrik Rorsman and I will have been collaborating for 30 years and it has been a constant delight. Never give up.

Professor Heidi de Wet



Career so far including what motivated you to study/research in physiology?

Ironically, I have never formally studied Physiology, and obtained my first degree from the North-West University, South Africa, in Biochemistry and Botany. I pursued my doctoral studies at the University of Cape Town where I studied membrane transporters implicated in multi-drug resistance, and from this point onward my research was irrevocably tied to whole-systems physiology. I moved to Prof. Frances Ashcroft's laboratory, Oxford, in 2003 to pursue post-doctoral studies, where I continued my research on the membrane transporters implicated in neonatal diabetes.

My life was always a two-career juggling act and I added a third ball after the birth of my son in 2010. While pregnant with my daughter in 2013, a University Lectureship position opened up in my department and with the valuable encouragement from other early-career women in my department, I applied and interviewed for the position when I was seven months pregnant. In addition to research, I also have departmental lecturing and college tutoring responsibilities. I have always enjoyed teaching, but was surprised at how much I enjoyed this aspect of my job. Research can be a harsh master, while teaching is incredibly rewarding and, unexpectedly, added great depth and breadth to my research.

What are your aspirations?

To always remember that it's about the science.

What achievements are you proud of so far?

My first paper from Prof. Ashcroft's laboratory, published in PNAS (de Wet et al. 2007). My now retired DPhil supervisor, Prof. David McIntosh, somehow instilled in me the unshakable belief that once you have published in PNAS, your life is complete.

The births of my son and daughter and my 20th wedding anniversary coming up this year.

Have you had to overcome any challenges?

Embarking on an independent research and teaching career with a very young family most certainly presented some logistical and time management challenges, but I found that my department, college and husband were all incredibly supportive. The fantastic thing about both children and research is that most problems are fairly temporary and you simply have to grit your teeth and hang on like grim death through the rough patches.

What if any challenges to do you foresee?

To balance life and work and to ensure that research remains my main priority in the face of other claims to my time.

Have you received any advice that has helped you?

Looking back over my career, I see the faces of a great many wonderful people who gave me life-changing advice and hoped that I remembered to thank them all! All one sometimes needs is one person to tell you 'Go on, you can do it!'.

What would you say to encourage girls at school into science?

It's the greatest job in the world. Go on, you can do it!

Professor Susan D Brain

Research career

I am an integrative pharmacologist/physiologist who researches the neuro-vascular junction and sensory neuropeptides. I carried out my first postdoctoral post at the Institute of Dermatology (London), my first taste of clinical research. Then, working with a team led by Tim Williams, FRS, I discovered that the sensory neuropeptide calcitonin gene-related peptide (CGRP) is an extremely potent vasodilator. I took up a lectureship at King's College London, in 1989, where I am now. I have concentrated on studies involving the activity of CGRP and related peptides and the TRP channels that activate sensory nerves. This has been an exciting and challenging research area, involving exciting discoveries, complexities that have led to still unanswered questions, and a realisation that this is an area that we are probably not even half way through understanding.

What research finding(s) and publications are you most proud of?

1. My first major paper was when I was working at the Institute of Dermatology (Brain et al. 1982); it was the work of a great interdisciplinary team.
2. It was obvious to me that CGRP was a vasodilator, from the very first experiment that I did with this peptide. It was hugely exciting to be part of the project led by Tim Williams, FRS (Brain et al. 1985).
3. Brain et al. (1988): this research was altogether more difficult. We had to work to convince referees and by the time it was published, I saw it as a great achievement.
4. Fernandes et al. (2011): this paper involving TRPA1 was special. The Brazilian scientist Beth Fernandes did some fantastic work, especially again, when it came to tackling the referees' comments.

5. ubdool et al. (2014): this recent paper was a labour of love for me, continuing an interest I had in cold responses from 1990. There was an instant realisation, again, that we had discovered something exciting. However, it took the dedication of a talented PhD student, Aisah Aubdool, to realise the potential and valuable discussions with our colleagues, especially Stuart Bevan.

What significant challenges have you overcome?

I have had a relatively trouble-free career in that I have been able to have a rewarding academic job and have a scientific career, working on more or less the same topic, in one city. This is quite rare. However, my husband is quick to remind me that I have been in utter despair so many times, in that he truly believed that I would never get a lectureship, never get a grant, etc., etc. In retrospect, he has probably spent many more evenings than I would want listening to me rambling on about the negative aspects of a career in science. On the other hand, I forget about the negative aspects once I manage to work out a positive plan to counteract things.

What advice would you give your younger self?

Never lose focus or faith in your abilities. Ensure you finish the tasks that you start and make the most of the opportunities that come your way. If you love science and want a research career, there will be a way.

Dr Aisah A Aubdool

Career so far including what motivated you to study/research in physiology?

My first taste of life as a researcher came as an undergraduate whilst studying airway hyper-responsiveness with Dr Spina at King's College London in 2009. Those few months in the laboratory were adventurous and introduced me to the amazing wonders of TRP channels, which have formed an integral part of my scientific life. I applied for an integrative physiology- and pharmacology-based PhD project at the Centre for Integrative Biomedicine, where I was introduced to Professor Susan Brain who, as my PhD supervisor, had an enormous impact on my career. I studied how the sensory nerves regulate blood flow following local cold exposure, and we discovered that TRPA1 acts as a vascular cold sensor. My PhD project provided me with in vivo expertise to study animal function, within the context of the 3Rs. Science is exciting; I find sensory nerves and neuropeptides very mysterious and there is still so much we don't understand about their role in the vasculature. As a post-doc, I am currently investigating the potential protective effects of a novel long-lasting sensory neuropeptide CGRP agonist in hypertension. My project has revealed some key findings, which will advance our knowledge of the impact of CGRP within the cardiovascular system. This is only the beginning of an exciting story, so watch this space! In the past six years, I have gained the extensive experience in aseptic microsurgery techniques and areas of molecular physiology and pharmacology that will allow me to develop a strong multidisciplinary research proposal for my next project.

What are your aspirations?

To emulate the achievement of Professor Brain by gaining recognition as a leading academic researcher while always being positive, energetic, enthusiastic and determined to unravel the mystery of the sensory nerve.

What achievements are you proud of so far?

My first publication in Nature Communications was a proud moment (Aubdool et al. 2014). It was a long journey to address a controversial issue of the role of the TRPA1 ion channel as a cold sensor. Our study provided a new perspective into the understanding of mechanisms underlying the protective response for local cold injury. This was a moment where there was dancing in the lab and cake in the tearoom!

Have you had to overcome any challenges?

There is pressure to publish and publish well, but the sting of rejection is always sharp! There is a lot of disappointment when a prestigious journal rejects your paper, but I am learning to deal with it effectively, giving each manuscript another chance. As Dr Phil Corlett says, look at submission, revision and resubmission 'as an iterative process'. This process has taught me to believe in my work, to be persistent and to be patient. Preparing manuscripts and writing grants can disrupt research in the laboratory, and hence as a post-doc my primary challenge was to achieve the right balance.

What if any challenges to do you foresee?

Two challenges: competition to secure fellowship funding to achieve my goal of becoming an independent researcher, and relocating from one institution to another.

Have you received any advice that has helped you?

Stay focused, work hard and never give up! Having a supportive mentor and colleagues definitely helped me to think about the next stage of my career. Being reminded that you are focused and making the right choice helps with confidence. Ensure you are meeting your deadlines and remain strong as you get to the end. I am passionate about women in science, outreach activities and knowledge exchange.

What would you say to encourage girls at school into science?

Dorothy Hodgkin remains the only female British scientist to have won a Nobel Prize and she always hoped there would be not much fuss about gender. Science is creative, fun and an adventure into the unknown! It is not about being 'perfect' in the science class, but embracing the subject, being innovative, asking questions and being willing to work through the problem to find the answers.

Professor Andrea H Brand

Research career

I studied Biochemistry at Oxford University as an undergraduate and then moved to the MRC Laboratory of Molecular Biology in Cambridge for my PhD, where I discovered and characterised the first transcriptional silencer. For postdoctoral research I joined Mark Ptashne's lab in the Biochemistry Department at Harvard University where I continued my work on transcription in yeast. I then decided to switch fields and moved to Norbert Perrimon's lab at Harvard Medical School to study nervous system development in Drosophila. There I originated the GAL4 system for targeted gene expression. I started my own lab, as a Wellcome Trust Senior Fellow, at the Gurdon Institute, University of Cambridge, where I am now Herchel Smith Professor of Molecular Biology, Wellcome Trust Senior Investigator and Head of Wellcome Trust Laboratories. I am a Fellow of the Royal Society, Fellow of the Academy of Medical Sciences and member of EMBO.

What research finding(s) and publications are you most proud of?

1. We showed that the BTB-Zn finger transcription factor, Lola, is required to maintain neurons in a differentiated state. In lola mutants, post-mitotic neurons dedifferentiate, turn on neural stem cell genes, and begin to proliferate, generating brain tumours (Southall et al. 2014).
2. We developed a technique for cell-specific, genome-wide profiling of chromatin-binding proteins without cell sorting, fixation, or affinity purification. We profiled genome-wide RNA pol II binding in neural stem cells, revealing expression of specific metabolic genes and gene regulatory networks that pattern cell fates (Southall et al. 2013).

3. We identified a population of glial cells that produce insulin/IGF-like peptides in response to nutrition, and showed that the insulin/IGF receptor pathway is necessary for neural stem cells to exit quiescence (Chell & Brand, 2010).
4. I originated the GAL4 system for targeted gene expression, enabling transcription of a chosen gene in any cell- or tissue-specific pattern in vivo (Brand & Perrimon, 1993).
5. I identified and characterised the first transcriptional silencer (Brand et al. 1985).

What significant challenges have you overcome?

Being told by my tutor that I should not bother applying to do a PhD.
Working and raising a child while also caring for an elderly parent with terminal cancer.

What advice would you give your younger self?

Apply for everything for which you are eligible and do not sell yourself short.
There is never a 'perfect' time to have children; do not leave it too late.

Dr Irene Miguel-Aliaga

Career so far including what motivated you to study/research in physiology?

I left Spain for a PhD in Oxford with Prof. Dame Kay E. Davies, which was a bit of a crash course in the use of flies, worms and cells to model human disease. In Kay's lab I established what, at the time, were some of the first Drosophila models of human neurodegeneration. That sparked my interest in developmental neuroscience and led me to a post-doc at Harvard in the lab of Prof. Stefan Thor, from whom I learned a lot about how neurons are made. It may not look that way from the outside, but a fly has ca 100,000 neurons, and our work identified novel mechanisms by which they become different from one another. In Stefan's lab, I became interested in eight of these neurons that do two unusual things: express what looked like a mammalian insulin, and innervate the fly gut. I then joined Prof. Alex Gould's lab at the National Institute for Medical Research in London, where we used these neurons to uncover unexpected similarities between their insulinergic regulatory programmes in insect neurons and mammalian pancreatic []-cells. Intrigued by their functions, I made the switch from development to physiology in order to study these gut-innervating neurons further. Developmental decisions can be black and white – you either make a limb or you don't; by contrast, physiology can be subject to many layers of regulation and the readout that you study may be a homeostatic set point. This comes with all sorts of interesting challenges such as system robustness, functional redundancy and unpredictable outcomes. I am hugely grateful to the Wellcome Trust for providing generous funding at such a crucial point in my career, allowing me to establish my own lab as a Research Career Development Fellow, first in Cambridge and then at the MRC Clinical Sciences Centre/Imperial College London – where I am now a Reader and Programme Leader. We have pioneered the study of the brain–

gut axis in flies, and have been probing the functional crosstalk between the nervous, digestive and reproductive systems. Awards such as an ERC Starting Grant and being elected to the EMBO Young Investigator Programme have provided external validation that our efforts are going in the right direction.

What are your aspirations?

I hope to continue to be surprised by biology. The practical realisation of this apparently simple aspiration relies on considerations such as ensuring long-term scientific independence, securing adequate and sustained funding and persuading open and creative minds to work with me. Lately I have been thinking that I may also need to somehow extricate myself from my background in genetic research; although the roles of genes and gene regulation are unquestionable, our focus on genetic mechanisms in recent decades may have led to a slightly unidimensional view of biological processes and their inheritance. We may find interesting surprises if we stop trying to get RNA or protein expression – or lack thereof – to explain everything.

What achievements are you proud of so far?

Managing to change research direction and start something new pretty much from scratch. My goal when setting up my lab was to establish the fruit fly Drosophila as a genetic system to explore the physiological roles of brain–gut interactions. We had to lay some foundations: a lot of descriptive and functional work, such as developing new methods to find out what is wrong when things go wrong (Cognigni et al. 2011). It all started with my first student and I looking at how flies defecate – an occupation that, at the time, provoked amusement and scepticism in equal measure. But our efforts paid off: we published well-received papers and several former members of my lab from that time are pursuing promising academic careers elsewhere. We were recently able to use the system we developed to find new ways by which organs communicate to cope with nutrient scarcity (Linneweber et al. 2014). Such communication involves gut-innervating neurons and local oxygen delivery systems and has implications for nutrient storage disorders such as malnutrition and obesity.

Have you had to overcome any challenges?

Plenty – and on a regular basis. But it is the same for everyone. Depending on your career stage you encounter a range of both scientific and personal challenges, from scientific frustration and funding issues to the huge workload, a sense of isolation and childcare issues. Unrealistic optimism and a passion for challenges are certainly two useful attributes in scientific research.

Professor Barbara Casadei

Research career

I graduated in Medicine in Pavia, Italy and obtained a tenure-track position shortly after. Instead of making me want to settle, the prospect of a tenure made me feel restless, so I left for a 'short visit' to Oxford and never made it back, even though it took me more than 20 years to get a tenured position in the UK. I started my academic career as a clinical investigator and became interested in basic science, as I became increasingly frustrated with not being able to unravel the mechanisms behind my clinical observations. By then I was in my mid 30s with a small child and about to complete my training in Cardiology, after obtaining a DPhil in Oxford. I tried to compensate for my lack of experience by collaborating with experts. It was an exciting and difficult time (many failures with a small breakthrough here and there). I am particularly grateful to Hilary Brown (Oxford), David Eisner (Manchester) and Karin Sipido (Leuven) for supporting my initial steps with patience and unfailing encouragement. There are critical moments in one's career where one is so fragile that even a little 'put down' may make a whole castle crumble. Another factor that gave me the confidence to carry on when things were at a very low ebb was the support of the British Heart Foundation – Peter Weissberg and Jeremy Pearson, in particular, always managed to make me feel as I was 'going places' (even when the BHF didn't fund my applications).

What research finding(s) and publications are you most proud of?

I spend so much time agonising on my papers before I submit them that I tend to lose interest in them the moment they are published. So, for me, my best and most interesting papers are always those that are still in the pipeline. Having

said that, I hold some of them in greater affection. For instance, studying patients who underwent thoracic sympathectomy for palmar hyperhidrosis to understand the role of sympathetic innervation in the exercising muscle was my first attempt to understand mechanisms (rather than describing associations) in human 'models' (Kardos et al. 2000). The discovery that nitric oxide increases heart rate directly by stimulating the 'funny' current in sinoatrial node cells was my first journey from a clinical observation to the understanding of the molecular mechanisms underpinning it (Musialek et al. 1997). Others followed on the role of the neuronal isoform of nitric oxide synthase and of oxidase systems in the myocardium in health and disease (Sears et al. 2003; Dawson et al. 2005) and, more recently, in atrial fibrillation (Reilly et al. 2011). This work has identified potential therapeutic targets that have been tested in clinical trials – so I have now gone full-circle.

What significant challenges have you overcome?

Being a 'bench to bedside' researcher was not fashionable when I started. Basic scientists were strictly doing animal or cell line work and investigation of human cardiac tissue was not encouraged (too messy!). I was always an outsider amongst cardiologists and an outsider amongst basic scientists (but later learnt to use this to my advantage ...). Coping with failure is difficult before one understands that everybody experiences it (though they don't necessarily like to talk about it). Belief in my abilities: I used to think that some people were so smart they did not need to try as hard as I did to succeed (which made me feel like those kids who get a 'good effort' badge at school), until I realised that they swotted 24/7 to appear 'effortless' ... that helped.

What advice would you give your younger self?

Try to plan your career, rather than let it happen. Attend 'assertiveness' and 'leadership' courses – this may sound like a waste of time but it is not. Decide on what you want to do and go for it – don't ask for advice; if you are a woman it is more likely than not that you'll be encouraged to 'underachieve'.

Dr Svetlana Reilly

Career so far including what motivated you to study/research in physiology?

As a clinician, I always tried to be guided by evidence and this practice developed into genuine interest in research. Moving to the UK in 2006 was a turning point as it offered an excellent opportunity to carry out a DPhil programme in basic science with an exceptional mentor, Prof. Barbara Casadei, at the University of Oxford. Pursuing some exciting observations on the role of nitric oxide synthase in arrhythmogenesis of atrial fibrillation and the regulation of this response by microRNAs gave a taste of being on the edge of novel findings and discoveries. As a result, this work led to an award of a very competitive Intermediate Fellowship by the British Heart Foundation Centre of Excellence in Oxford in 2013 and a number of prestigious local, National and International prizes. But the prospect that one day my work will make a real difference to patients' management and care gives me the real purpose of my career as a clinician-scientist.

What are your aspirations?

To advance our understanding of cardiac physiology and pathophysiology to an extent that would ultimately improve patients' care and management.

What achievements are you proud of so far?

The most significant achievement was to ensure a successful transition between a purely clinical career and basic science, which was made enjoyable through the continuous support of my long-time mentor, Prof. Barbara Casadei.

Have you had to overcome any challenges?

Pursuing my passion in science was and continues to be a great experience with a few challenges. During and straight after

completion of my DPhil I gave birth to two lovely sons
(in 2009 and 2011); becoming a 'mum-scientist' taught me to think positively and quickly, to be flexible, and to manage time more efficiently, as neither children nor science can wait.

What if any challenges to do you foresee?

Perhaps the main challenge would be to secure funding for innovative, pioneering projects which are inevitably high-risk.

Have you received any advice that has helped you?

'Everything is possible!' – a piece of advice or perhaps a life-time attitude that was cultivated by my mother. 'Be persistent!' – a great piece of advice that was given to me by my mentor, Prof. Barbara Casadei. Believe me a combination of these works perfectly.

What would you say to encourage girls at school into science?

Given that you already have a passion for science be positive, have courage and this will take you a long way.

Professor Shamshad Cockcroft

Research career

I first got into science when I read the biographies of various scientists including William Harvey and Marie Curie aged 14 when living in Zanzibar. After my undergraduate studies at the University at Manchester, I went to Birmingham University for my PhD where, through Bob Michell, I was introduced to a novel class of lipids, the phosphoinositides, that might play a big role in signal transduction. This got me hooked and I was fortunate to find a lab at UCL where I could pursue my interest in these lipids as a postdoctoral fellow. I was subsequently awarded a Fellowship from the Lister Institute and remained at UCL. I joined the Department of Physiology at UCL in 1989 and established the Lipid Signalling Group.

What research finding(s) and publications are you most proud of?

1. A serendipitous observation led me to identify that externally added ATP led to a gradual formation of an increasingly larger ion pore. We now know that this receptor (P2X7) has widespread significance in inflammatory diseases and is also an emerging target in central nervous system diseases (Cockcroft & Gomperts, 1979).
2. The discovery that phospholipase C activation was regulated by G-proteins (Cockcroft & Gomperts, 1985), subsequently purified and named as the Gq family.
3. The discovery that exocytic secretion was regulated by G-proteins (Cockcroft et al. 1987).
4. The discovery that lipid transfer proteins were required for phospholipase C signalling for the supply of substrate (Thomas et al. 1993).
5. The discovery that phospholipase D was regulated by the small GTP binding protein, ARF (Cockcroft et al. 1994).

What significant challenges have you overcome?

My major challenge was to go to University. I was born in Zanzibar and grew up amidst the many charms of its old town and its beautiful coastline. One month after independence from Britain, in January 1964, a socialist revolution transformed society. I was 12 years old. I quietly 'escaped' to the mainland of Tanzania when I was 17. I came to the UK aged 18 armed with four O levels, maths, English, British constitution and geography, which I took as a private student in Zanzibar. Applying to university to study Medicine was a challenge for two reasons: no-one in my family had ever been to university and secondly, applying to university with four O levels got me nowhere. I was fortunate to find support from the headmistress of a convent school in Harrow who allowed me to do my A levels in physics, chemistry and maths. After obtaining my A level results in August, a family friend, who was doing his PhD in Manchester negotiated a place for me in Manchester University to study Biological Chemistry. As luck would have it, the government then introduced higher fees for overseas students and at the same time my family were unable to fund my education due to foreign exchange regulations introduced in Tanzania at that time. Regardless of this, I survived the three years at university and was able to obtain several small grants from educational charities as well as working during the holiday period. As an overseas student, I had a limited choice for my PhD. Birmingham University offered me a demonstratorship and this allowed me to study with Bob Michell.

What advice would you give your younger self?

Go where the science takes you and follow those leads that take you into new territories.

Dr Kathryn Garner

Career so far including what motivated you to study/research in physiology?

I remember being fascinated by physiology and cell biology at school, but circumstance led me to train as an artist, gaining an undergraduate degree in Fine Art from Falmouth College of Arts. At Falmouth we were encouraged to explore the world as we saw it. My inspiration came from the biology section of the library, particularly from the iconic book Gray's Anatomy. Through making my 'cell paintings' I became hooked, hungry to learn more about the microscopy images I was copying, and to learn how to make the images myself. After graduating from art school I moved to London and eventually secured a job as a Cryobank Scientist, at last looking down a microscope to analyse and freeze sperm for a leading infertility clinic. Further A levels in biology and chemistry led to an undergraduate degree and PhD at University College London. I currently work as a Research Associate in the lab of Professor Craig McArdle at the University of Bristol. Our research is focused on signalling downstream of the neuropeptide gonadotrophin releasing hormone (GnRH), which is central in the control of reproduction.

What are your aspirations?

The way our bodies work at the molecular level continues to delight me and I'd like to use my unique position to tell other people about it! I still dream of having my first solo art show and I'd also like to facilitate art–science collaborations by establishing more schemes to invite artists into laboratories.

What achievements are you proud of so far?

Gaining a first class honours degree in Molecular Cell Biology from UCL proved I was serious about a career in science! My PhD with Professor Shamshad Cockcroft (supported by a studentship from the BHF) was a really fruitful time, but I'm

most proud of the discovery of the first phosphatidic acid-specific transfer protein (Garner et al. 2012), which has rumbled the lipid signalling field.

Have you had to overcome any challenges?

I made many personal and financial sacrifices to change direction and return to study as a mature student, but it was worth every one.

What if any challenges to do you foresee?

Securing funding for my scientific research and other projects continues to be a concern.

Have you received any advice that has helped you?

My tutor at art school told me that if it's boring, it's not worth doing. I took this to mean I should be led by what entices me, and it gave me the confidence to pursue a career in science.

What would you say to encourage girls at school into science?

If it fascinates you, then you have to go for it! Ultimately, you're the one who has to live your choices.

Professor Dame Kay Davies CBE DBE

Research career

I have always been a biologist interested in disease, but my school career prevented me from studying biology . I had to do Latin instead to win a place at Oxford to read chemistry. This basic training was a good grounding and I was fortunate to be at Somerville when Dorothy Hodgkin was still around inspiring students. My DPhil studies were in biochemistry but I rapidly progressed to genetics and physiology for the study of muscle disease, particularly Duchenne muscular dystrophy (DMD). My group is now very focused on the development of treatment for this devastating muscle wasting disease.

What research finding(s) and publications are you most proud of?

1. My first important paper in DMD published with clinicians and other scientists reported the first DNA markers for the prenatal diagnosis and carrier detection of this disease which had not been possible before and confirmed the location of the DMD gene (Davies et al. 1983).
2. Analysing patient data we showed that the disease was caused by mutations in hot spots of the gene. This facilitated the carrier detection and diagnosis of the disease (Forrest et al. 1987).
3. Finding that mildly affected patients could function well with 50% of their gene missing, we showed that this minigene could rescue the pathology in the mdx mouse model of the disease paving the way for the use of minigenes in gene therapy protocols (England et al. 1990).
4. We discovered the dystrophin related protein utrophin and postulated that it is so similar to dystrophin that its expression can be increased in muscle to prevent the disease in the mouse (Love et al. 1989).

5. We have developed small molecules that can increase the levels of utrophin, which can significantly increase the physiological function of muscle in the mdx mouse showing this to be a viable approach to therapy (Guiraud et al. 2015). Summit Therapeutics have taken this forward to Phase I clinical trials.

What significant challenges have you overcome?

Having been told that I should not expect a lectureship at Oxford as my husband had one and having the confidence, encouraged by my mentors, to apply for independent funding. Juggling a scientific career with being a mother in an era when others did not understand the pressures. Making my voice heard in all-male committees without seeming aggressive. Realising that even when jobs are very demanding, such as being Head of Department, colleagues want you to succeed and will often help.

What advice would you give your younger self?

Be confident enough to make your views known.

If things fail, or people are against you, move on without bitterness – there are many exciting things to do!

Be passionate and focused.

Be tenacious!

Dr Lisa Heather

Career so far including what motivated you to study/research in physiology?

Following an undergraduate degree in medical biochemistry at the University of Surrey, I knew medical research sparked my interest. I joined the Department of Physiology, Anatomy and Genetics at the University of Oxford for my PhD, studying the effects of cardiac disease on substrate metabolism. A constant supply of ATP is essential to support all cellular processes; therefore, understanding how disease can impact on metabolism is critical for understanding its development and progression. My passion for metabolism continued through my post-doctoral research and in 2011 I was awarded a Diabetes UK RD Lawrence fellowship, to establish my own research into the effects of type 2 diabetes on the heart. Since then my research group has grown, and the sky is the limit.

What are your aspirations?

I admire scientists who have made significant achievements within their fields, but who still show humility to help and inspire others. That is the type of scientist I aspire to be.

What achievements are you proud of so far?

Each stage of a scientific career has its milestones; the first paper, the first study that you lead, and the first conference award. Obtaining my own funding was a big milestone, as it was recognition that my ideas and achievements were important, novel and worth investing in.

Have you had to overcome any challenges?

Science is full of rejection: from journals, funding bodies, institutions and other scientists. Learning to accept these setbacks, maintaining self-belief in your ability and convictions, is a huge step towards dealing with these challenges.

Recently I have returned to work after having a baby, which has raised new challenges involving time management and prioritisation. However, the change in working practices, such as flexible working and family-friendly meeting scheduling resulting from the Athena SWAN charter, has made this process easier.

What if any challenges do you foresee?

The biggest challenges I foresee aren't in the research itself, but in obtaining money to keep the research going. A tenured position is my future challenge.

Have you received any advice that has helped you?

I have been fortunate to have a group of strong female mentors encouraging me throughout my career, both within my university and internationally within my field. These women have taught me how to foster collaborations, alerted me when suitable opportunities arise, and taught me to stand up for what I believe in. Their advice and faith in me has been indispensable.

What would you say to encourage girls at school into science?

At the age of 14 my chemistry teacher told me I was good at science. His encouraging comments led me to where I am today. There are hundreds of scientific careers available, so if you enjoy science go for it – I am privileged to work in a job I love.

Professor Annette Dolphin

Research career

I received my BA in Natural Sciences (Biochemistry, Class I) from the University of Oxford and my PhD from University of London, Institute of Psychiatry. I then held postdoctoral fellowships at the College de France in Paris and at Yale University before returning to UK to the National Institute for Medical Research, London, followed by a lectureship in the Pharmacology Department of St George's Hospital Medical School, London University. I was appointed Chair of the Department of Pharmacology at Royal Free Hospital School of Medicine, London University in 1990, and moved to University College London in 1997. I am Professor of Pharmacology in the Department of Neuroscience, Physiology and Pharmacology at UCL. I was elected as a fellow of the Academy of Medical Sciences in 1999, and The Royal Society in 2015.

I have won a number of prizes and awards, including the Sandoz Prize (British Pharmacological Society, 1986), Australasian visitor (British Pharmacological Society, 1990), the Pfizer Prize in Biology (1991), the GL Brown Prize (The Physiological Society, 1994), Astra Anglo-Nordic visiting scientist and lecturer (British Pharmacological Society, 1996), Julius Axelrod Distinguished Lecturer in Neuroscience, Toronto (2000), Gary Price memorial lecturer (British Pharmacological Society, 2011), British Neuroscience Association plenary lecture (2015), the inaugural Mary Pickford lecture (University of Edinburgh, 2015) and the Annual Review Prize lecture of The Physiological Society (2015). I am currently a Wellcome Trust Senior Investigator.

What research finding(s) and publications are you most proud of (limit of 5):

1. Dolphin & Prestwich (1985): this was my first paper as an independent lecturer.
2. Canti et al. (2005): this was our first major paper on α2δ-1, and started our work on calcium channel trafficking.
3. Hendrich et al. (2008): this paper identified a novel mechanism of action for the α2δ ligand drug gabapentin.
4. Davies et al. (2010): this was a very unexpected and novel finding on α2δ proteins, which we pursued with numerous different biochemical, imaging and electrophysiological techniques.
5. Cassidy et al. (2014): this paper has provided us with a fantastic new tool for studying N-type calcium channel trafficking into the future.

What significant challenges have you overcome?

Lack of mentoring (and my own naïvety) meant I never thought to ask for promotion when I was a lecturer, even though I had two Nature papers in my first four years.

A litany of personal problems that I would hate to bore you with here.

What advice would you give your younger self?

Do the best science you can, that is the only thing that counts in the end.

Compartmentalise your career away from problems in your personal life (are men able to do this to a greater extent than women?).

Look to the future and don't dwell on setbacks in the past.

Say yes to challenges, but don't be afraid of saying no to chores.

Dr Claudia Bauer

Career so far including what motivated you to study/research in physiology?

My passion for research in life sciences was sparked by the enthusiasm of my biology teacher in secondary school. I then went on to study biology at the University of Würzburg in Germany. For my PhD I investigated calcium-mediated signal transduction in plants using electrophysiology and imaging methods. I was captivated by the fact that you can actually 'see a cell at work'. As a post-doc in Prof. Jian Yang's lab at Columbia University in New York, I had the opportunity to switch from plant physiology to basic neuroscience. Working with Prof. Annette Dolphin at UCL was another decisive moment in my career. Annette not only enabled me to bridge the gap between basic and translational neuroscience, she also became my mentor. My research now focuses on investigating neuronal Ca2+ channels and Ca2+-dependent secretion of neurotransmitters and their role in health and disease.

What are your aspirations?

I am very excited about joining the research team in SITraN (Sheffield Institute for Translation Neuroscience). SITraN, founded by Prof. Dame Pamela Shaw, is one of the world's leading centres for research into motor neurone disease, and Alzheimer's and Parkinson's disease. I hope that one day my work will make a difference for patients and their families.

What achievements are you proud of so far?

Jian's trust in my capabilities led to a publication in Nature and helped with his tenure. I am particularly proud of the recognition I received from basic and clinical scientists but also from patients and their carers when presenting my work at conferences while in Annette's lab. Such meetings showed me the dire need for better therapies and made me to focus my research on translational neuroscience.

Have you had to overcome any challenges?

As a postdoctoral researcher on a fixed-term contract with a partner in the same situation, we had to be very flexible; we moved around a lot. By the time we built up our independent research we had to realise that we weren't eligible for early career fellowships anymore.

What if any challenges to do you foresee?

Securing funding is and will remain challenging. A researcher has to be very resilient and good in self-motivation. But every grant or funding scheme not applied for is a missed opportunity.

Have you received any advice that has helped you?

Before I left for my first conference, my PhD supervisor told me to 'seize the opportunities' and to 'just go for it'. What he probably hadn't anticipated was that his advice encouraged me to instigate a collaboration that successfully propelled my PhD project. I still remind myself of his encouragement.

What would you say to encourage girls at school into science?

Doing science is vital for our future and being a scientist is incredibly exciting! There aren't many careers where you can discover something truly novel; where some crazy Friday-afternoon-projects may one day save people's lives; and where you keep learning throughout your career.

Professor Kim Dora

Research career:

After my PhD in Australia, studying the physiological control of muscle blood flow, I moved to the USA to learn how to image the microcirculation working with in Brian Duling's group at the University of Virginia. Brian was a careful scientist and encouraging mentor who trained me in many of the techniques I still use. Once I saw the coordinated and smooth movement of blood through arterioles and capillaries with a muscle preparation in a living animal I was hooked, and have wanted to understand more about the controlling mechanisms. It was clear that electrical coupling between cells was a key mechanism, enabling hyperpolarisation to coordinate vascular dilatation, so I moved to the UK to join Chris Garland's group, then in Bristol, and under his guidance learned about the pharmacology of K+ channels in arteries and to make sharp microelectrode recordings from the very small cells in arteries, whilst continuing my work on conducted dilatation and Ca2+ measurement in the endothelium of cannulated small arteries. This all led to my first academic post at the University of Bath. In 2008, Chris and I moved to Pharmacology in Oxford with the support of Antony Galione, and set up labs and immersed ourselves in Oxford life. I am now a British Heart Foundation Senior Basic Science Research Fellow in the pharmacology department and a Fellow at Worcester College, where I teach pharmacology and physiology to medical students.

What research finding(s) and publications are you most proud of?

The three pieces of work that I am most proud of and have add made a significant difference to the vascular field are the following. Firstly with Brian Duling I showed that heterocellular Ca2+ signalling from smooth muscle to endothelial cells can release nitric oxide and activate K+ channels (KCa), to limit

contraction (Dora et al. 1997). Then, collaborating with Arthur Weston and Gillian Edwards, Chris and I showed that the K+ ions leaving cells through KCa could act on nearby K+ channels (KIR) and the Na+/K+ pump to further hyperpolarise smooth muscle cells, an endothelium-derived hyperpolarising factor (Edwards et al. 1998). Finally, a mechanism that enables both of these fundamental processes is the arrangement of key K+ and Ca2+ channels to endothelial projections to signal to smooth muscle. This forms the basis for a heterocellular signalling microdomain in the microcirculation (Dora et al. 2008).

What significant challenges have you overcome?

Moving between continents and institutions has required supportive senior colleagues and funding bodies, and I have been fortunate enough to experience both. The Australian NH&MRC funded my move to the US, and the Wellcome Trust and BHF have supported me in the UK. Being in the lab and doing research is my number one priority and drives everything else I do. Helped by the BHF I have achieved this and I am forever grateful.

What advice would you give your younger self?

Keep true to the principle of enjoying what you do, and doing what you enjoy.

Dr Pooneh Bagher

Career so far including what motivated you to study/research in physiology?

My interest in physiology stems from my undergraduate research project in the lab of Prof. Terrence Sweeney. He challenged me to think beyond the textbooks to get at the crux of a scientific question. I was convinced that I was going to be a medic, but he saw something in me that I didn't realise was there, a curiosity about the way things work, and a natural inclination to question things. He suggested that I consider a career in research and urged me to consider applying for PhD programmes. I am really glad that he was persistent, because after years of being in the laboratory I know that research is what I am meant to do. I look back with gratitude that he was my mentor during the early years of my career development.

I attended Cornell University for my doctorate, working with Dr Teresa Gunn where my interest in mouse genetics was sparked. I then started my first post-doctoral fellowship at the University of Missouri in the laboratory of Prof. Steven Segal, where I worked on the microcirculation in a calcium biosensor mouse line. I wanted to continue my training in calcium imaging, and that is what brought me to the UK and the University of Oxford to complete a post-doctoral fellowship in the lab of Profs. Kim Dora and Christopher Garland. They have provided the support to allow me to continue my professional development as well as develop independently. I am currently the Course Director for the MSc in Pharmacology and a Lecturer at Magdalen College, Oxford.

What are your aspirations?

There is no doubt that I want to run my own research group; it has been my goal for years and it is what drives me to continue when things get tough.

What achievements are you proud of so far?

I am proud of developing my own lab space and training my first graduate student. I am hoping it is just the beginning of a long career in science!

Have you had to overcome any challenges?

If you asked me this question one year ago, you would have a completely different answer to what I would say today. A little less than a year ago, I identified a lump in my breast during a routine self-exam. A few weeks later I was diagnosed with high-grade invasive breast cancer. Through the last year I endured things that I didn't think possible, both physically and mentally, and really questioned my long-term goals. Although it can be difficult to talk about my battle with breast cancer, as a scientist and an educator, I feel the importance of raising awareness about breast cancer and self-exams trumps any reservations I may have about sharing my story. I continued to work during my recovery and as much as I could during my chemotherapy, which ended five months ago. I am still trying to get back to 100% physically after everything I endured, but I won't go down without a fight.

What if any challenges to do you foresee?

There will always be the usual challenges with an academic career of obtaining/maintaining funding and publishing, but what I have learned is that there will always be challenges around the corner that you can't plan for. The best you can do is give 100% effort, and not give up.

Have you received any advice that has helped you?

I was meeting with a well-respected scientist and asked if he had any advice for a young scientist trying to make it. I remember him saying, 'Don't give up. When times get tough everyone will want to give up, and it is those that don't give up who will succeed.'

What would you say to encourage girls at school into science?

The beauty of science is that there are so many paths you can take, all depending on your personal interests. You can be a medical doctor, a research scientist, an engineer, a patent lawyer… the sky is the limit. I would encourage young students to ask questions of their teachers, explore their interests and see what career opportunities are out there. They may find a path that perfectly suits their interests and skillset.

Professor Maria Fitzgerald

Research career

I call myself a neuroscientist but in my heart I am a physiologist. My formative years as an undergraduate (Oxford) and a PhD student (UCL) were in wonderful Physiology departments and moving over the years to other UCL departments (Anatomy; Cell & Developmental Biology; Neuroscience, Physiology & Pharmacology) has not changed my view that it is the function of the whole brain connected to the whole body that is really important. My mentor was Professor Patrick Wall, FRS, the father of pain neurobiology and a true original. He taught me to enjoy science, to never be afraid to question the status quo, and to keep a sense a humour. I have tried to be a good mentor myself as I still believe that this is the key to a successful career. Being an academic research scientist is a tough business at times but there is nothing like it – every day you learn something new.

What research finding(s) and publications are you most proud of?

1. My first independent paper, which was published in *The Journal of Physiology* (of course) and described the postnatal development of peripheral and spinal somatosensory processing (Fitzgerald, 1987).
2. A small but important study that began my passion for working with human infants as well as rat pups. We showed, contrary to opinion at the time, that babies do indeed feel pain (Fitzgerald et al. 1988).
3. The first demonstration that spinal pain circuits are shaped by sensory experience after birth. All the young co-authors went on to great things. Should have been in a higher impact journal (Beggs et al. 2002).

4. A wonderful collaboration between neurophysiologists, neonatologists and statisticians - we showed how the human infant brain may begin to distinguish touch from pain (Fabrizi et al. 2011).
5. The recent result of a great transatlantic collaboration and a fearless student, explaining the mystery of why infants apparently do not develop neuropathic pain (McKelvey et al. 2015).

What significant challenges have you overcome?

Breath-taking misogyny from some of the most influential scientists in the field. Freeing my lab of a rogue post-doc. Balancing travel to conferences with being a good mother. Realising that many of my colleagues were doing half the work that I was and getting paid more. Learning to be proactive about changing university governance.

What advice would you give your younger self?

Don't feel that you have to do what everyone else does – plough your own furrow.

Don't feel embarrassed about putting your family first.

Stay calm and focused and use your intelligence to see you through.

Don't expect everyone to like you.

Be open – secretive people are not to be trusted.

Dr Stephanie Koch

Career so far including what motivated you to study/research in physiology?

My interest in physiology and systems biology began as an undergraduate MPharmS student at the University of Bath; I became fascinated by how these finely tuned systems can go awry in pathological situations, such as in chronic pain states. I chose to pursue this interest in research and was accepted into the MSc Neuroscience programme at University College London. There I met Professor Maria Fitzgerald, my PhD supervisor and future mentor. Work with Maria Fitzgerald led me to examine the postnatal development of inhibition in the spinal dorsal horn, first using electromyography, and later extracellular recordings. Seeing the quantifiable effects of cutaneous sensation and integration in real time was incredible, and I could not imagine a better way of examining sensory systems. I am currently building on this work with Professor Martyn Goulding and integrating genetics in order to target and manipulate defined cell populations. The integrated approach of physiology and finely tuned genetic manipulations allowed me to secure a Marie Curie International Outgoing Fellowship, which is a definite highlight of my career thus far.

What are your aspirations?

To lead my own laboratory and strengthen our understanding of how sensory input is integrated at a cellular and circuit level.

What achievements are you proud of so far?

Publishing in PNAS was a milestone after my PhD. Maria Fitzgerald had given me a lot of intellectual freedom on the project and it was a great experience to go through that process. My proudest achievement has been securing a fellowship, which is the first independent assessment of my scientific ideas, and has given me the confidence to pursue my research interests.

Have you had to overcome any challenges?

Securing funding when you are determined to work in a similar field to your academic past is difficult, but I had a strong sense of what I wanted to achieve and this came through in the end.

What if any challenges do you foresee?

Competition within science is challenging, both to secure funding and for tenured positions. A strong belief in your own goals and methodology will help you adapt to changes the research environment.

Have you received any advice that has helped you?

Study what you are passionate about. Academia is hard enough as it is; your passion and interest are likely to pull you through the harder moments.

What would you say to encourage girls at school into science?

I believe good science stems from curiosity and creativity. This is why it makes for such an exciting career, you can find what fascinates you and seek it out in ways that no one has thought of before; there are no boundaries.

Professor Abigail L. Fowden

Research career

I arrived in Cambridge as an undergraduate in 1972 and have never left. When I graduated in 1975, I stayed to take a PhD degree in fetal physiology in the Department of Physiology, because it was one of the few places worldwide where I could study chronically instrumented fetuses in utero across a range of species. Before completing my thesis, I became a temporary demonstrator in the department to cover the teaching of Colin Blakemore, who had been awarded an external fellowship. When he moved to Oxford in 1979, I was appointed to the vacant tenure track demonstratorship, probably because I was already doing the job. My academic career, therefore, began more by luck than strategic design on my part. Since then, I have worked my way up the career ladder through lectureship and readership to a personal chair in 2002, now held in the Department of Physiology, Development and Neuroscience formed by merging the Departments of Physiology and Anatomy in 2006. Since 2002, I have had several stints as acting Head of Department and have just been appointed as the University's next Head of the School of the Biological Sciences.

What research finding(s) and publications are you most proud of?

1. First demonstration that fetal insulin is essential for normal fetal growth (Fowden & Comline, 1984).

2. My first *Journal of Physiology* paper: a collaborative study of the nutritional regulation of prostaglandin production in utero done while on sabbatical leave in Australia. I have loved Australia ever since (Fowden et al. 1987).

3. Final major paper with my mentor, Marian Silver, published after her early death, identifying the factors involved in the developmental regulation of fetal glucose metabolism (Fowden et al. 1998).

4. First paper on equine fetal metabolism bringing together techniques and skills built up in Cambridge over many years (Fowden et al. 2000).

5. A collaborative study using genetically modified mice investigating resource allocation during pregnancy from the gene to systems level which first presented the concept of maternal–fetal signalling in matching nutrient supply and demand to optimise fetal growth (Constância et al. 2005). These studies are still ongoing in all the species that we study in Cambridge today.

What significant challenges have you overcome?

Working in a different country from my husband for seven years from shortly after we married in 1976 until he too obtained a lectureship at the University of Cambridge.

Early in my career, retaining a farm animal research facility despite departmental cost cutting.

Leadership of the department as acting head during the successful merger negotiations.

Juggling the practicalities of my research and keeping it fundable and compliant in the ever increasing regulatory environment for science alongside my College responsibilities and family life.

What advice would you give your younger self?

Be braver. Don't be daunted by the unfamiliar or the apparent mountain to climb. Think ahead strategically. Don't drift. Always challenge yourself. Listen carefully. Ainsley Iggo asked me at the IUPS meeting in Glasgow in 1993 whether I was a Chief or an Indian. I gave him a noncommittal answer because I had not thought about my long term career direction then. However, his question started me thinking and showed that others could see potential in me that I was blind to at the time. Be ambitious. Strive for the best – science, publications, teaching feedback and working relationships. Strength comes from adversity. Keep going. You only get where you are going with the help of others so be generous with your time in return.

Dr Amanda Sferruzzi-Perri

Career so far including what motivated you to study/research in physiology?

My main research interest is to understand the unique relationships between the mother, placenta and fetus, with the ultimate goal to improve the long-term health of women and their families. My interest in this field was ignited during graduate training at the University of Adelaide, Australia after finding out that, shockingly, more than one in every eight women develops a life threatening complication during pregnancy. I undertook a one-year research project assessing the role of maternal leukocytes in regulating reproductive function. I was awarded a 1st class Honours grade for my efforts and published my first paper. I then pursued a PhD at the University of Adelaide, which assessed the role of insulin-like growth factors (IGFs) in the maternal circulation in regulating placentation and fetal growth and nutrient acquisition using in vivo physiological methods (this yielded five research papers plus three reviews). Through the award of a CJ Martin Overseas Biomedical Research Fellowship from the Australian National Health and Medical Research Council, I then moved to Cambridge, UK to explore whether the maternal environment affects the IGF system and gained expertise in cellular and molecular techniques by collaborating with leaders in the field (this yielded six research papers plus three reviews). Through the award of a Next Generation Fellowship from the Centre for Trophoblast Research and more recently a Dorothy Hodgkin Research Fellowship from the Royal Society, I have been using unique genetic tools and high throughput technologies in Cambridge to more precisely decipher the role of IGFs and their signalling pathway, PI3K in maternal–placental–fetal interactions governing pregnancy success (manuscripts currently in preparation for publication). Over the years,

a number of renowned female researchers (particularly Prof. Abigail Fowden) have inspired and encouraged me to achieve independence. At present, my laboratory is combining genetic, molecular and functional approaches to comprehensively decipher the molecular dialogue between the placenta and mother in the control of fetal growth and maternal health, which we hope will aid the development of diagnostic tools and therapeutic agents for pregnancy complications.

What are your aspirations?

To undertake high quality research that is not only important for addressing fundamental biological questions but has clinical significance, with the ultimate goal of improving the health of mothers and their families. Moreover to inspire the younger generation of female scientists to do the same!

What achievements are you proud of so far?

Securing a prestigious Fellowship from the Royal Society in 2014, enabling me to pursue a novel, independent line of research. Moreover, having my first two PhD students successfully complete their thesis in just of the allocated three years (in Jan 2015), with manuscripts showcasing their research efforts currently being prepared for publication.

Have you had to overcome any challenges?

Finding a way to maintain both a healthy family life and an ambitious research career without family support in the UK. Through the award of a Dorothy Hodgkin Research Fellowship, I have the option to claim back time spent on parental responsibilities so that I can continue my research at an international level without the added stress. Moreover, by having a supportive partner and surrounding myself with colleagues and collaborators, I am able keep the experiments going even in the event of a spontaneous family emergency. The process of becoming a mum and running a laboratory has taught me a lot about being persistent, becoming efficient and believing in yourself.

What if any challenges to do you foresee?

Being competitive for grant applications. However, in my experience, seeking feedback and going through reviewers' comments are valuable for improving future applications.

Have you received any advice that has helped you?

Don't take rejection (of grants, fellowships, papers) personally – believe in your abilities. Keep trying, seek feedback, learn from your mistakes and persevere – you will get there in the end.

Professor Christine Holt

Research career

I had an interest in nature and wildlife from an early age growing up in Northumberland. I went to Sussex University to study Biological Sciences where I was introduced to the exciting world of research. I was amazed to discover that you could actually make a career out of what I loved doing –pursuing questions in biology! As an undergraduate, I became interested in how nerve connections are made in the visual system and I went to King's College London to do my PhD working in this area. I had a wonderfully inspiring supervisor, John Scholes, who gave me a lot of freedom in my research while gently guiding me. In 1982 I went on to do post-doctoral studies at the University of California San Diego (UCSD) where I worked with Bill Harris, another inspiring mentor. Our similar research interests sparked a lifetime collaboration. In 1992, I joined the faculty in the Biology Department at UCSD and became a tenured Associate Professor in 1996. In 1997, I moved to the Anatomy Department at the University of Cambridge and became Professor of Developmental Neuroscience in 2003, where I remain today.

What research finding(s) and publications are you most proud of?

1. My PhD work showing that nerves from the eye grow directly to their correct targets. This finding arose from a new technique I developed that allowed us to see developing axons and the embryo, and went against the favoured hypothesis of trial-and-error growth (Holt & Harris, 1983).
2. Being able to visualise axons growing in the live vertebrate brain for the first time with time-lapse imaging was one of the most exciting moments in my career (Harris et al. 1987).

3. The study where we identified the molecular mechanism that helps to direct axons from the eye to the right side of the brain (Nakagawa et al. 2000). It was a memorable moment seeing a discrete 'blob' of EphrinB at the chiasm!
4. Our study showing that the growing tips of axons rely on local protein synthesis to respond to extrinsic guidance signals. This unexpected finding challenged dogma and met considerable resistance when we tried to publish it (Campbell & Holt, 2001).
5. A screen we developed to find out which proteins are made locally in axons led us to identify a surprising player (lamin B2) whose local synthesis is needed to maintain axon survival (Yoon et al. 2012).

What significant challenges have you overcome?

Significant challenges arose in my early career mainly because I was married to my collaborator who already had a faculty job. My department at UCSD did not see me as an independent scientist and assumed that he was the lead scientist in all of our publications. We stopped collaborating so that I could publish my work separately and eventually got a tenure track position. Being the mother of two children posed significant challenges in terms of striking a good work–life balance. These were eased somewhat by hiring good help and sharing childcare duties with my husband.

What advice would you give your younger self?

It is very important to find a question that really interests you and that you want to find out the answer to. This type of all-consuming interest keeps you going through the lean times and keeps you motivated through the many inevitable failures. Collaborate with others who have expertise that you lack. Be confident in your own scientific discoveries and convictions and resist following the crowd.

It is not necessary to be aggressive to be heard, do the best possible science, play fair and learn how to give killer talks!

Dr Paloma T. Gonzalez-Bellido

Career so far including what motivated you to study/research in physiology?

I wanted to be a marine biologist since I was five years old and once I moved to Australia (UQ, Brisbane) for my undergraduate studies, I became fascinated with the physiology of the native organisms. Do reef fish perceive each other and the corals as being colourful? How does the brain of a tiny shrimp make sense of so much visual information? Such questions motivated me to contribute to discovering how neural structures work. Since I had so much to learn, a PhD that included recording from photoreceptors in vivo in a model animal seemed the perfect opportunity (University of Sheffield, UK). From there, my questions moved into understanding how the acquired information is transformed into timely action, and my love for research about extreme adaptations took me to study neural control in a variety of animals, from prey capture in dragonflies and miniature insects to skin iridescence in squids.

What are your aspirations?

I aspire to never hold back until it is time to retire and always make those that gave me opportunities proud of providing such support. To remain level headed and kind, in the face of ever increasing stresses and demands. I am extremely lucky to count with mentors that fill these criteria. I have big shoes to fill!

I also aspire to develop and maintain an honest dialogue with the public, so that they can update their idea of what a scientist is and why basic research ought to be funded.

What achievements are you proud of so far?

Obtaining a lectureship in physiology at the University of Cambridge by doing what I love to the best of my ability. The Capranica (I. Society for Neuroethology), Cozzarelli (PNAS board) and Student (Society for Experimental Research) awards were truly amazing moments.

Have you had to overcome any challenges?

The lack of funding from my home country in my research field and learning English. Recently, Facing the two-body problem and starting a laboratory when my daughter was four months old.

What if any challenges to do you foresee?

In general terms, the common two body problem is still not solved in science and finding the right balance between family and work life is tricky.

Making sure that the students and post-doctoral scientists that come through my laboratory settle in positions that they are happy with, whether in Academia or Industry.

Have you received any advice that has helped you?

Remember that time and energy are limited and much better spent focusing on finding solutions, instead of dwelling on the problems.

Understand the big picture, but focus on one challenge at a time. This prevents me from getting overwhelmed.

Think carefully about what advice to act upon, and what to ignore. This is not as straightforward as it seems!

What would you say to encourage girls at school into science?

You get paid to learn, discover and develop! In science you get to be the first to see things and solve the questions that no one had answers to. If you have a new idea that can be tested with the equipment in the laboratory, you could have discovered something new by the end of the day. It is extremely demanding, and rewarding at the same time. You have a great level of independence on the day to day basis, but you also get to socialise, liaising with dozens of collaborators around the world regularly.

Professor Anne King

Research career

I discovered Physiology as a student at Aberdeen University and undertook a PhD on muscle neurophysiology at Southampton. The department was led by Gerald Kerkut, a maverick who relished challenging dogma, and he encouraged us to do the same. As a post-doc at Barts, London I worked with Andreas Nistri, who introduced me to the mysteries of the spinal cord, an area of research I have never left. I joined Patrick Wall's 'Pain Group' at UCL and worked with Clifford Woolf to help establish the mammalian spinal cord in vitro as a tool for pain and nociception research. Working with such passionate scientists through my early career allowed me to begin to dream that I too could set up my own lab. In 1989 I joined Leeds University as a nervous lecturer in the then Physiology Department, and established pain work at Leeds, which continues today. I now hold a Chair in Translational Neuroscience at Leeds.

What research finding(s) and publications are you most proud of?

My earliest paper was published under the name of A.E. McBain and it has a particular co-author on it, D.J. King – we married shortly after finishing our PhDs! I have still not got over the fact that he was first author because his surname started with 'K' (King et al. 1982).

One of my first pain-related 'in vitro' publications described 'wind-up', a form of plasticity relevant to chronic pain but the data represent much behind-the-scenes teeth gnashing and frustration (Thompson et al. 1990).

Early outputs from my lab at Leeds that describe synaptic and biophysical properties of dorsal horn neurones in vitro were co-authored with my very first post-doc, the gifted J.A. Lopez-Garcia who now heads up his own lab in Madrid (Lopez-Garcia & King, 1994).

More recently, we detailed a functional role for gap junctions in nociceptive regions of the mammalian spinal dorsal horn, a topic criticised by the grant referees but fortunately supported by the BBSRC (Chapman et al. 2009, 2012).

What significant challenges have you overcome?

I have had three career breaks. The first two were almost immediately after arriving in Leeds with the births of my daughter and soon after my son, so I understand fully the term 'working mum'. The third was for health reasons; I was off for so long that when eventually I got back to work my computer username had expired – happily I had not!

What advice would you give your younger self?

Make a career plan and go for it. Don't wait for someone else to decide when you are ready to take the next step up the career ladder – agitate!

Set-backs bring that elusive thing called 'experience', so go to a quiet place to scream and then move on.

Life is precious so enjoy it even when it is kicking your butt!

'Don't get tipsy before pudding'!

Dr Ilona Obara

Career so far including what motivated you to study/research in physiology?

After graduating from the Jagiellonian University (Krakow, Poland) with an MSc degree, I started working as a research assistant in the Institute of Pharmacology, at the Polish Academy of Sciences. This was my first real exposure to research in the pain field and soon I knew it was the path I wanted to follow. I did my PhD, studying the contribution of peripheral opioid receptors in neuropathic pain under the mentorship of Prof. Barbara Przewlocka (Krakow, Poland) who had a huge impact on my future professional decisions. Also, being awarded a scholarship at that time from the Foundation for Polish Science (FNP), gave me a real kick and belief that this may be a career for me. During my three subsequent postdoctoral research positions (University of California at Santa Barbara, UCL and Leeds University) I was lucky to work under the supervision of truly passionate scientists (two of which are women! – Profs. Karen Szumlinski and Anne King). They allowed me to explore novel approaches to understand chronic pain mechanisms and gave me an opportunity to extend my research skills from behavioural to genetic and imaging methods. These years shaped me as an experienced researcher, but being mentored by such passionate scientists gave me a drive to develop as an independent researcher myself. In December 2012, I was appointed as a lecturer in Pharmacology at Durham University where I have set up my own lab to continue research in pain. Importantly, I still have the support and friendship from my former mentors.

What are your aspirations?

There are three things that are consistently on my mind: (1) to gain recognition in my research field; (2) to be a passionate mentor like the ones that I had; and (3) to successfully and consistently secure research funding.

What achievements are you proud of so far?

Within the last 10 years I have moved four times, changing countries and following my husband who also works as a researcher in Computer Science. This was challenging every time, but I managed to secure a job for myself in great institutions and kept my family (including my daughter) together!

I am also very proud of establishing my own lab. When I joined Durham at the end of 2012 my lab had only walls, windows and benches – now research is thriving and results are being produced which is really exciting. Whilst establishing a lab from scratch is very enjoyable, it is also quite challenging and sometimes even daunting. Thus, I will always be very sentimental thinking about the first summer when we were able to run our first experiments.

Have you had to overcome any challenges?

I feel like the whole academic career is full of various challenges and securing a permanent position does not necessarily mean it will get easier. Undoubtedly, passion and persistence help us survive - so believe in yourself! I still find this a major challenge!

What if any challenges to do you foresee?

Securing funding will be always the biggest challenge; the other aspects of the academic job are just a matter of good time management.

Have you received any advice that has helped you?

When one door closes, another opens. This helped me to move forwards in my most uncertain times and indeed many other doors opened for me! Also, I was consistently reminded about a good balance in life, as this is the only way to have full satisfaction in both your personal and professional life.

What would you say to encourage girls at school into science?

A career in science is never boring! Every day in the lab brings something new, often exciting, and obtaining publishable results is very satisfying. Plus, research science allows development of skills that are easily transferable to many interesting careers.

Professor Bridget Lumb

Research career

My initial application to university was to study Geography & Sociology, but during a gap year I worked as a technician in the Physiology Department at the University of Nottingham and saw the light – no looking back. I switched my programme to Biological Sciences at the University of Birmingham and followed a course of study that enabled me to become a Physiologist and Neuroscientist. I had never intended to follow an academic career, but all that changed after undertaking a final year project in the laboratory of John Wolstencroft – who was inspirational, a well rounded individual whose interests encompassed wine, art and science. If I'm honest I chose his final year project because, although fascinating, I didn't fully understand his lectures and I was seeking some clarification – more than 30 years on I'm still searching ... That's what makes a research career so stimulating.

What research finding(s) and publications are you most proud of?

1. The first demonstration of the role of descending control in the spinal processing of nociceptive input from abdominal viscera (Tattersall et al. 1986a,b; Cervero & Lumb, 1988).
2. The use of chemical stimulation in the brain to establish for the first time the importance of the hypothalamus as a modulator of spinal nociception (Lumb, 1990).
3. The development of novel functional anatomical approaches that combine tract tracing with markers of neuronal activation to study the precise organisation of descending control systems that originate in the hypothalamus.

4. The demonstration that inescapable (visceral and C-nociceptor mediated) and escapable (cutaneous and Aδ-nociceptor mediated) pain are represented in distinct hypothalamic-midbrain circuits.
5. The development of a novel method to study the central processing of C- and A[]-mediated nociception. This approach has enabled studies of the role of descending control in central mechanisms that underlie the control of pain of different behavioural significance and of groups of nociceptors that have distinct roles in the initiation and maintenance of chronic pain. To date, findings arising from the use of the method are (a) the first description of the dynamic encoding properties of spinal sensory neurones following activation of C- and A-fibre nociceptive afferents (McMullan & Lumb, 2006a); (b) the first direct evidence for differential descending control of C- and A-fibre mediated spinal nociception from the midbrain (McMullan & Lumb, 2006b) and the hypothalamus; (c) the first evidence that centrally acting prostaglandins set the gain of acute nociception (Leith et al. 2007).

What significant challenges have you overcome?

The untimely death of my PhD supervisor within a year of completing my PhD and embarking on an academic career was a significant early challenge. John Wolstencroft and I were writing up the first manuscript when he died. Colleagues were very generous with their support at this time and the first paper was published posthumously.

The following significant challenges all revolve around the need to overcome the 'imposter syndrome' and to believe in my ability to succeed in diverse academic roles: as a researcher, a teacher, Meetings Secretary of The Physiological Society, Head of School, etc.

What advice would you give your younger self?

You can do it if you really want – keep the faith and enjoy.

Dr Emma C Hart

copyright 'Queen Mary University of London'

Career so far including what motivated you to study/research in physiology?

Exercise physiology was really the subject that got me hooked on research into physiology. I did my undergraduate dissertation (Hons) on the athlete's heart in rugby players with Prof. Keith George and realised that I really did love cardiovascular research. I liked cardiovascular exercise physiology particularly because it made me think integratively about physiology. I loved thinking about how body systems worked together to facilitate exercise and how this changed in disease. After that I realised I wanted to do a PhD in Cardiovascular Physiology and continued researching the athlete's heart with Prof. Rob Shave. I was lucky enough to go and complete some experiments in with Prof. Niels Secher at the Copenhagen Muscle Research Centre, which was really inspiring. I felt particularly inspired because of the technology available and the history of the department; Niels had August Krogh's exercise bike in his lab!

After my PhD, I was lucky enough to go and complete an American Heart Association Postdoctoral Research Fellowship with Drs Michael Joyner, Nisha Charkoudian and Gunnar Wallin at the Mayo Clinic in Minnesota. This had an enormous impact on me – I've been fortunate to work with lots of brilliant people in science, but Nisha, Gunnar and Mike all made a huge impact. Their enthusiasm for cardiovascular and neuroscience research inspired me to consider a career in science. I've learnt that the people you work with make the most important impact: having a team that are on a similar wavelength and that you enjoy working with is half the battle. It encourages you to think in different ways. At Mayo, I became interested in blood pressure regulation between men and women and why women are at higher risk of developing high blood pressure. Now, I am working at the University of Bristol, where I am developing my independent research group. I have a BHF Intermediate Fellowship and have developed a high blood pressure

translational research programme with Prof. Julian Paton. Here we have taken basic research into clinical trials on patients with hypertension; this is literally bench to bedside and is a fascinating and most exciting experience. I really do think this research will help make an impact in the future – especially in blood pressure management. Over the years, I've learnt that you should really base your research on core principles that you believe in.

Finally, one of the biggest things that has made an impact on my enthusiasm for cardiovascular research is my mother becoming sick – she had a brain aneurysm that burst. She is only alive because of the research that went into treating this kind of event. In science sometimes we have to accept that we aren't going to save the world with one experiment, but we can do some research that may eventually play a minor part in the development of a major new treatment for a disease. For me, to even play a small part in this is really important.

What are your aspirations?

To build a successful research group and complete research that really does make an impact for health and disease. The most important thing is to enjoy it at the same time. I also want to provide chances for students to experience research and to start a career in research – pretty much like the chance I was given.

What achievements are you proud of?

A defining moment was my first ever publication, which was in *The Journal of Physiology*. I remember being very proud and excited. I don't ever want to lose the enthusiasm that I felt for research at that time. Since then, getting my BHF Fellowship was a significant moment for me. I felt very proud as this meant I would be a step closer to becoming an independent researcher. I have built a human integrative physiology lab to complete autonomic research studies for my fellowship. This has been a challenge, but I feel very proud that I have developed both the lab and the team of researchers that we have.

What challenges have you had to overcome?

Taking the step towards becoming independent is a massive step and comes with its difficulties and challenges. Sometimes, being a younger scientist means that you get brushed aside or not taken seriously by more senior scientists. I have experienced this a few times. To try and overcome this, I have tried to put myself into the academic and public eye – presenting your work is critical. Participating and contributing in Departmental and institutional academic life is really important for this issue too – it helps to get yourself known. Additionally, collaborating and networking with people is also essential, since other scientists get to know you and your work.

Professor Margaret (Mandy) R MacLean

Research career

I actually wanted to be a hurdler but after winning the Scottish Intermediate Women's gold medal, a permanent injury made me re-think! I loved biology as I had a really inspiring biology teacher at school and so signed up for a biology degree at Edinburgh University. The rest, as they say, is history. I was fascinated by pharmacology and still am. I have been lucky to have been taught and mentored (both experimentally and pastorally) by some incredible pharmacologists and physiologists. After my degree I worked with Syntex for two years, then completed my PhD at Edinburgh University, a post-doc in Florida, then one in Cambridge, moving to The University of Glasgow in 1989. I have been there ever since. I champion in vivo science, postgraduate studies and public engagement and have run Glasgow's Cafe Scientifique since 2004.

What research finding(s) and publications are you most proud of?

My research has always focused on the pulmonary circulation and pulmonary hypertension. Looking back I can separate my career into three main 'eras': endothelin, serotonin and sex! So I have selected papers to illustrate these and the unique nature of pulmonary arteries.

1. Characterising the ETB receptor on pulmonary arteries, we demonstrated it is atypical and unlike those in the systemic artery (McCulloch et al. 1998).
3. We showed that it is the 5-HT1B receptor that mediates contraction of the human pulmonary artery and could be a target for pulmonary hypertension (Keegan et al. 2001).
3.. Peripheral serotonin is critical for the development of dexfenfluramine-induced pulmonary hypertension (Dempsie et al. 2008).

4. The oestrogen metabolising enzyme CYP1B1 plays a role in the development of pulmonary hypertension (White et al. 2012).
5. Inhibition of oestrogen synthesis reverses pulmonary hypertension in males, not females (Mair et al. 2014).

What significant challenges have you overcome?

Bringing up two children on my own whilst developing my career (I can't have done too badly as my daughter now has a degree in pharmacology!). Setting up a new Graduate School from three old ones when I became Dean of Graduate Studies, and Colleges were created; people don't like change so this was quite challenging. Dealing with difficult and disrespectful PhD students. Keeping a healthy life–work balance. Maintaining a funded research group.

What advice would you give your younger self?

Always trust your instincts and voice your opinion with confidence. Things are always as they should be. People at work are just people at work. The brave woman is not she who does not feel afraid, but she who conquers that fear. Illegitimi non carborundum.

Dr Kirsty Mair

Career so far including what motivated you to study/research in physiology?

I really enjoyed science at school so decided to study Biochemistry and Pharmacology at university. During my undergraduate studies I had the opportunity to carry out a summer lab project within the Faculty of Pharmacy at the University of Porto, which really sparked my interest in research. This opportunity along with the experiences I gained working with PhD students and post-docs during my final year honours project at the University of Strathclyde made me decide to apply for a PhD. Since then I have mainly worked in the laboratory of Professor Mandy MacLean at the University of Glasgow studying the mechanisms underlying the development and progression of pulmonary hypertension. My work currently involves investigating the role gender and hormones play in the condition.

I was recently awarded my own small grant from the British Pharmacological Society to investigate the potential role of oestrogen and sphingosine kinase in animal models of pulmonary hypertension. I hope to use the data obtained from this to put together a proposal for a research fellowship so I can carry out my own independent research.

What are your aspirations?

I would like to become an independent researcher, mentoring and inspiring younger scientists.

What achievements are you proud of so far?

Having my research published in the American Journal of Respiratory and Critical Care Medicine, which is one of the highest ranked journals for respiratory research.

Have you had to overcome any challenges?

I have recently returned for maternity leave. Leaving my little one was difficult and things move on so quickly in science that it took me some time to get up to speed again.

What if any challenges to do you foresee?

There is a lot of competition for fellowships and it will be difficult process to trying to secure one but I relish a challenge.

Have you received any advice that has helped you?

Keep trying, be persistent! Having grants proposals or research papers rejected can be disheartening, but treat the reviewers' comments as constructive criticism to improve on what you are already doing.

What would you say to encourage girls at school into science?

If you enjoy it, go for it! There are so many areas of science that there are always new things to learn and discoveries to be made. You are just as capable (if not more so) than the boys!

Professor Eleanor A. Maguire

Research career

I have always been interested in navigation, mainly because I am so bad at finding my way around. At the start of my PhD I came across O'Keefe and Nadel's, by then, classic book proposing a brain structure called the hippocampus was critical for navigation. I was hooked! For my PhD at University College Dublin and Beaumont Hospital, Dublin I studied the effects of hippocampal lesions on patients' navigation. That the hippocampus is also involved in recalling our past experiences made it even more intriguing. After my PhD, I was fortunate to work at the new Functional Imaging Laboratory in Queen Square, London, where techniques such as functional MRI were just taking off. This enabled me to extend my work into the healthy human brain in vivo. I started there as a post-doc, eventually becoming a group leader, and have had my lab there ever since.

What research finding(s) and publications are you most proud of?

1. One of my first functional neuroimaging studies used virtual reality in a brain scanner to study real-world navigation (Maguire et al. 1998). We observed increased hippocampal activity, which was exciting because up until then it was thought that sparse neuronal coding in the hippocampus may preclude detection using these techniques.
2. My studies of licensed London taxi drivers have had wide appeal. In the original study in 2000 we found that taxi drivers had greater grey matter volume in the posterior hippocampus compared with controls, and a longitudinal within-subjects study in 2011 (Woollett & Maguire, 2011) confirmed that hippocampal plasticity in adult humans was possible in response to environmental stimulation.

3. Our finding that patients with bilateral hippocampal lesions are not only amnesic for the past (and poor at navigation) but also cannot imagine the future (Hassabis et al. 2007) also generated interest.
4. This discovery helped to reinvigorate the field of memory, leading to my Scene Construction Theory of the hippocampus (Maguire & Mullally, 2013).
5. Taking advantage of new developments in 'decoding' algorithms, we have also discovered that it is possible to predict solely from patterns of fMRI activity in the hippocampus, which particular personal past experience someone is recalling (Bonnici et al. 2012), opening up exciting new avenues to interrogate memory and the hippocampus.

What significant challenges have you overcome?

Other than the usual lack of confidence and raging imposter syndrome, three other challenges spring to mind. First, my interest in real-world tasks like navigation and recalling past experiences meant having to be innovative in how to test these in restricted environments like brain scanners. Use of techniques like virtual reality has been key. Second, in the early days other neuroscientists were very hostile believing that nothing useful could be learned from using such complex real-world tasks in brain scanners. Fortunately they were wrong! Third, contesting long-standing dogmas in the field has, and is, a big challenge and can be tough, but I continue to fight the good fight!

What advice would you give your younger self?

Be more confident, worry less, do not be afraid to go with your instincts, be brave, seek out mentors – they have been through it all before! Learn to say NO! And take more time off to step back and put things, scientific and personal, in perspective.

Dr Cornelia McCormick

I am a Postdoctoral Research Associate at the Wellcome Trust Centre for Neuroimaging under the supervision of Prof. Eleanor Maguire. Previously, I completed my PhD at the University of Toronto, Canada under the supervision of Prof. Mary Pat McAndrews and Prof. Morris Moscovitch. Even before that, I completed degrees in Psychology and Medicine at the University of Hamburg, Germany.

What are your aspirations?

From very early on, I was fascinated by the relationship between the physiological processes of the brain and the cognitive processes of our mental life. My current research focuses on how the hippocampus, a small structure right in the middle of the brain, communicates with other brain regions to help us remember the key events in our lives and to create images in our imagination. In future, I hope to become an independent researcher in the field of neuroimaging and human memory.

What achievement are you proud of?

When I think back of an achievement that I am proud of, an email that I wrote comes to my mind. In 2005 I conducted my first research project on human memory at the Epilepsy Centre in Hamburg and I was reading a lot about the work of Prof. Morris Moscovitch in Toronto. Despite my poor knowledge of the English language, no personal connection to him or anybody else in Canada, I took a chance and emailed him to ask whether I could come over to Toronto for a research internship. He said yes, and in retrospect, so much grew out of this initiative.

Have you had to overcome any challenges?

Have I had to overcome any challenges? Yes, lots. That's what makes life so interesting. It was challenging to go to Canada, where I knew absolutely nobody. Over there I met my husband but at the time he had to finish his PhD in Toronto and I had to finish my studies in Germany. Consequently, we had to endure a three-year long-distance relationship between Toronto and Hamburg. It was also challenging to be pregnant and give birth in a foreign country while finishing my PhD, and lastly, it was challenging to move with my family over to England and start here all over again.

What if any challenges do you foresee?

Having painted this journey as a challenge, these are also the most exciting and beautiful years of my life so far.

If I have any advice to offer, I think it would be 'take a chance and jump in'.

What would you say to encourage girls at school into science?

Science can be a great place for women.

Professor Janice Marshall

Research career

I didn't really know what Physiology was when I left school and went to the University of Birmingham to do Biological Sciences. In my second year, I took a subsidiary in Physiology and was hooked! I was lucky to be offered a PhD studentship with Sidney Hilton who was then Head of the Department of Physiology, and so I crossed the canal to the Medical School and I have been here ever since. Although Sidney was a 'hands-off' supervisor, he introduced me to the whole world of cardiovascular physiology. It was very widely based department including people like Mike Spyer, John Coote and Andrez Zbrozyna who worked on central neural and reflex control. So, after a PhD in which I used intravital microscopy to follow responses in tissue microcirculation, I moved 'up' in the cardiovascular world, with post-doc experience on the peripheral chemoreceptor reflex and defence response. I gained a lectureship in 1987, and gradually built up my own research group. Our work was initially animal-based, but we branched out into complementary research on healthy volunteers and developed collaborations to work on patient groups including those with primary Raynaud's and sickle cell disease. Looking back, everything we've done has built in one way or another on the foundation of my first few years in research, adding techniques and approaches as we've gone along.

What research finding(s) and publications are you most proud of?

1. My first and only single author paper in *The Journal of Physiology* (Marshall, 1982), because it represented much of my PhD work and because it took so long to actually submit it, for reasons that some will understand!
2. A substantial review on chemoreceptors (Marshall, 1994). It took a long time to compile, but I learned so much from writing it.

3. A paper in which we showed by using several different approaches that during systemic hypoxia, adenosine acts on endothelial A1 receptors to induce dilatation by generating PGI2 as an intermediate, which then triggers NO synthesis (Ray et al. 2002). This was a novel pathway that helped us explain hypoxic dilatation and it has attracted a lot of interest since.
4. A key piece of work in which we showed, by collaborating with Salvador Moncada, how endothelial cells release adenosine in response to hypoxia, by NO outcompeting oxygen at their common binding site on mitochondrial cytochrome oxidase (Edmunds et al. 2003). As such, it explains a fundamental aspect of hypoxic dilatation.
5. Our recent study on fetal programming induced by chronic hypoxia during pregnancy (Rook et al. 2014). We showed for the first time that this causes sympathetic hyperactivity, increased innervation density and early hypertension. These results may provide a new basis for our understanding of the development of hypertension.

What significant challenges have you overcome?

Maintaining research funding over a period in which integrative physiology has fallen out of fashion. Juggling with competing interests and responsibilities, so that I could not only retain an active involvement in research, but also make a significant contribution to teaching and take on significant management responsibilities: I enjoy all three.

Dealing with difficult people and difficult decisions when running a big Division.

Gaining the confidence to realise I could do these things.

Learning to prioritise and accepting this means that not everything gets done.

What advice would you give your younger self?

Follow research questions that seem interesting to you rather than ones that others tell you to follow.

Read widely and keep an interest in areas of research that are outside of your own – you never know when you will come across something that you can apply in a different way.

Work with people you enjoy working with and with whom you can discuss things freely.

Take opportunities when they arise, or at least, think seriously about them. They may not arise again.

Work hard in your first post-doctoral years and try to be as productive as you can. This is likely to be when you are building the foundation for your future career.

Dr Jeanette Woolard

Career so far including what motivated you to study/research in physiology?

As an undergraduate Life Sciences BSc Honours student in Canada, I was lucky to be taught by some inspiring and prolific research scientists, including Professor Michael Adams. He encouraged me to undertake MSc studies in his lab, focusing on the long-term physiological changes caused by anti-hypertensive therapy. Very few labs in Canada offered PhD positions in integrative cardiovascular physiology, so I had to look farther afield. After a worldwide search, I came across a PhD opportunity in Nottingham, working with Professors Terry Bennett and Sheila Gardiner. They had established a novel method, using Doppler flowmetry, to measure regional haemodynamic changes in a number of vascular beds, in conscious, freely moving animals. This memorable time in their lab cemented my desire to stay within the field of whole systems physiology, although I appreciated the need to gain experience in related areas, including pharmacology and molecular biology. Following completion of my PhD in Nottingham, I joined the lab of Dave Bates in Bristol, to gain that additional experience. I worked firstly as a post-doc and then as a Wellcome Trust Fellow within his group. In 2010 I returned to Nottingham following the retirements of Terry and Sheila, and I now have oversight of their haemodynamics labs.

What are your aspirations?

Throughout my career, I have been supported by some highly successful colleagues. My aspirations are to one day return this kindness to my junior colleagues, providing the same level of advice and support that I have personally benefited from thus far, whilst also maintaining grant funding and excellence in teaching.

What achievements are you proud of so far?

The award of my Wellcome Trust Advanced Training Fellowship was a personal highlight. The purpose of the award was to allow

researchers, who may not be otherwise competitive in a particular field, such as molecular biology, to re-train and gain new expertise. I was heavily pregnant at the time of the interview, and clearly knew very little about molecular cloning! The committee was highly supportive of my maternity leave and allowed me to work flexibly during the fellowship period. The outputs were significant, and the experience certainly helped me secure my academic position in Nottingham.

Have you had to overcome any challenges?

During my post-doc and fellowship, I chose to start, and 'grow' my family. Having two young children whilst trying to establish a career was not straightforward. However, I was fortunate to work in a very supportive environment, and continue to deal with the challenge of maintaining a productive and healthy work–life balance.

What, if any, challenges to do you foresee?

Having stepped in and out of academia when my children were small, I still feel a little behind 'the pack'. While the Athena SWAN initiative has shed light on some of the issues faced by female academics, I still appreciate the challenges for young women entering this career. Moreover, I see the competitive funding issue as a challenge for all of us in the future.

Have you received any advice that has helped you?

I have been heavily supported by Emeritus Professor Sheila Gardiner and Professor Janice Marshall (Birmingham). Both have been generous with their time, input and friendly advice. Sheila has often picked me up and brushed me off from the disappointments of failed grant applications or manuscript submissions. Janice was my external examiner for my PhD viva voce, and after a decade of friendly encounters at conferences and seminars, she is now my mentor. Both of these wonderful individuals often remind me to 'keep looking forward'. With every grant that is rejected, they see the positives in the reviewers comments, rather than the failure of the attempt. I have slowly established myself as both principal investigator and co-investigator on some interesting collaborative projects, and these successes are largely down to their unwavering support and advice.

What would you say to encourage girls at school into science?

The beauty of a career science is that you never know where it will take you. There is excitement, flexibility, opportunity to travel and novelty in knowing that whatever you discover has never been seen before.

Professor Anne McArdle

Research career

I was inspired to become a scientist by a wonderful team of junior school teachers who were clearly ahead of their times. I graduated with a BSc (Hons) in Biochemistry from the University of Liverpool in 1988. As a keen sportswoman, I was drawn to a career in muscle physiology and completed my PhD studying muscle damage in a mouse model of Duchenne muscular dystrophy. I undertook postdoctoral training at the University of Michigan in the laboratories of Professor John Faulkner and was awarded a Research into Ageing Fellowship in 1998 working on sarcopenia. I was appointed as Professor at the University of Liverpool in 2007 and am Head of the Department of Musculoskeletal Biology. I am past Chair of the British Society for Research on Ageing and the British Council for Ageing.

What research finding(s) and publications are you most proud of?

1. My PhD thesis. I thoroughly enjoyed the relative freedom of scientific research during my PhD. The major findings went against the trend but I am proud to say that our findings and interpretation survived the test of time.
2. The publications that emerged from my training at Michigan. This was a challenging transatlantic study which resulted in clarification of the role of Vitamin E in muscle damage (McArdle et al. 1999).
3. The novel studies that demonstrated that the acute exercise-induced heat shock protein response was attenuated in muscles of old rodents (Vasilaki et al. 2000) and studies in transgenic mice that showed that this attenuated response had functional consequences (McArdle et al. 2004).

4. My involvement in the groundbreaking approaches led by Professor Malcolm Jackson at Liverpool on the elucidation of the role of reactive oxygen species (ROS) in muscle dysfunction (Jackson & McArdle, 2015).
5. Being part of the outstanding team from Michigan, Liverpool and Oklahoma which has taken a large scale transgenic approach which led to novel data on key roles for ROS in maintenance of neuromuscular integrity (Sataranatarajan et al. 2015).

What significant challenges have you overcome?

Developing an independent career while staying at the same institution. This is a significant challenge, even in today's world where it is recognised that there are considerable pressures, especially for female scientists. Scientifically, the challenge of ageing research is ongoing. The topic is not seen as 'sexy' by the young scientists but without such research, the area is an economic and social time bomb.

What advice would you give your younger self?

Be confident of your own abilities and don't put off until tomorrow. Perseverance is good but also know when to give up! Find outstanding mentors and listen to them (especially when they tell you to give up!). I had outstanding mentors and this is critical to success.

Dr Aphrodite Vasilaki

Career so far including what motivated you to study/research in physiology?

I was inspired to study muscle physiology when I met my mentor, Professor McArdle. I was still an undergraduate student back then and Professor McArdle was my supervisor during my final year laboratory based project. My research background has focused on reactive oxygen species (ROS) generation and skeletal muscle ageing ever since.

I completed my PhD in the Department of Medicine and School of Biological Sciences at the University of Liverpool in 2003. I then undertook a five-year postdoctoral position funded by the US National Institutes of Health (NIH), which also allowed me to travel regularly to the prestigious laboratories of Professors John Faulkner and Susan Brooks at the University of Michigan. In 2006 I was elected to the Executive Committee of the British Society for Research on Ageing and served as the Treasurer of the society. In 2009, I was awarded a Personal Research Fellowship by the UK charity, Research into Ageing/Age UK. This highly competitive fellowship was awarded to me in competition with a large number of young investigators from the UK. My fellowship provided me with the opportunity to train and obtain new skills in nerve/muscle biology, development of nerve–muscle co-cultures and 3D muscle constructs and techniques to generate and detect ROS in single muscle and neuronal cells, leading to my development as an independent researcher. I am currently a lecturer in the Department of Musculoskeletal Biology at the Institute of Ageing and Chronic Disease, University of Liverpool. The overall aim of my work is to determine the mechanisms underlying the weakness of skeletal muscles that occurs with ageing.

What are your aspirations?

To become a successful, internationally renowned female academic and to help other young scientists to do the same. I aspire to one day become a Professor and an inspiration to a new generation of young scientists.

What achievements are you proud of so far?

In 2012 I was awarded the Catherine Pasquier Award from the European Society for Free Radical Research for my achievements in the area of free radical research. I am only the second UK winner of this prestigious award since its inception. As part of this award, I was invited to present a keynote review lecture of my work at the Society for Free Radical Research International meeting at Imperial College London in September 2012, an experience I will never forget and definitely something to be proud of!

Have you had to overcome any challenges?

Being a successful scientist and a mother of two. Having young children is highly demanding and very time consuming so efficiency is the key.

What if any challenges to do you foresee?

Securing external funding is a major challenge especially at the early stages of an academic career, so having a good mentor is crucial. I am indebted to the strong mentorship of Professor McArdle and have been fortunate to train in her internationally recognised laboratory.

Have you received any advice that has helped you?

Never give up! 'A smooth sea never made a skilful sailor'.

What would you say to encourage girls at school into science?

Science provides you with the amazing opportunity to discover the unknown. And to make a real difference!

Professor Mary J Morrell

Research career

I received my PhD in Physiology having previously trained as a nurse at St Mary's Hospital, Paddington. I loved nursing – it was an education for life. I left to see if I could go further, and I guess I achieved this with my Fellowship at the University of Wisconsin-Madison. I loved my time in the States – it changed my life. On returning to the UK I set up the Academic Unit of Sleep and Breathing with colleagues at the Royal Brompton Hospital; it has been a great journey and, yes, I love Chelsea darlings! I have recently taken on the leadership of Years 1 and 2 MBBS/BSc at Imperil College London, which has been both inspiring and rewarding.

What research finding(s) and publications are you most proud?

Every night we go to sleep and relax, safe in the knowledge that our sleeping brain will control our body's vital functions. As we sleep we breathe, but very little is known about how we actually breathe. I was very fortunate to have awesome PhD supervisors, from whom I learned so much about the power of clinical observations (Morrell et al. 1999).

Sleep Apnoea occurs when the control of breathing goes wrong (Morrell et al. 1998). By understanding the physiological mechanisms that lead to sleep apnoea (Browne et al. 2003) we have been able to set up multi-centre trials to determine the most effective way of treating this disease. The results of our recent trial in older people will directly inform clinical care and NHS costs (McMillan et al. 2014).

Optimising treatment strategies is a way of maintaining health. It is now accepted that the accumulation of small vessel brain injuries can lead to an early dementia-like process. Patients with obstructive sleep apnoea experience repeated dips in oxygen

and these dips are associated with lesions in specific areas of the brain. My group have shown structural (Morrell et al. 2003) and functional (Twigg et al. 2010) neural impairment in patients with sleep apnoea; these were some of the first studies of their kind and they attracted a lot of attention. Sometimes it's not the biggest studies that have the most impact. We are now investigating whether sleep apnoea treatment can ameliorate age-related cognitive decline, with the potential links to Alzheimer's disease (Rosenzweig et al. 2015).

What significant challenges have you overcome?

Never feeling good enough – it's my daily challenge.

What advice would you give your younger self?

Follow your heart.

Education is freedom.

Stop worrying and be beautiful.

Dr Ivana Rosenzweig

Career so far including what motivated you to study/research in physiology?

My early passion for translational neuroscience was inspired by Rita Levi-Montalcini, who is probably the main reason why I, even as a trainee physician, always saw myself as a scientist.

I am a currently working as a clinical academic and a Consultant Neuropsychiatrist with subspecialty in sleep at Guy's and St Thomas's Hospitals. Over the last two decades I have been training and working as both researcher and clinician in the UK and abroad. As a clinician, I have trained and worked in university teaching hospitals in Cambridge and London. Cambridge is also the place where I obtained my PhD from the Physiological Laboratory. My research later took me to the RIKEN Brain Science Institute in Japan and the Weizmann Institute of Science in Israel, and ultimately back to London.

Most recently, I was fortunate to establish collaboration with Professor Mary Morrell at Imperial College. Mary is an amazing scientist and a wonderful colleague and she was pivotal in my decision to return to science, and the field of sleep medicine.

What are your aspirations?

To be there for, and to keep happy, all important people from various facets of my life, primarily my son, my patients, my family and my friends, whilst also producing some important scientific work.

What achievements are you proud of so far?

Last year I was awarded a Wellcome Trust Career Re-Entry Fellowship. Thanks to their generous help, I am currently, together with my colleagues at the Department of Neuroimaging at King's College London, exploring the role of sleep and hypoxia on brain plasticity. We have already been

lucky to show that effects of sleep apnoea on the brain may be both adaptive and maladaptive, something which may have a significant implication for the treatment of patients in a near future (Rosenzweig et al. 2015).

Have you had to overcome any challenges?

It is difficult to establish a clear research trajectory in an area in which you are still relatively unknown. However, this is somewhat offset by the advantage of being able to draw on prior skills and knowledge.

What if any challenges to do you foresee?

Firstly, funding and security of academic jobs. Secondly, the biggest challenge in the scientific community, in my opinion, is the current unhealthy trend of favouring quick returns and blind following of fashion. It is easy to forget that some of the biggest and most important discoveries took decades of 'blue sky' research in varied disciplines, which only much later made sense.

Have you received any advice that has helped you?

My beloved grandfather was a great believer in the classical education, and three of his favourite quotes have stuck with me: *Panta rhei* (Heraclitus), *Carpe Diem* (Horace) and *Omnia Mea Mecum Porto* (Cicero).

In a very loose conglomerate translation: we are all but a small and negligible part of the fabric of this universe and we and our dearest will be gone tomorrow. So, not to seize the moment and to be dragged down by our preconceptions, is a loss – our loss. I am not certain that I have always followed this advice, but I do keep trying very hard indeed.

What would you say to encourage girls at school into science?

In my opinion, the female brain is quintessentially scientifically wired. I believe this question to be flawed in its laterality – it is up to the educational establishment to encourage changes in the current science teaching in order to unlock that young potential. On that topic, the character of Sister Rahel from Heinrich Böll's *Group Portrait with Lady* would probably have a useful piece of advice, or perhaps even two.

Professor Lucilla Poston

Research career

My first degree, in physiology, at University College London gave me a fantastic grounding in human and animal biology. I was lucky to be taught by an internationally renowned faculty, but more importantly they were all so excited about their subject – really infectious enthusiasm. Even in those early days I was keen to do translational research and went on to a PhD in sodium transport and homeostasis in liver disease at King's College Hospital. Then a post-doc in sodium transport in renal disease led to the opportunity for a physiology lectureship at UMDS (later KCL), where I was expected to teach across the whole Physiology syllabus. This was the best apprenticeship ever for my career in clinical research, and I am now Head of the Division of Women's Health at KCL. How did I get into this subject? Well, from my work on ion transport in the vasculature, then endothelium dependent dilatation and on to maternal endothelial dysfunction in pre-eclampsia. You never know where you will end up in science; that's the fun of it!

What research finding(s) and publications are you most proud of?

1. A laborious but important study which characterised the constrictor and dilator function in placental resistance arteries which control uteroplacental blood flow (McCarthy et al. 1994).
2. The first illustration of abnormal flow mediated dilatation in resistance arteries from women with pre-eclampsia (Cockell & Poston, 1997).
3. My first clinical trial in pre-eclampsia representing translation of our lab work to clinical research (Poston et al. 2006).

4. Finding out which lifestyle and clinical factors can help prevent pre-eclampsia in a large collaborative study (great) fun (Chappell et al. 2013).
5. Work just finished: a clinical trial to help obese women have a healthy pregnancy (Briley et al. 2014).

What significant challenges have you overcome?

My biggest challenge was when I became a new Professor for Tommy's baby charity and had to set up a new research unit in obstetrics. I had to learn a lot about obstetrics as well as management very quickly!

What advice would you give your younger self?

Read, read, read. Learn your subject in depth, but importantly in breadth – this is where new ideas come from. Be collaborative; it always pays to be generous about your ideas and data with those who you trust and like. Work very hard. Science doesn't have room (or jobs) for anyone but dedicated enthusiasts.

Dr Anne-Maj Samuelsson

Career so far including what motivated you to study/research in physiology?

I always knew that I would be a scientist and so did my family. Trying to convince me of something as a child without supporting evidence was either fallen on deaf ears or being questioned. During my masters (2002) I got appointed to a one year research scholarship (in my native country of Sweden). This was the beginning of my love for physiology research; the dynamics and complexity intrigued me and left me with a childlike urge to find out more. I therefore made the life-changing decision to drop out of medical school and instead embark on a PhD in medicine. To this day people question my decision calling it naive, daring to choose the 'unsafe' career path of academia, but I have never looked back! My adventurous mind and determination also made me leave Sweden to start a new life in London, working for King's College London, which was at the top of my potential employers list. During my interview for the EU funded post at the Women's Health Division at King's College London, I was introduced to Prof. Lucilla Poston, who would turn out to have a profound impact on my future career as my post-doc supervisor and later as my Fellowship mentor. As a post-doc, I investigated the metabolic and cardiovascular pathophysiology in offspring of obese rodent dams. This work gave me competence in several techniques including small vessel myography, echocardiography and radiotelemetry. The expanded confidence in cardiovascular biology allowed me to develop a strong research proposal to study the development origins of hypertension in offspring of obese rodents. In April 2011 I was awarded the Intermediate Basic Research Fellowship by the British Heart Foundation, a day of glory and contentment becoming an independent researcher. This was also highly rewarding for someone who dared to start a family of four in central London.

What are your aspirations?

Achieving a greater understanding of the pathogenesis of primary hypertension, overcoming any hurdles there may be as an independent researcher, and to enjoy the ride.

What achievements are you proud of so far?

My finest hour was receiving the publication prize for Hypertension Top Paper Award 2010 (Samuelsson et al. 2010) at the American Heart Association Meeting in Miami, receiving appraisals at an international venue with many of my scientific idols in the audience congratulating me, including previous Hypertension Editor-in-Chief Prof. Allyn Mark and Prof. John E Hall.

More recently, leading on a transgenic mice project with a short lead time with the support of my fantastic collaborator (Dr Nina Balthasar) and my stalwart research assistant (Joaquim Pombo). Together we overcame many obstacles including impregnating mice on a high fat diet. I remember the day Joe showed me the gel of the 300 base pair band confirming the knockout mice born to an obese dam. That one small step forward that brings a four-year project to its completion. Happy days!

Have you had to overcome any challenges?

I have implemented several multidisciplinary techniques that were unfamiliar in my laboratory, as a result of good collaboration, being persistent and being more persistent.

What if any challenges to do you foresee?

The process of securing funding and positions is always news to an independent researcher. Having a good team of dedicated and supportive mentors, collaborators and students/assistance makes it worthwhile.

Have you received any advice that has helped you?

Check everything twice. Never be afraid of asking the wrong questions. You cannot start something new without an adventure.

What would you say to encourage girls at school into science?

Being a researcher is most rewarding. Since my time as a research student I have had the pleasure of working on a number of interesting topics together with some truly inspiring people.
The independence, flexibility and critical way of thinking liberates me and gives my life a higher purpose.

Professor Sheena E Radford

Research career

I never really formally made a career decision. It started with a BSc in Biochemistry at the University of Birmingham where I fell in love with protein structure and function. Then I attended the University of Cambridge for my PhD, where I realised the power of combining biochemical analyses with biophysical analyses, particularly NMR, and worked with my inspirational supervisor, Professor Richard Perham, FRS. After my PhD and postdoctoral research at the University of Oxford, I joined the academic staff at the University of Leeds. I have not looked back since and am now the Astbury Professor of Biophysics, the Director of the Astbury Centre for Structural Molecular Biology, and a Fellow of The Royal Society of Chemistry, of the Academy of Medical Sciences and of The Royal Society. I have a large, active research group, and wonderful colleagues and collaborators, many long-standing. I speak at numerous international conferences, and have published over 230 peer-reviewed papers. I also enjoy serving on various funding bodies, scientific advisory boards, PhD committees and journal editorial boards. I am never stuck for something to do!

What research finding(s) and publications are you most proud of?

1. Everyone remembers their early publications with great warmth. My work with Richard Perham taught me the importance of dynamics in protein function (Texter et al. 1988).
2. As a post-doc in Oxford we showed that proteins fold in multiple pathways, the beginning of the route leading to my FRS (Radford et al. 1992).
3. As a young PI, my group showed that a small helical protein, Im7, folds via a misfolded, but on-pathway, intermediate (Capaldi et al. 2002). Small is not always simple!

4. Most recently, my group has used the powers of NMR to show how misfolded proteins can be infectious (Karamanos et al. 2014). Exciting times.
5. I am proud of our innovative work. With new approaches, one can always learn exciting new things!

What significant challenges have you overcome?

Having confidence in my abilities, finding persistence when the going gets tough.

Keeping my research at the cutting edge, while helping others to develop their careers, especially as Director of the Astbury Centre.

What advice would you give your younger self?

Do what you love.

Work hard in an area that excites you.

Don't worry too much about the future: most great scientific discoveries come from chance observations.

Have confidence in yourself.

Make sure your partner understands academia! A life in science is tough, and you will need good support on the home front.

Dr Anastasia Zhuravleva

Career so far including what motivated you to study/research in physiology?

When I was small, I always wanted to be a medical doctor, inspired by my mother's achievements in medicine. In secondary school I fell in love with science: chemistry and molecular biology in particular. Finally, I undertook my BSs and MSs in Chemistry and Materials Science at the Moscow State University. It was a very challenging programme that not only allowed me to learn 'hard core' chemistry, maths, physics and computer science, but also gave me a taste of top-notch biological research. At that time I started to learn nuclear magnetic resonance (NMR), a state-of-the-art structural biology technique. I completed my PhD at the Swedish NMR Centre with Professor Vladislav Orekhov and Professor Martin Billeter, who taught me many 'magic' tricks about bio-NMR and protein biophysics. After my graduation in 2006, I moved to the United States; my goal was to become proficient in biochemistry and molecular biology, and I spent several fantastic years in the laboratory of Professor Lila Gierasch, a great scientist and an excellent mentor. In 2013, I moved to Leeds for a lectureship. The last two years were probably the toughest, but most interesting. At this stage of my career, I feel very lucky and privileged to have encouraging mentorship and aspiration from Professor Sheena Radford.

What are your aspirations?

To lead research that helps to tackle important biomedicine problems.

What achievements are you proud of so far?

Obtaining the insights into the mechanisms of fine-tuning molecular chaperones (Zhuravleva et al. 2012; Zhuravleva & Gierasch 2015).

My first big grant as an independent researcher for characterisation of molecular chaperone BIP.

Have you had to overcome any challenges?

Realising that I must learn how to clearly explain my ideas and thoughts to people with very different backgrounds.

What if any challenges to do you foresee?

Competitiveness in the area of my research, but I am certain that it will be a rather good challenge.

Have you received any advice that has helped you?

Never regret any decision you ever make.

What would you say to encourage girls at school into science?

Do not be afraid to try different things, because you never know if it will work for you until you try and you might surprise yourself.

Professor Dame Nancy Rothwell DBE

Research career

I dropped biology at the age of 14, but then (on a whim) decided to study physiology at London (Queen Elizabeth College, now part of King's). My PhD was on energy balance regulation and I was fortunate to get first a junior Royal Society Fellowship, then a longer one which I started at St George's Medical School and which moved with me to Manchester in 1987, where I went to be closer to my partner. After several years as a Reader then Professor in Manchester, I was awarded an MRC Research Professorship in 1998. In 2004 I was elected a Fellow of the Royal Society and became Vice-President for Research the newly formed University of Manchester then President and Vice-Chancellor in 2010. But I am still involved in research – now led by my scientific and clinical colleagues, including stroke trials of a potential new treatment that we discovered.

What research finding(s) and publications are you most proud of?

1. My first paper was on feeding behaviour in rodents, which challenged our understanding of appetite regulation (Rothwell & Stock, 1978).
2. My most cited paper was on brown fat showing that it can burn off extra energy intake in rats. Soon afterwards this formed the basis of a Horizon programme that featured our work (Rothwell & Stock, 1979).
3. After moving to Manchester I showed that some cytokines act in the brain to cause fever and other metabolic changes (Rothwell, 1988).

4. My paper that was the first to show that blocking the cytokine IL-1 (using its antagonist (IL-1Ra) reduced ischaemic brain damage (Relton & Rothwell, 1992).
5. The report of our first clinical trial of IL-Ra in stroke patients (Emsley et al. 2005).

What significant challenges have you overcome?

I don't think of them as challenges really, but the most difficult things I have found have been choosing research directions and balancing all the things I have wanted to do (at work and outside). The choice to completely change field mid-career from energy balance and obesity where I had a significant reputation to stroke and inflammation where I knew almost nothing was challenging but also very invigorating.

Probably most difficult was the decision to become a vice-chancellor!

What advice would you give your younger self?

Be a bit bolder – most things are possible with determination. Don't always take the easy routes – my colleague Andre Geim has good advice: 'If you follow the trodden path, you may find that all the grass has been eaten'. Bury failure and celebrate success.

Dr Catherine Lawrence

Career so far including what motivated you to study/research in physiology?

From a very early age I have always been fascinated with how the body works, and even at primary school I think I was destined to follow a scientific career in research. My first major experience of scientific research was when I did a PhD at the University of Manchester, where I studied how cytokines affect neuronal injury and outcome after stroke. My PhD supervisor, Professor Dame Nancy Rothwell (then Dr), was then and probably still is one of my biggest influences in what drives me to succeed. She never fails to amaze me in how ambitious, driven and motivated she is in whatever she does. After my PhD I had break of over two years to gain experience in the commercial sector, but during this time I realised how much I missed academic research. I had kept in contact with Professor Rothwell and she offered me advice about my career and gave me the confidence to return to academia. I was lucky enough to be offered a post-doctoral position, again under the supervision of Nancy but also Professor Simon Luckman. During my post-doc I examined the regulation of food intake and body weight. After my grant had finished, I worked as a Senior Research Scientist at AstraZeneca, where for 15 months I set up methods to evaluate pain in animal models of osteoarthritis. However, I always felt that my true home was in academia, so I secured a RCUK fellowship in 2005, and spent five years establishing myself as an independent researcher. I was appointed as a lecturer in 2010, and since this time (including a break for maternity leave) I have been interested in understanding how extreme changes in energy balance, such as obesity, influence disorders that affect the brain such as stroke and Alzheimer's disease.

What are your aspirations?

It might sound a bit corny, but one of main things that drives me is the hope that my research may one day make a real difference. In other words, I want to be able to help people who suffer from the diseases I study. In doing this I also hope to gain recognition as a respected researcher within my field.

What achievements are you proud of so far?

To be honest no one thing sticks out. I do remember being really proud (and excited) that my first publication during my post-doc was published in Nature Neuroscience. I think this was a great achievement as this was my first publication since my return to academic research after a period in the commercial sector.

Have you had to overcome any challenges?

As an academic scientist you constantly have to try to balance your effort between research and delivering excellent quality teaching. Also returning after a period of maternity leave was quite challenging as no one did my work for me while I was away and I had a lot of catching up to do!

What if any challenges to do you foresee?

I think one of the biggest challenges is securing funding to be able to continue to publish in high-impact journals.

Have you received any advice that has helped you?

Do not wait for things to happen. You are in control of your own destiny so go out and grab every opportunity you can.

What would you say to encourage girls at school into science?

A career in science is exciting and you will never get bored, as every day is different. Life as a scientist is like being a detective, but instead of solving crimes you get to find out new things about the body that could really make a difference to our health.

Professor Maria Grazia Spillantini

Research career

I am Professor of Molecular Neurology in the Department of Clinical Neurosciences at the Clinical School of the University of Cambridge. I was born in Arezzo, Italy, grew up in a small village in the Tuscan Apennine 'Caprese Michelangelo', and studied at the 'Liceo Scientifico Piero Della Francesca' in Sansepolcro. After receiving a Laurea in Biological Sciences, summa cum Laude, in 1981 from the University of Florence, I pursued research on headache and pain mechanisms at the Department of Clinical Pharmacology of the University of Florence, at the Unité de Neurobiologie of the INSERM in Paris, at the Istituto Superiore di Sanita' in Rome, and at the Molecular Neurobiology Unit of the Medical Research Council in Cambridge. In 1987 I moved to the Medical Research Council Laboratory of Molecular Biology, where first, working in Dr Michel Goedert's group, I obtained a Ph.D. in Molecular Biology from Cambridge University, and later worked as a postdoctoral fellow with Prof. Sir Aaron Klug.
In 1996 I moved to the Cambridge Centre for Brain Repair and in 2014 to the Clifford Allbutt Building, both in the Department of Clinical Neurosciences of the University of Cambridge. I have received several international awards including the Potamkin Prize of the American Academy of Neurology, the International Prize Fair Play 'Semplicemente Donna' (2013), the Cotzias Prize of the Spanish Neurological Society (2014) and the Jay Van Andel Prize (2015). I was elected Fellow of the Academy of Medical Sciences (of London), in 2010 and Fellow of the Royal Society in 2013. I am a Professorial Fellow at Clare Hall and a life member of Peterhouse, Cambridge.

What research finding(s) and publications are you most proud of?

My group works on the molecular neuropathology of diseases characterised by protein aggregates, in particular **τ** and **α-**

synuclein. With my collaborators, I identified **α-**synuclein as the main component of the filaments that form the Lewy bodies in Parkinson's disease and dementia with Lewy bodies and described one of the first mutations in the MAPT gene leading to frontotemporal dementia and Parkinsonism linked to chromosome 17.

1. Spillantini et al. (1997a) was the paper in which the term 'tauopathy', now generally used, was described for the first time.
2. Spillantini et al. (1997b) was the first report of **α**-synuclein in Lewy bodies in Parkinson's disease opening a new field.
3. Spillantini et al. (1998a) describes one of the first Tau gene mutations in frontotemporal dementia with parkinsonism linked to chromosome 17; it was published in June 1998 with another two papers from different groups.
4. Spillantini et al. (1998b) demonstrated that **α**-synuclein is the main component of the filaments present in the Lewy bodies in Parkinson's disease and not just a non-specific component of the aggregates.
5. Garcia Reitböck et al. (2010) was the first study showing that **α**-synuclein aggregates disrupt neurotransmitter release by redistributing synaptic proteins.

What significant challenges have you overcome?

I grew up in a small village in the Tuscan mountain and the first challenge was to get out from there. While very young I asked my father if I could go to a boarding school in a nearby town.

After years in Cambridge I obtained a job in an institute of the Italian National Research Council. I went back to Italy also because Rita Levi-Montalcini, a person to whom I was very close and who had supported me, had always told me: 'Dear, one day we have to go back to our country.' I did not want to disappoint her. It was very hard time trying to integrate in such a different environment. It was a tenure position and it was my country but I could not work as I was used to. One day Rita Levi Montalcini saw me so depressed that she said 'what are you doing here?' I felt free to go and after 24 hours I was on the plane to Cambridge going to a postdoctoral position in the University after having resigned from my tenured group leader position.

I was for 18 years the only woman with a tenure position in our department here at Cambridge University. Now more women have arrived. Although it was a challenge, I was fine, I was interested only in research, and not power, otherwise it could have been different.

Dr Joanne Jones

Career so far including what motivated you to study/research in physiology?

I am a clinician scientist based in Cambridge, working as a consultant neurologist and researching mechanisms of human autoimmunity; in particular I am interested in why autoimmunity often occurs during recovery from T cell lymphopenia.

I trained in medicine at the University of Bristol, and by the time I graduated (after an MRC funded intercalated degree in microbiology with a large immunology component) I was certain that I wanted to pursue a career in medical research, specifically in immunology. Clinically I was drawn to neurology – to its diversity and complexity, so in 2003, following my post graduate medical training, I moved to Cambridge to complete my specialist training in neurology and to do a PhD in neuroimmunology with Dr Alasdair Coles (now Rev. Prof. Alasdair Coles).

Serendipity plays a part in most people's career and my lucky break was joining Alasdair Coles's group; not only did I gain Alasdair as a supervisor and mentor (and now colleague and friend), but I also joined a team of talented individuals working on the development of the lymphocyte depleting humanised monoclonal antibody alemtuzumab, as a treatment of multiple sclerosis. Alemtuzumab is (arguably) the most effective treatment of multiple sclerosis tested to date, and it is now licensed. However work on this drug is far from over. Indeed its use continues to inform basic science, revealing aspects of the pathogenesis of multiple sclerosis, and fundamental workings of the immune system. Of particular interest to me is why one in three individuals treated with alemtuzumab develop a new autoimmune disease after treatment (30% develop thyroid autoimmunity, 1–2% ITP). And this work forms the basis of my Wellcome Trust fellowship.

What are your aspirations?

My goal is to lead a successful 'translational' research group making real and meaningful contributions to the field of neuroimmunology.

What achievements are you proud of so far?

I was extremely proud to be awarded the Wellcome Trust Beit Prize Fellowship in 2014. I am also proud of the 'out-reach' scheme I developed with Alasdair Coles, which aims to encourage students (particularly girls) from state schools to consider a career in science and/or medicine.

Have you had to overcome any challenges?

I have been extremely well supported by my department, but like others in my position my biggest challenge has been securing 'next stage' funding in order to make the move to independence.

Challenges do you foresee?

I think one of the biggest challenges for a clinical academic is how to manage the demands of clinical work with the demands of research – particularly in an environment where research success is often measured in terms of quantity of publications.

Have you received any advice that has helped you?

From a teacher at school, 'don't let the fear of failure stop you from trying', and most recently from Prof. Compston (Head of the Department of Clinical Neurosciences at Cambridge, and the person who first thought to use alemtuzumab as a treatment of MS), 'surround yourself with talented individuals and be lucky'.

What would you say to encourage girls at school into science?

If you want a varied career, if you want the opportunity to meet and work with people from all over the world, and if you want to make a real contribution to society consider a career in science.

Professor Tilli Tansey OBE

Research career

My first degree was in Zoology; my PhD, on catecholamine distribution in Octopus brain, got me hooked on research. Over the following years I worked at the MRC Brain Metabolism Unit in Edinburgh (on Parkinsonism) and as MS Society Research Fellow at St Thomas' Hospital. For me 1986 was a memorable year in many ways. I was elected to The Physiological Society, was co-awarded a large grant from the MS Society to continue my research, and accidentally changed the direction of my career towards medical history. I took a second PhD (on Sir Henry Dale and the history of chemical neurotransmission) at UCL in 1990, and since then as a member of staff at the Wellcome Trust, UCL and now QMUL, I have studied the history of modern biomedicine. I created, and still run, the History of Modern Biomedicine Research Group (http://www.histmodbiomed.org/), and pioneered the Witness Seminar approach to modern medical history.

What research finding(s) and publications are you most proud of?

1. My second full paper, which included the most wonderful quality half-tone illustrations, over 100 of them (Tansey, 1980).
2. I have been fascinated by history, especially Russian history, since I was small, and whilst in Edinburgh I researched my first 'historical' paper (Tansey, 1984). This was to prove one of the most important I have ever written as it brought me to the attention of the editor, Sir William Paton, the distinguished physiologist/pharmacologist, then a Wellcome Trustee.

Tony Angel, the Committee Secretary of The Physiological Society, encouraged me to telephone 'Bill' and tell him of my interests; shakingly I did so, and he remembered that paper, but had not connected me with the same person giving scientific Communications to The Society. He put me in touch with the Wellcome Trust, which gave me a small grant to pursue physiological history in my spare time, and this turned into a larger grant to do a PhD in history.

3. My earliest paper during that PhD period examined the debates to register the first commercial premises to undertake animal experimentation, the Wellcome Physiological Research Laboratories, with the Home Office (Tansey, 1989).
4. My interest in all matters Wellcome culminated in a co-authored book on the early history of the Burroughs, Wellcome Company (Church & Tansey, 2007).
5. The Wellcome Witness Seminar series captures accounts of many fields of contemporary biomedicine, and rather than pick just one, I hope I may be cheeky and point to the entire collection of volumes: http://www.histmodbiomed.org/article/wellcome-witnesses-volumes.

What significant challenges have you overcome?

Moving from lab science to the humanities was, and remains, somewhat difficult. Whilst exciting to work at the boundary of different disciplines, it is often uncomfortable 'not properly belonging' to any one constituency.

What advice would you give your younger self?

Follow your instincts.

Don't be shy of having different views and dreams.

Emma M Jones

Copyright 'Queen Mary University of London'

Career so far including what motivated you to study/research in physiology?

My route into a wide range of biomedical sciences has been through the 'medical humanities' as a researcher in the history of modern medicine. I discovered my appetite for medical history while researching drinking water at the Wellcome Library, a topic that developed from my training in architectural history and a curiosity about the origins of London's many nineteenth century drinking fountains. At the Wellcome, I discovered the wealth of literature in the medical humanities. I was hooked.

I now work with the History of Modern Biomedicine Research Group, led by Professor Tilli Tansey and funded by the Wellcome Trust. Our Group records the testimonies of clinicians and scientists through 'Witness Seminars'. These oral histories offer personal accounts of working in, for example, clinical genetics, which is the area I specialise in as an editor. I enjoy the fact that we reveal the twists and turns of biomedical career paths, as well as the major achievements, and therefore we produce warts-and-all histories. I am also an advocate of the 'open source' philosophy that our publications follow as free downloads from the internet.

What are your aspirations?

To research, write and edit more books and blogs about biomedical history for wide audiences.

What achievements are you proud of so far?

Three events in 2013: a book on drinking water history, my first Witness Seminar publication, and certainly not last or least for me or my partner Grace was the birth of our wonderful son, Lorcan.

Have you had to overcome any challenges?

Developing a second career in my 30s as a researcher/author without a PhD qualification. Learning the lingo of clinical genetics was also a steep learning curve.

What if any challenges to do you foresee?

Proving the worth of medical history to funding bodies.

Have you received any advice that has helped you?

Do not pretend to know anything.

What would you say to encourage girls at school into science?

There are rewarding career opportunities in biomedicine, just read some of the testimonies of our female witnesses: you can use your brain and make a real difference to society.

Professor Alex M. Thomson (Emeritus)

Research career

Intent upon experiencing 'Life', I left home at 16. University offers disappeared in the face of miserable A levels and I found myself studying Chemistry at Bedford College, through clearing. Chemistry is not my forte, but, supplying the Physiology tutor with cigarettes and a stiff drink facilitated a move and I found myself in heaven. After three years working in mind-numbing jobs, my mind and hands were being challenged, continuously. All I knew was that this was what I wanted to do for the rest of my life.

During my PhD I learnt to run on no money, and above all, to design my own research projects within the limits of available and home-made equipment and scrounged consumables. This proved invaluable training when I found myself, at 27, in Oxford, the proud possessor of a Beit Memorial Fellowship, an empty lab and no funding for equipment or consumables. With a serendipitous finding, I entered a young, exciting field and funded my work and salary through a variety of grants in Oxford, Cardiff and London, until, nearing 40, I acquired an established post and a personal chair at 45. At 49 I became Wellcome Professor of Pharmacology at The School of Pharmacy, stepping down from HoD after 5 years and retiring due to ill health last year.

What research finding(s) and publications are you most proud of?

1. In the face of dogma 'NMDA receptors … have no role in normal synaptic transmission', NMDA receptors were indeed alive and kicking at healthy CNS synapses (Thomson, 1986).

2. The NMDA receptor co-agonist site is not, as was thought, saturated by glycine in physiological conditions and can be manipulated pharmacologically with therapeutic benefit (Thomson et al 1989).

3/4 Once more, flying in the face of 'firmly held convictions' the properties of a synapse are determined by the postsynaptic as well as the presynaptic neurone. The field of 'synaptic dynamics' (not my term), was born (Thomson & West, 1993; Thomson et al. 1993).

5. The class of presynaptic neurone plays a pivotal role in determining the GABAA receptor subclass it innervates. Exploration of the mechanisms involved during development continues under Dr Jasmina Jovanovic's direction (Thomson et al. 2000).

What significant challenges have you overcome?

Disbelief that a young woman could perform useful electrophysiological experiments; it's not whether she can do it well...

Patience – to watch others perform badly, what you can do well, yourself.

Management.

What advice would you give your younger self?

If this is not what you want to do – more than anything else – find another job.

Fall in love with the most talented equipment/software designer around.

The people you hire are not you, don't want what you wanted and are not doing the job for the same reasons.

Don't formulate a hypothesis until you are writing the paper, or the next grant application - observe.

Don't waste time and emotional energy on high profile journals. When your colleagues know your name, they will find you.

Funding is a lottery. You do need a good application, but many good ones are rejected. Try again... and again.

Dr Audrey Mercer

Career so far including what motivated you to study/research in physiology?

The moment that determined my career in science was my move from France to London in 2001 and my meeting with Professor Alex Thomson. I was offered a technician position in her laboratory at the Royal Free Hospital School of Medicine, University College London, and I was eager to be involved in a research team and to have the opportunity to improve my English. Working with Alex and her group, watching their incredible dedication and enthusiasm, spending time at the microscope and reconstructing neurones not only gave me the aspiration to follow Alex's path but also provided me with the training, experience and knowledge needed to become an independent researcher. Following my PhD and post-doctoral studies, I was awarded a Research Council UK fellowship and started my own group at UCL School of Pharmacy focusing on synaptic connectivity in cortical regions and particularly in the CA2 region of the hippocampus by combining electrophysiological recordings with biocytin filling, immunofluorescence, histological procedures and neurone reconstruction.

What are your aspirations?

To continue building a strong and internationally recognised group working on cortical circuitry and neuronal anatomy.

What achievements are you proud of so far?

Although the CA2 region of the hippocampus is beginning to excite considerable interest, I am proud to have been the first scientist to study its local circuitry and neuronal properties and comparing it directly with the neighbouring CA regions. Collecting some of the data for our publication on electrical

coupling between pyramidal cells was, by far, the most technically challenging part of my career; however, it was all worth it when the paper was published.

Have you had to overcome any challenges?

My first challenge as a PhD student was to convince my peers that the CA2 region represents more than a transitional region between CA1 and CA3 and that this region was missing from the hippocampal map that they cited for many years. Finding the right work–life balance has also been a challenge.

What if any challenges to do you foresee?

To secure funding on a long-term basis will always be the major challenge that all scientists are facing.

Have you received any advice that has helped you?

The advice and help I received from Alex along the way have been invaluable. If I have to choose, I would say stay positive, stubborn (in a good way!) and driven.

What would you say to encourage girls at school into science?

Science is a fascinating field that can satisfy people's natural curiosity and need to understand how the world works. I would encourage schoolgirls to meet with women who have successfully made contributions to science. By speaking to role models, they will realise how exciting and rewarding it is to finally be able to solve a problem or answer a question that nobody else has addressed.

Professor Susan Wray

Research career

I found out I was going to be a physiologist when applying to university and asking my biology teacher to decipher all the 'ologies for me. I undertook my BSc, PhD and post-doc work at UCL and loved it. Although I can't remember smooth muscle featuring on the undergraduate curriculum in this bastion of striated muscle research (Andrew Huxley was in the coffee room most days), I gravitated towards it. This forced me to be independent from an early career stage. I still recall phoning Alison Brading, the doyenne of smooth muscle, and asking for clues on how to get this stringy tissue to contract. I moved to Liverpool for a lectureship in 1990, established a smooth muscle group, and remained there.

What research finding(s) and publications are you most proud of?

1. My first paper, (obviously!), which was published in *The Journal of Physiology* and distinguished the roles of hormonal vs mechanical stimuli on postpartum uterine changes (involution).
2. Being part of the team that worked out how photons travel through living cerebral tissue (time of flight measurements) to then extract oxygenation and blood volume data and develop tools to help sick babies. Cool science.
3. Two findings related to intracellular pH and smooth muscle. Firstly, that acidification can increase force, and secondly that external pH changes are rapidly transmitted intracellularly. These went against the orthodoxy (developed in striated muscle). Rebel rebel.
4. Obtaining, with clinical colleagues, the first insight into the mechanism of dysfunctional labour- the all too common

condition that forces women to have unplanned Caesarean sections. Cinderella research areas need champions. This work has led on to diagnostic testing.

5. Elucidating the complex, intriguing and eventually satisfying roles of the sarcoplasmic reticulum in smooth muscle.

What significant challenges have you overcome?

Realising I would not get a lectureship unless I moved, which meant uprooting husband and children. As a head of department, trying to manage staff who don't want to be managed (and a bad case of nasty personal attacks from a colleague brought on by jealousy). Going back to work after my first child for all the usual reasons. Keeping and leading a group when fashions change and funding is crunched. Believing in myself.

What advice would you give your younger self?

Speak up – your voice is as worthwhile as the others round the table.

Go for it; say yes; you almost certainly can do it. Brush yourself off and carry on if you fail. Ask for help and find your allies.

Don't wait for permission – proceed until apprehended!

Following your heart is usually the best choice.

Illegitimi non carborundum.

.

Dr Rachel Floyd

Career so far including what motivated you to study/research in physiology?

My first taste of life as a researcher came as an undergraduate and then a technician, working in the Ophthalmology Unit at the Royal Liverpool University Hospital. Those two years taught me a lot about the harsh reality of being a post-doc long before I would be in a position to choose that path myself. Seeing brilliant researchers come and go as grants ended wasn't enough to dissuade me from taking the plunge into academia. During my interview for the Wellcome Trust PhD Studentship in the Department of Cellular and Molecular Physiology, I was introduced to Dr Susan Wray (now Professor), who would have an enormous impact on my future career as my PhD supervisor and later as my Fellowship mentor. As a PhD student and later as a post-doc, I studied smooth muscle pathophysiology in the genitourinary tract. This work evolved during my second post-doc; to focus on host-pathogen interactions in the GU tract. The extensive experience I gained in areas of cellular and molecular physiology and infection biology allowed me to develop a strong multidisciplinary research proposal to study the effects of host-pathogen interactions at the genetic, molecular and functional levels, a unique strength in the field. Being awarded a Research Fellowship in 2013 by Kidney Research UK was one of my proudest moments, as it signified that I'd achieved my goal of becoming an independent researcher. This is only the beginning so watch this space.

What are your aspirations?

To emulate the achievements of Prof Wray by gaining recognition as a leading academic researcher while always keeping a smile on my face.

What achievements are you proud of so far?

My first publication in the *Journal of Infectious Diseases*, (Floyd R et al, 2012) was a defining moment, as it established that my research had successfully bridged physiology and infection biology and as a result was chosen as Editors Pick. More recently, my group have been using RNAseq to determine key checkpoints regulating *E.coli* infections of the urinary tract. Sequencing the transcriptome of just a few thousand bacteria amongst millions of host cells was like finding a needle in a haystack. Definitely a moment when there was dancing in the lab!

Have you had to overcome any challenges?

By choosing positions that would allow me to specialise in academic research, I inadvertently made myself ineligible for 80% of fellowship funding streams. It didn't occur to me that there was such a thing as being 'too experienced'. The process of securing a Fellowship taught me a lot about being persistent, having a thick skin and believing in your work.

What if any challenges to do you foresee?

The competition to secure funding will always be challenging but it is all part of the journey.

Have you received any advice that has helped you?

Never give up. Having a dedicated, supportive mentor has definitely helped at every stage of my career. Being constantly reminded that you will succeed ensures that when you get to the end of your rope, you are strong enough to tie a knot and hang on!

What would you say to encourage girls at school into science?

Science is one of the few careers where you are encouraged to think outside the box, to challenge the norm and to push boundaries without being judged. If you embrace the path towards making scientific advances, you are treated as an equal.

Afterword

As a Society, we are very proud of the diverse population of scientists that forms our membership. Our meetings welcome people from a wide range of countries and cultures and we strive to provide support for attendees with a variety of options for childcare needs.

We are particularly delighted, in writing this afterword for a book on women in physiology, that there has been an increase in the percentage of women physiologists registered as Members of The Society. However, we note that there may be an issue in the retention of women as they move from affiliate (54.4%) to full membership (25.1%). This may reflect changes in the proportion of women staying in physiology past the postdoctoral stage (which is known to be an issue in most science departments) or may just be due to the fact that historically there have been a lot more men in The Society. In this case, we should be celebrating the fact that in the younger generation (affiliates, undergrads), there are more women coming through than men. Furthermore, it is clear from looking at the statistics provided by Tilli Tansey and Lynn Bindman that there is a lot still to be done within The Society to improve and recognise the contributions of women at all levels, with woefully few women being honoured with prize lectureships and a paucity of women acting as senior officers of The Society. In fact, just 7.8% of all honorary members are female at this moment, although this may increase with the recent nominations of several females for Honorary Members. Actions like these would be useful in providing external validation and support for women in their progress up the career ladder.

With this in mind, The Council of Trustees has formally committed The Physiological Society to the Science Council's declaration on diversity, equality and inclusion (http://www.sciencecouncil.org/content/declaration-diversity-equality-and-inclusion) and as a result, The Society will focus on enhancing the opportunities and support for our female Members. The Society has already started this journey with our appointments as Equality and Diversity Champions, which entail our close working with Chrissy Stokes, Head of Education and Outreach at The Physiological Society, along with its CEO, Philip Wright. We have already launched a series of initiatives to identify key issues. The first step has been to carry out a survey of staff within The Physiological Society, followed closely by a survey of all Members of The Society to discover whether there is equality of opportunity for all and if not, to identify where there is disparity.

From this, we will share the outcomes with staff, Council and membership and work together to form strategies for improving highlighted areas of concern. These may include further focus group discussions and specific actions that could include improved accessibility to the website, updating of

the website with information about accessibility at meetings, updating terms and conditions of grant schemes, the type and location of outreach activities, and so forth. Coming from departments that have been successful in obtaining Athena SWAN awards, with Sue Deuchars forming part of the self-assessment teams at both faculty and institution level, we are both aware of issues that are being tackled within universities and more importantly best practice/strategies to implement change. These can help inform the action plan we will develop for The Society to enhance equality and diversity through all of our activities.

Steps have already been taken to address the balance of females at more senior levels of The Society with nine females (giving nearly 50/50 parity) on the current Board of Trustees and Anne King acting as the first female Treasurer. The new Chair of the Membership and Grants Committee, as of July 2015, is also female (RT), and will work alongside the two other current female chairs of committee. Moreover, we are delighted to say that, with the consideration of retention of females moving from affiliate to full membership, our last two affiliate members of Council were female. The gender balance of speakers at symposia is now being carefully monitored and steps are being taken to ensure that there is at least one female senior speaker for each of these symposia. Perhaps most pertinent to this celebratory book are two key positive steps for recognition and celebration of the contributions of females at senior level: firstly we note with pleasure that all The Society's prize lectureships were awarded to female physiologists in this centenary year of the first election of women to The Society, and secondly a big rise in the number of female nominations for honorary membership.

We feel that The Physiological Society is making a very real effort to promote the advancement of gender equality and this book acclaiming some of our best female physiologists is a lovely example of how to accentuate the positive achievements of those who have gone before us.

Sue Deuchars and Rachel Tribe

Equality and Diversity Champions of The Physiological Society

List of Contributors

Lynn J. Bindman BSc PhD

Hon. Reader, University College London.

Born 1938, her University education and entire career were in the Department of Physiology, UCL, until retirement in 2002, with brief periods of research abroad at UCLA, California and at the University of Auckland, New Zealand. She is co-author with Olof Lippold of the Neurophysiology of the Cerebral Cortex (1981). Her research papers are mainly concerned with long-lasting changes in synaptic transmission and excitability of cortical neurons. Lynn produced teaching materials (films, audiotapes with booklets, books of MCQs with answers and explanatory comments) with colleagues. With co-editors Alison Brading and Tilli Tansey, she wrote sections of Women Physiologists (1993). She was an elected member of the Committee of The Physiological Society (1987-1991); the Committee of the British Neuroscience Association (1988-1991); the Society of Neuroscience (USA) - elected 1984, membership committee 2002-2004, and was on the Congress Executive Committee of the XXXIInd International Congress of the Physiological Sciences (1993). On retirement, Lynn continued her association with UCL, as an Honorary Reader, serving on their Research Ethics Committee and the Animal Welfare and Ethics of Research Board; was a Justice of the Peace, Trustee of the Prisoners' Education Trust and is Chair of Governors of a special school. Lynn is married to lawyer Geoffrey Bindman; they have three children and six grandchildren.

Having been elected a Member of The Physiological Society in 1967, Lynn was made an Honorary Member of The Physiological Society in 2015.

Sue Deuchars BSc PhD

Reader in Neuroscience, University of Leeds.

Graduated from Cardiff University in 1988 with a BSc in Physiology and then studied for a PhD with Professors Gilbey and Spyer, at The Royal Free Hospital in London, graduating in 1992. Sue's first son was born in 1996 and from that point to the present day, she has worked part-time, moving to the University of Leeds in 1997, having been awarded funding from the BHF. Her second son was born in 1999 and she continued to work part-time, still securing her own funding. In 2005, she was successful in becoming an RCUK Fellow and in 2008, was promoted to Reader in Neuroscience. She was involved in successful bids for Athena Swan bronze awards at both the institution and faculty level. She became a Trustee for The Physiological Society in 2013 and is now one of the two equality and diversity champions for The Society. Sue's first love is her family and friends and she spends her spare time watching her lads play various sports and enjoying holidays with them.

Sue has been a Member of The Physiological Society since 1995

Helga Groll MSc PhD

Media and Communications Officer, The Physiological Society

Helga graduated from the University of Vienna, Austria and Université Paul Sabatier Toulouse III, France, in zoology, animal cognition and behaviour. After completing her MSc, Helga spent a year doing research with mice and whales (embracing nature's variety!) in Montréal, Canada. After finishing her PhD at the University of Southampton, she decided to take a leap of faith and follow her dreams of combining science, languages and communications by moving into science communications. Helga joined The Physiological Society in 2014 working in media and communications.

Chrissy Stokes BSc PhD

Head of Education and Outreach, The Physiological Society.

Chrissy Stokes graduated from the University of Bristol with a degree, and later a PhD, in Physiology. Before joining The Physiological Society, Chrissy worked at BioMed Central and the Wellcome Trust. As part of her current role, Chrissy is leading the Diversity work for The Society, under guidance from the Trustee Champions. The Physiological Society is a signatory of the Science Council's Declaration on Diversity. Chrissy has two boys, Alex and Rory.

Chrissy has worked for The Physiological Society since 2007.

Tilli Tansey OBE BSc PhD PhD DSc Hon MD Hon MRCP Hon FRCP FMedSci

Professor of the History of Modern Medical Sciences, Queen Mary University of London

Tilli, graduated in zoology from the University of Sheffield, where she also did her PhD on neurotransmitters in Octopus brain, awarded in 1978. After working on Parkinson's Disease in the MRC Brain Metabolism Unit in Edinburgh, and as a Multiple Sclerosis Society Research Fellow at St Thomas' Hospital Medical School in London, she re-trained as a medical historian , gaining a PhD from UCL in 1990. She became professor of the History of Modern Medical Sciences at UCL in 2007 and currently has the same title at Queen Mary University of London. Her work is principally in recent biomedical history and supported by the Wellcome Trust for many years, she has pioneered the 'Witness Seminar' approach. She collaborated with Lynn Bindman and Alison Brading in editing Women Physiologists in 1993. She was created OBE in 2014 for her 'services to medical research and to the public understanding of science'. She has honorary children and grandchildren in the UK, Russia and the USA, and visits them all as often as she can.

Tilli became a Member of The Physiological Society in 1986, and was elected an Honorary Member in 2014.

List of Contributors

Rachel Tribe BSc PhD

Reader in Women's health, Kings College London

Rachel graduated from the University of Sheffield with a BSc in Physiology and Zoology, and the University of London with a PhD on sodium transport and asthma. Subsequently, she was awarded an American Heart Association Postdoctoral Fellowship to study smooth muscle calcium regulation at the University of Maryland at Baltimore with Dr Mordecai Blaustein. After her return to the UK, Rachel married and had two lovely daughters (now 13 and 10 years old) and somehow manages to maintain a good balance between family life and a full time career by utilising flexible working opportunities. She is now a Reader in Women's Health at King's College London, leads a well-funded multidisciplinary research group of scientists, midwives and clinicians that researches K_V7 channels, myometrial physiology, prediction of preterm birth and the innate immune system in pregnancy. She has been a Trustee of The Physiological Society since 2013, and was recently appointed as Chair of the Membership and Grants committee. She greatly enjoys being a 'Equality and Diversity' co-lead for The Society and hopes that this initiative will have as much of a positive impact as the appointment of women to The Society did over 100 years ago.

Rachel was elected as a Member of The Physiological Society in 1996.

Susan Wray BSc PhD FMedSci FRCOG MAE

Professor of Physiology, University of Liverpool

Sue graduated with a BSc and PhD in physiology from University College London. After a series of postdoctoral positions exploring the emerging biomedical potential of NMR and near infrared spectroscopy she moved to a lectureship in Liverpool in 1990. She obtained her Chair in 1996, and was head of department for four years. Sue has focussed on elucidating the relation between metabolism and function in smooth muscle, with particular expertise in myometrial physiology. She was Director of the Centre for Better Births and is currently co-Director of the Harris-Wellbeing Centre for preterm birth research. She has enjoyed being a member of The Physiological Society and served on its committee (Council). She is Director of Athena SWAN for her university and Editor-in-Chief of Physiological Reports. She has three children, three grandchildren, one husband and four cats.

Sue was elected as a Member of The Physiological Society in 1984 and became an Honorary Member in 2015.

To contact any of these authors please email membership@physoc.org

References

Professor Heidi de Wet

de Wet H, Rees MG, Shimomura K, Aittoniemi J, Patch AM, Flanagan SE, Ellard S, Hattersley AT, Sansom MS & Ashcroft FM (2007). Increased ATPase activity produced by mutations at arginine-1380 in nucleotide-binding domain 2 of ABCC8 causes neonatal diabetes. Proc Natl Acad Sci U S A 104, 18988–18992.

Professor Susan D Brain

Aubdool AA, Graepel R, Kodji X, Alawi KM, Bodkin JV, Srivastava S, Gentry C, Heads R, Grant AD, Fernandes ES, Bevan S & Brain SD (2014). TRPA1 is essential for the vascular response to environmental cold exposure. Nat Commun 5, 5732.

Brain SD, Camp RD, Dowd PM, Black AK, Woollard PM, Mallet AI & Greaves MW (1982). Psoriasis and leukotriene B4. Lancet 2, 762–763.

Brain SD & Williams TJ (1988). Substance P regulates the vasodilator activity of calcitonin gene-related peptide. Nature 335, 73–75.

Brain SD, Williams TJ, Tippins JR, Morris HR & MacIntyre I (1985). Calcitonin gene-related peptide is a potent vasodilator. Nature 313, 54–56.

Fernandes ES, Russell FA, Spina D, McDougall JJ, Graepel R, Gentry C, Staniland AA, Mountford DM, Keeble JE, Malcangio M, Bevan S & Brain SD (2011). Arthritis Rheumatol 63, 819–829.

Dr Aisah A Aubdool

Aubdool AA, Graepel R, Kodji X, Alawi KM, Bodkin JV, Srivastava S, Gentry C, Heads R, Grant AD, Fernandes ES, Bevan S & Brain SD (2014). TRPA1 is essential for the vascular response to environmental cold exposure. Nat Commun 5, 5732.

Professor Andrea H Brand

Brand AH, Breeden L, Abraham J, Sternglanz R & Nasmyth K (1985). Characterization of a silencer in yeast: A DNA Sequence with properties opposite to those of a transcriptional enhancer. Cell 41, 41–48.

Brand AH & Perrimon N (1993). Targeted gene expression as a means of altering cell fate and generating dominant phenotypes. Development 118, 401–415.

Chell JM & Brand AH (2010). Nutrition-responsive glia control exit of neural stem cells from quiescence. Cell 143, 1161–1173.

Southall TD, Davidson CM, Miller C, Carr A & Brand AH (2014). Dedifferentiation of neurons precedes tumour formation in lola mutants. Dev Cell 28, 685–696.

Southall TD, Gold KS, Egger B, Davidson CM, Caygill EE, Marshall OJ & Brand AH (2013). Cell type-specific profiling of gene expression and chromatin binding without cell isolation: Assaying RNA Pol II occupancy in neural stem cells. Dev Cell 26, 101–112.

Dr Irene Miguel-Aliaga

Cognigni P, Bailey AP & Miguel-Aliaga I (2011). Enteric neurons and systemic signals couple nutritional and reproductive status with intestinal homeostasis. Cell Metab 13, 92–104.

Linneweber GA, Jacobson J, Busch KE, Hudry B, Christov CP, Dormann D, Yuan M, Otani T, Knust E, de Bono M & Miguel-Aliaga I (2014). Neuronal control of metabolism through nutrient-dependent modulation of tracheal branching. Cell 156, 69–83.

References

Professor Barbara Casadei

Dawson D, Lygate CA, Zhang MH, Hulbert K, Neubauer S & Casadei B (2005). nNOS gene deletion exacerbates pathological left ventricular remodeling and functional deterioration after myocardial infarction. Circulation 112, 3729–3737.

Kardos A, Taylor DJ, Thompson C, Styles P, Hands L, Collin J & Casadei B (2000). Sympathetic denervation of the upper limb improves forearm exercise performance and skeletal muscle bioenergetics. Circulation 101, 2716 - 2720.

Musialek P, Lei M, Brown HF, Paterson DJ & Casadei B (1997). Nitric oxide can increase heart rate by stimulating the hyperpolarization-activated inward current, If. Circ Res 81, 60–68.

Reilly SN, Jayaram R, Nahar K, Antoniades C, Verheule S, Channon KM, Alp NJ, Schotten U & Casadei B (2011). Atrial sources of reactive oxygen species vary with the duration and substrate of atrial fibrillation: implications for the antiarrhythmic effect of statins. Circulation 124, 1107–1117.

Sears CE, Bryant SM, Ashley EA, Lygate CA, Rakovic S, Wallis HL, Neubauer S, Terrar DA & Casadei B (2003). Cardiac neuronal nitric oxide synthase isoform regulates myocardial contraction and calcium handling. Circ Res 92, e52–59.

Professor Shamshad Cockcroft

Cockcroft S & Gomperts BD (1979). ATP induces nucleotide permeability in rat mast cells. Nature 279, 541-542.

Cockcroft S & Gomperts BD (1985). Role of guanine nucleotide binding protein in the activation of polyphosphoinositide phosphodiesterase. Nature 314, 534–536.

Cockcroft S, Howell TW & Gomperts BD (1987). Two G-proteins act in series to control stimulus-secretion coupling in mast cells: use of neomycin to distinguish between G-proteins controlling polyphosphoinositide phosphodiesterase and exocytosis. J Cell Biol 105, 2745–2750.

Cockcroft S, Thomas GM, Fensome A, Geny B, Cunningham E, Gout I, Hiles I, Totty NF, Truong O & Hsuan JJ (1994). Phospholipase D: a downstream effector of ARF in granulocytes. Science 263, 523–526.

Thomas GM, Cunningham E, Fensome A, Ball A, Totty NF, Truong O, Hsuan JJ & Cockcroft S (1993). An essential role for phosphatidylinositol transfer protein in phospholipase C-mediated inositol lipid signaling. Cell 74, 919-928.

Dr Kathryn Garner

Garner K, Hunt AN, Koster G, Somerharju P, Groves E, Li M, Raghu P, Holic R & Cockcroft S (2012). Phosphatidylinositol transfer protein, cytoplasmic 1 (PITPNC1) binds and transfers phosphatidic acid. J Biol Chem 287, 32263–32276.

Professor Dame Kay Davies CBE

Davies KE, Pearson PL, Harper PS, Murray JM, O'Brien T, Sarfarazi M & Williamson R (1983). Linkage analysis of two cloned DNA sequences flanking the Duchenne muscular dystrophy locus on the short arm of the human X chromosome. Nucleic Acids Res 11, 2303–2312.

England S, Nicholson LVB, Johnson MA, Forrest SM, Love DR, Zubrycka-Gaarn EE, Bulman DE, Harris JB & Davies KE (1990). Very mild muscular dystrophy associated with the deletion of 46% of dystrophin. Nature 342, 180–182.

Forrest SM, Cross GS, Speer A, Gardner-Medwin D & Davies KE (1987). Preferential deletion of exons in Duchenne and Becker muscular dystrophies. Nature 329, 638–640.

Guiraud S, Squire SE, Edwards B, Chen H, Burns DT, Shah N, Babbs A, Davies SG, Wynne GM, Russell AJ, Elsey D, Wilson FX, Tinsley JM, Davies KE (2015). Second-generation compound for the modulation of utrophin in the therapy of DMD. Hum Mol Genet (in press).

Love DR, Hill DF, Dickson G, Spurr NK, Byth BC, Marsden RF, Walsh F, Edwards YH & Davies KE (1989). An autosomal transcript in skeletal muscle with homology to dystrophin. Nature 339, 55–58.

Professor Annette Dolphin

Canti C, Nieto-Rostro M, Foucault I, Heblich F, Wratten J, Richards MW, Hendrich J, Douglas L, Page KM, Davies A & Dolphin AC (2005). The metal-ion-dependent adhesion site in the Von Willebrand factor-A domain of α2δ subunits is key to trafficking voltage-gated Ca2+ channels. Proc Natl Acad Sci U S A 102, 11230–11235.

Cassidy JS, Ferron L, Kadurin I, Pratt WS & Dolphin AC (2014). Functional exofacially-tagged N-type calcium channels elucidate the interaction with auxiliary α2δ-1 subunits. Proc Natl Acad Sci U S A 111, 8979–8984.

Davies A, Kadurin I, Alvarez-Laviada A, Douglas L, Bauer CS, Nieto-Rostro M, Pratt, WS & Dolphin AC (2010). The α2δ subunits of voltage-gated calcium channels form GPI-anchored proteins, a post-translational modification essential for function. Proc Natl Acad Sci U S A 107, 1654–1659.

Dolphin AC & Prestwich SA (1985). Pertussis toxin reverses adenosine inhibition of neuronal glutamate release. Nature 316, 148–150.

Hendrich J, Tran Van Minh A, Heblich F, Nieto-Rostro M, Watschinger K, Striessnig J, Wratten J, Davies A & Dolphin AC (2008). Pharmacological disruption of calcium channel trafficking by the α2δ ligand gabapentin. Proc Natl Acad Sci U S A 105, 3628–3633.

Professor Kim Dora

Dora KA, Doyle MP & Duling BR (1997). Elevation of intracellular calcium in smooth muscle causes endothelial cell generation of NO in arterioles. Proc Natl Acad Sci U S A 94, 6529–6534.

Dora KA, Gallagher NT, McNeish A & Garland CJ (2008). Circ Res 102, 1247–1255.

Edwards G, Dora KA, Gardener MJ, Garland CJ & Weston AH (1998). K+ is an endothelium-derived hyperpolarizing factor in rat arteries. Nature 396, 269–272.

Professor Maria Fitzgerald

Beggs S, Torsney C, Drew L & Fitzgerald M (2002). The postnatal reorganization of primary afferent input and dorsal horn cell receptive fields in the rat spinal cord is an activity-dependent process. Eur J Neurosci 16, 1249–1258.

Fabrizi L, Slater R, Worley A, Meek J, Boyd S, Olhede S & Fitzgerald M (2011). A shift in sensory processing that enables the developing human brain to discriminate touch from pain. Curr Biol 21, 1552–1558.

Fitzgerald M (1987). Spontaneous and evoked activity of fetal primary afferents in vivo. Nature 326, 603-605.

Fitzgerald M, Millard C & MacIntosh N (1988). Hyperalgesia in premature infants. Lancet 1, 292.

McKelvey R, Berta T, Old E, Ji RR & Fitzgerald M (2015). Neuropathic pain is constitutively suppressed in early life by anti-inflammatory neuroimmune regulation. J Neurosci 35, 457–466.

References

Professor Abigail L. Fowden

Constância M, Angiolini E, Sandovici I, Smith P, Smith R, Kelsey G, Dean W, Ferguson-Smith A, Sibley CP, Reik W & Fowden A (2005). Adaptation of nutrient supply to fetal demand in the mouse involves interaction between the Igf2 gene and placental transporter systems. Proc Natl Acad Sci U S A 102, 19219–19224.

Fowden AL & Comline RS (1984). The effects of pancreatectomy on the sheep fetus in utero. Q J Exp Physiol 69, 319–330.

Fowden AL, Harding R, Ralph MM & Thorburn GD (1987). The nutritional regulation of plasma prostaglandin E concentrations in the fetus and pregnant ewe during late gestation. J Physiol 394, 1–12.

Fowden AL, Mundy L & Silver M (1998). Developmental regulation of glucogenesis in the sheep fetus during late gestation. J Physiol 508, 937–947.

Fowden AL, Taylor PM, White KL & Forhead AJ (2000). Ontogenic and nutritionally induced changes in fetal metabolism in the horse. J Physiol 528, 209–219.

Professor Christine Holt

Campbell DS & Holt CE (2001). Chemotropic responses of retinal growth cones mediated by rapid local protein synthesis and degradation. Neuron 32, 1013–1026.

Harris WA, Holt CE & Bonhoeffer F (1987). Retinal axons with and without their somata, growing to and arborizing in the tectum of Xenopus embryos: a time-lapse video study of single fibres in vivo. Development 101, 123–133.

Holt CE & Harris WA (1983). Order in the initial retinotectal map in Xenopus: a new technique for labelling growing nerve fibres. Nature 301, 150–152.

Nakagawa S, Brennan C, Johnson KG, Shewan D, Harris WA & Holt CE (2000). Ephrin-B regulates the Ipsilateral routing of retinal axons at the optic chiasm. Neuron 25, 599–610.

Yoon BC, Jung H, Dwivedy A, O'Hare CM, Zivraj KH & Holt CE (2012). Local translation of extranuclear lamin B promotes axon maintenance. Cell 148, 752–764.

Professor Anne King

Chapman RJ, Cilia La Corte PF, Asghar AU & King AE (2009). Network-based activity induced by 4-aminopyridine in rat dorsal horn in vitro is mediated by both chemical and electrical synapses. J Physiol 587, 2499–2510.

Chapman RJ, Lall VK, Maxeiner S, Willecke K, Deuchars J & King AE (2012). Localization of neurones expressing the gap junction protein Connexin45 within the adult spinal dorsal horn: a study using Cx45-eGFP reporter mice. Brain Struct Funct 218, 751–765.

King DJ, McBain AE, Jais MM, Roberts CJ, Collins JF, Wheal HV & Walker RJ (1982). The excitatory actions of a series of piperidine dicarboxylates on central neurons of the rat, snail, leech and horseshoe crab and on crab neuromuscular junction. Comp Biochem Physiol C 73, 771–777.

Lopez-Garcia JA & King AE (1994). Membrane properties of physiologically classified rat dorsal horn neurons in vitro: correlation with cutaneous sensory afferent input. Eur J Neurosci 6, 998–1007.

Thompson SW, King AE & Woolf CJ (1990). Activity-dependent changes in rat ventral horn neurons in vitro; summation of prolonged afferent evoked postsynaptic depolarizations produce a d-2-amino-5-phosphonovaleric acid sensitive windup. Eur J Neurosci 2, 638–649.

Professor Bridget Lumb

Cervero F & Lumb BM (1988). Bilateral inputs and supraspinal control of viscero-somatic neurones in the lower thoracic spinal cord of the cat. J Physiol 403, 221–237.

Leith JL, Wilson AW, Donaldson LF & Lumb BM (2007). COX-1 derived prostaglandins in the periaqueductal grey differentially control C- versus A-fibre-evoked spinal nociception. J Neurosci 27, 11296–11305.

Lumb BM (1990). Hypothalamic influences on viscero-somatic neurones in the lower thoracic spinal cord of the anaesthetised rat. J Physiol 424, 427–444.

McMullan S & Lumb BM (2006a). Spinal dorsal horn neuronal responses to myelinated versus unmyelinated heat nociceptors and their modulation by activation of the periaqueductal grey in the rat. J Physiol 576, 547-556.

McMullan S & Lumb BM (2006b). Midbrain control of spinal nociception discriminates between responses evoked by myelinated and unmyelinated heat nociceptors in the rat. Pain 124, 59–68.

Tattersall JEH, Cervero F & Lumb BM (1986a). Viscerosomatic neurones in the lower thoracic spinal cord of the cat: excitations and inhibitions evoked by splanchnic and somatic nerve volleys and by stimulation of brain stem nuclei. J Neurophysiol 56, 1411–1423.

Tattersall JEH, Cervero F & Lumb BM (1986b). Effects of reversible spinalisation on the visceral input to viscerosomatic neurones in the lower thoracic spinal cord of the cat. J Neurophysiol 56, 785–796.

Professor Margaret (Mandy) R MacLean

Dempsie Y, Morecroft I, Welsh DJ, MacRitchie NA, Herold N, Loughlin L, Nilsen M, Peacock AJ, Harmar A, Bader M & MacLean MR (2008). Converging evidence in support of the serotonin hypothesis of dexfenfluramine-induced pulmonary hypertension with novel transgenic mice. Circulation 117, 2928–2937.

Keegan A, Morecroft I, Smillie D, Hicks MN & MacLean MR (2001). Contribution of the 5-HT1B receptor to hypoxia-induced pulmonary hypertension: Converging evidence using 5-HT1B-receptor knockout mice and the 5-HT1B/1D-receptor antagonist GR127935. Circ Res 89, 1231–1239.

Mair KM, Wright AF, Duggan N, Rowlands DJ, Hussey MJ, Roberts S, Fullerton J, Nilsen M, Loughlin L, Thomas M & MacLean MR (2014). Sex-dependent influence of endogenous estrogen in pulmonary hypertension. Am J Respir Crit Care Med 190, 456–467.

McCulloch KM, Docherty C & MacLean MR (1998). Endothelin receptors mediating contraction of rat and human pulmonary resistance arteries: effect of chronic hypoxia in the rat. Br J Pharmacol 123, 1621–1630.

White K, Johansen AK, Nilsen M, Ciuclan L, Wallace E, Paton L, Campbell A, Morecroft I, Loughlin L, McClure JD, Thomas M, Mair KM & MacLean MR (2012). Activity of the estrogen-metabolizing enzyme cytochrome P450 1B1 influences the development of pulmonary arterial hypertension. Circulation 126, 1087–1098.

Professor Eleanor A. Maguire

Bonnici HM, Chadwick MJ, Lutti A, Hassabis D, Weiskopf N & Maguire EA (2012). Detecting representations of recent and remote autobiographical memories in vmPFC and hippocampus. J Neurosci 32, 16982–16991.

Hassabis D, Kumaran D, Vann SD & Maguire EA (2007). Patients with hippocampal amnesia cannot imagine new experiences. Proc Natl Acad Sci U S A 104, 1726–1731.

References

Maguire EA, Burgess N, Donnett JG, Frackowiak RS, Frith CD & O'Keefe J (1998). Knowing where and getting there: a human navigation network. Science 280, 921–924.

Maguire EA & Mullally SL (2013). The hippocampus: a manifesto for change. J Exp Psychol Gen 142, 1180-1189.

Woollett K & Maguire EA (2011). Acquiring "the Knowledge" of London's layout drives structural brain changes. Curr Biol 21, 2109–2114.

Professor Janice Marshall

Edmunds NJ, Moncada S & Marshall JM (2003). Does nitric oxide allow endothelial cells to sense hypoxia and mediate hypoxic vasodilatation? In vivo and in vitro studies. J Physiol 546, 521-527.

Marshall JM (1982). The influence of the sympathetic nervous system on individual vessels of the microcirculation of skeletal muscle of the rat. J Physiol 332, 160-186.

Marshall JM (1994). Peripheral chemoreceptors and cardiovascular regulation. Physiol Rev 74, 543-594.

Ray CJ, Abbas MR, Coney AM & Marshall JM (2002). Interactions of adenosine, prostaglandins and nitric oxide in hypoxia-induced vasodilatation: in vivo and in vitro studies. J Physiol 544, 195–209.

Rook WM, Johnson CD, Coney AM, Marshall JM (2014). Maternal hypoxia in pregnancy induces hypertension in male offspring with raised muscle sympathetic nerve activity, sympathetic hyperinnervation, premature blunting of the NPY component of vasoconstriction and hypertension in adult life. Hypertension 64, 1321-1327.

Professor Anne McArdle

Jackson MJ & McArdle A (2015). J Physiol (in press).

McArdle A, van der Meulen JH, Catapano M, Symons MC, Faulkner JA & Jackson MJ (1999). Free radical activity following contraction-induced injury to the extensor digitorum longus muscles of rats. Free Radic Biol Med 26, 1085-1091.

McArdle A, Dillmann WH, Mestril R, Faulkner JA & Jackson MJ (2004). Overexpression of HSP70 in mouse skeletal muscle protects against muscle damage and age-related muscle dysfunction. FASEB J 18, 355-357.

Sataranatarajan K, Qaisar R, Davis C, Sakellariou GK, Vasilaki A, Zhang Y, Liu Y, Bhaskaran S, McArdle A, Jackson M, Brooks SV, Richardson A & Van Remmen H (2015). Neuron specific reduction in CuZnSOD is not sufficient to initiate a full sarcopenia phenotype. Redox Biol 5, 140–148.

Vasilaki A, Jackson MJ & McArdle A (2002). Attenuated HSP70 response in skeletal muscle of aged rats following contractile activity. Muscle Nerve 25, 902-905.

Professor Mary J Morrell

Browne HA, Adams L, Simonds AK & Morrell MJ (2003). Ageing does not influence the sleep-related decrease in the hypercapnic ventilatory response. Eur Respir J 21, 523-529.

McMillan A, Bratton DJ, Faria R, Laskawiec-Szkonter M, Griffin S, Davies RJ, Nunn AJ, Stradling JR, Riha RL, Morrell MJ & PREDICT Investigators (2014). Continuous positive airway pressure in older people with obstructive sleep apnoea syndrome (PREDICT): a 12-month, multicentre, randomised trial. Lancet Respir Med 2, 804-812.

Morrell MJ, Arabi Y, Zahn B & Badr MS (1998). Progressive retropalatal narrowing preceding obstructive apnea. Am J Respir Crit Care Med 158, 1974-1981.

Morrell MJ, Heywood P, Moosavi SH, Guz A & Stevens J (1999). Unilateral focal lesions in the rostrolateral medulla influence chemosensitivity and breathing measured during wakefulness, sleep, and exercise. J Neurol Neurosurg Psychiatry 67, 637-645.

Morrell MJ, McRobbie DW, Quest RA, Cummin AR, Ghiassi R & Corfield DR (2003). Changes in brain morphology associated with obstructive sleep apnea. Sleep Med 4, 451-454.

Rosenzweig I, Glasser M, Polsek D, Leschziner GD, Williams SC & Morrell MJ (2015). Sleep apnoea and the brain: a complex relationship. Lancet Respir Med 3, 404-414.

Twigg GL, Papaioannou I, Jackson M, Ghiassi R, Shaikh Z, Jaye J, Graham KS, Simonds AK & Morrell MJ (2010). Obstructive sleep apnea syndrome is associated with deficits in verbal but not visual memory. Am J Respir Crit Care Med 182, 98-103.

Dr Ivana Rosenzweig

Rosenzweig I, Glasser M, Polsek D, Leschziner GD, Williams SC & Morrell MJ (2015). Sleep apnoea and the brain: a complex relationship. Lancet Respir Med 3, 404-414.

Professor Lucilla Poston

Briley AL, Barr S, Badger S, Bell R, Croker H, Godfrey KM, Holmes B, Kinnunen TI, Nelson SM, Oteng-Ntim E, Patel N, Robson SC, Sandall J, Sanders T, Sattar N, Seed PT, Wardle J & Poston L (2014). A complex intervention to improve pregnancy outcome in obese women; the UPBEAT randomised controlled trial. BMC Pregnancy Childbirth 14, 74.

Chappell LC, Seed PT, Myers J, Taylor RS, Kenny LC, Dekker GA, Walker JJ, McCowan LME, North RA & Poston L (2013). Contribution of modifiable factors associated with uncomplicated pregnancy in nulliparous women: development and validation in a prospective cohort study. BMJ 347, f6398.

Cockell AP & Poston L (1997). Flow mediated vasodilation is enhanced in normal pregnancy but reduced in preeclampsia. Hypertension 30, 247-251.

McCarthy AI, Woolfson RG, Evans BJ, Davies DR, Raju SK & Poston L (1994). Functional characteristics of small placental arteries. Am J Obstet Gynecol 170, 945-951.

Poston L, Briley AL, Seed PT, Kelly FJ & Shennan AH (2006). Vitamins in Pre-eclampsia Trial Consortium. Vitamin C and E in pregnant women at risk for pre-eclampsia (VIP Trial): randomised placebo controlled trial. Lancet 367, 1145-1154.

Dr Anne-Maj Samuelsson

Samuelsson AM, Morris A, Igosheva N, Kirk SL, Pombo JM, Coen CW, Poston L & Taylor PD (2010). Evidence for sympathetic origins of hypertension in juvenile offspring of obese rats. Hypertension 55, 76-82.

Professor Sheena E Radford

Brockwell DJ, Paci E, Zinober RC, Beddard GS, Olmsted PD, Smith DA, Perham RN & Radford SE (2003). Pulling geometry defines the mechanical resistance of a []-sheet protein. Nat Struct Biol 10, 731–737.

Capaldi AP, Kleanthous C & Radford SE (2002). Im7 folding mechanism: misfolding on the path to the native state. Nat Struct Biol 9, 209–216.

Karamanos TK, Kalverda AP, Thompson GS & Radford SE (2014). Visualization of transient protein-protein interactions that promote or inhibit amyloid assembly. Mol Cell 55, 214–226.

References

Radford SE, Dobson CM & Evans PA (1992). The folding of lysozyme involves partially structured intermediates and multiple pathways. Nature 358, 302-307.

Texter FL, Radford SE, Laue ED, Perham RN, Miles JS & Guest JR (1988). Site-directed mutagenesis and H-1-NMR spectroscopy of an interdomain segment in the pyruvate-dehydrogenase multienzyme complex of Escherichia coli. Biochemistry 27, 289-296.

Dr Anastasia Zhuravleva

Zhuravleva A, Clerico EM & Gierasch LM (2012). An interdomain energetic tug-of-war creates the allosterically active state in Hsp70 molecular chaperones. Cell 151, 1296-1307.

Zhuravleva A & Gierasch LM (2015). Substrate-binding domain conformational dynamics mediate Hsp70 allostery. Proc Natl Acad Sci U S A 112, E2865–2873.

Professor Dame Nancy Rothwell DBE

Emsley HCA, Smith CJ, Georgiou RF, Vail A, Hopkins SJ, Rothwell NJ & Tyrrell PJ (2005). A randomised phase II study of interleukin-1 receptor antagonist in acute stroke patients. J Neurol Neurosurg Psychiatry 97, 1366–1372.

Relton JK & Rothwell NJ (1992). Interleukin-1 receptor antagonist inhibits ischaemic and excitotoxic neuronal damage in the rat. Brain Res Bull 29, 243–246.

Rothwell NJ (1988). Central effects of TNF alpha on thermogenesis and fever in the rat. Biosci Rep 8, 345–352.

Rothwell NJ & Stock MJ (1978). A paradox in the control of energy intake in the rat. Nature 273, 146–147.

Rothwell NJ & Stock MJ (1979). A role for brown adipose tissue in diet-induced thermogenesis. Nature 281, 31-35.

Professor Maria Grazia Spillantini

Garcia Reitböck P, Anichtchik O, Bellucci A, Iovino M, Ballini C, Fineberg E, Ghetti B, Della Corte L, Spano PF, Tofaris GK, Goedert M & Spillantini MG (2010). SNARE protein redistribution and synaptic failure in a mouse model of Parkinson's disease. Brain 133, 2032–2044.

Spillantini MG, Goedert M, Crowther RA, Murrell J, Farlow MJ & Ghetti B (1997a). Familial multiple system tauopathy with presenile dementia: a disease with abundant neuronal and glial tau filaments. Proc Natl Acad Sci USA 94, 4113–4118.

Spillantini MG, Schmidt ML, Lee VM, Trojanowski JQ, Jakes R & Goedert M (1997b). **α-**Synuclein in Lewy bodies. Nature 388, 839–840.

Spillantini MG, Murrell JR, Goedert M, Farlow MR, Klug A & Ghetti B (1998a). Mutation in the tau gene in familial multiple system tauopathy with presenile dementia. Proc Natl Acad Sci USA 95, 7737-7741.

Spillantini MG, Crowther RA, Jakes R, Hasegawa M & Goedert M (1998b) **α-**Synuclein in filamentous inclusions of Lewy bodies from Parkinson's disease and dementia with Lewy bodies. Proc Natl Acad Sci USA 95, 6469-6473.

Tilli Tansey

Church RA & Tansey EM (2007). Burroughs, Wellcome & Co.: Knowledge, Trust and Profit, and the Transformation of the British Pharmaceutical Industry. Carnegie Publishing, Lancaster.

Tansey EM (1980). Aminergic fluorescence in the cephalopod brain. Philos Trans R Soc Lond B Biol Sci 291, 127-145.

Tansey EM (1984). The life and works of Sir Alexander Crichton, FRS (1763-1856): A Scottish physician to the

Imperial Russian court. Notes Rec R Soc Lond 38, 241–259.

Tansey EM (1989). The Wellcome Physiological Research Laboratories 1894-1904: the Home Office, pharmaceutical firms and animal experiments. Med Hist 33, 1-41.

Dr Emma M Jones

Jones EM & Tansey EM (eds) (2015). The Development of Narrative Practices in Medicine c.1960–c.2000. Wellcome Witnesses to Contemporary Medicine, vol. 52. Queen Mary University of London, London.

Jones EM & Tansey EM (eds) (2014). Monoclonal Antibodies to Migraine: Witnesses to modern biomedicine, an A–Z. Wellcome Witnesses to Contemporary Medicine, vol 50. Queen Mary University of London, London.

Jones EM & Tansey EM (eds) (2014). Clinical Molecular Genetics in the UK c.1975-c.2000. Wellcome Witnesses to Contemporary Medicine, vol. 48. Queen Mary University of London, London.

Jones EM & Tansey EM (eds) (2013). Clinical Cancer Genetics: Polyposis and familial colorectal cancer c.1975-c.2010. Wellcome Witnesses to Contemporary Medicine, vol. 46. Queen Mary University of London, London.

Jones EM (2013). Parched City: A History of London's Public and Private Drinking Water. Zero Books, Winchester.

The History of Modern Biomedicine Research Group's website: www.histmodbiomed.org

Professor Alex M. Thomson

Thomson AM (1986). A magnesium sensitive postsynaptic potential in rat cerebral cortex resembles neuronal responses to N-methylaspartate. J Physiol 370, 531–549.

Thomson AM, Bannister AP, Hughes DI & Pawelzik H (2000). Differential sensitivity to Zolpidem of IPSPs activated by morphologically identified CA1 interneurones in slices of rat hippocampus. Eur J Neurosci 12, 425-436.

Thomson AM, Deuchars J & West DC (1993). Single axon EPSPs in neocortical interneurones exhibit pronounced paired pulse facilitation. Neuroscience 54, 347-360.

Thomson AM, Walker VE & Flynn DM (1989). Glycine enhances NMDA-receptor mediated synaptic potentials in neocortical slices. Nature 338, 422-424.

Thomson AM & West DC (1993). Fluctuations in pyramid-pyramid EPSPs modified by presynaptic firing pattern and postsynaptic membrane potential using paired intracellular recordings in rat neocortex. Neuroscience 54, 329–346.

Professor Susan Wray

Wray, S (1982) The role of mechanical and hormonal stimuli on uterine involution in the rat. J Physiol 328, 1-9

Wray, S, Cope, M, Delpy, DT, Wyatt, JS & Reynolds, EOR (1988) Characterisation of the near infrared absorption spectra of cytochrome aa3 and haemoglobin for the non invasive monitoring of cerebral oxygenation. Biochim Biophys Acta 933, 184-192

Austin, C & Wray, S (2000) Interactions between Ca2+ and H+ and functional consequences in vascular smooth muscle. Circ Res 86, 355-363

Quenby, S, Pierce, SJ, Brigham, S & Wray, S (2004) Dysfunctional labour is associated with myometrial acidosis. Obstetrics &Gynaecology 103, 718-23

Burdyga, T & Wray, S (2005) Action potential refractory period in ureter smooth muscle is set by Ca sparks and BK channels and peristalsis set by Ca sparks in ureter. Nature 436, 559-62

Dr Rachel Floyd

Floyd R, Upton M, Wray S, Hultgren S, Burdyga T, Winstanley C (2012) Escherichia coli-mediated impairment of ureteric contractility is UPEC-specific. IF 6.288 Editors' pick. J Infect Di; doi: 10.1093/infdis/jis554.