The
Physiological
Society
Magazine

Spring 1996
No 22
Entrance to the Physiology Department, UCL

Sir Bernard Katz

Jonathan Fry in his lab

Robert Harbness

Tony Gardner-Medwyn on the roof

Michael Duchen and Lynx Birdman discussing slides

Roger Woledge (now at Stanmore) being used for an experiment

Practical class at the Royal Free with PhD student (left), Matthew Skinner

Mike Gilbey at the Royal Free

Photography by Martin Rosenberg

Front cover: Painting of University College London by Mark Hanson, Department of Physiology, UCL.
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**Action Points**

- **Affiliate Travel Grant Scheme** The next two deadlines for receipt of applications are 31 March and 31 May 1996.

- **Eastern European and Third World Grants** The next two deadlines for receipt of applications are 31 March and 31 May 1996.

- **Edinburgh Meeting** Abstracts should be submitted to the Meetings Secretary between 1 and 14 March 1996.

- **Leeds Meeting** Abstracts should be submitted to the Meetings Secretary between 17 and 30 May 1996.

- **Magazine Letters, Articles and Advertisements** for inclusion in the next issue should reach the Editor by 8 March 1996. Items for the Committee News and Noticeboard sections should reach the Administration office by 27 March, whilst Special Interest Group Forum items should reach the Meetings Secretary's office by 27 March 1996.

- **Membership Proposals** Candidates for election as new Members at the 1996 Annual General Meeting should ensure that their proposal papers reach the Administration Office by 26 April.

- **MSc Bursaries** The next deadline for receipt of applications is 31 May 1996.

- **New Lecturers Support Scheme** The next deadline for receipt of applications is 31 March 1996.

- **Vacation Studentships** The deadline for receipt of applications for the summer of 1996 is 30 April 1996.

- **Semi-Annual General Meeting** The Semi-Annual General Meeting will take place during the University College London Meeting at 445 on Wednesday 17 April in Theatre I (The Chemistry Auditorium).

**GUIDELINES FOR CONTRIBUTORS**

These guidelines are intended to assist authors in writing their contributions and to reduce the subsequent editing process. The Magazine Editorial Group is trying to ensure that all articles are written in a journalistic style so that they will have an immediate interest value for a wide readership and will be readable and comprehensible to non-experts. In particular, scientific articles should give a good overview of the field rather than focus on the authors' own research.

**Format of articles**

The main message or question posed should be introduced in the first paragraph. The background for the topic should then be established, leading up to the final denouement or conclusion.

**Length of articles**

This will be determined by the subject matter and agreed between the contributor and the commissioning editor. Articles will vary in length from 300 to a maximum of 800 words.

**Submission of articles**

Authors should submit text in the form of a disk accompanied by a printout wherever possible. Use of disks reduces the risk of introduction of errors during retyping. It is helpful to give brief details of the computer, operating system and software package(s) used (DOS formatted Wordperfect 5.1 files preferred, but not essential).

**Deadlines for submission**

See Notable Dates (inside covers of 1995 edition of the Grey Book) or contact the Editorial & Production Office. Late submissions will not be accepted or publication will be deferred to a later issue.

**Illustrations**

Authors are encouraged to submit diagrams, drawings, photographs or other artwork to illustrate their articles or, if they cannot provide these themselves, to suggest what artwork might be appropriate. Photographs may be in colour or black & white, prints or transparencies.

**Author photographs**

The Magazine normally includes photographs of the authors of articles. These may be colour or black & white; prints are preferable if cropping is required.

**References**

Authors are requested to keep the number of references to a minimum (preferably no more than two or three).

**Suggestions for articles**

These should be made (in writing, by phone, or in person at Scientific Meetings) either to the Editor, to the Editorial Assistant or to the relevant member of the Magazine Editorial Group (see list).

**Magazine Editorial Group**

Saffron Whitehead ................................................. News from Abroad, Letters
Phil Harrison ......................................................... Science News & Views
David Davies ......................................................... Teaching & Technology
Laurence Snaize ..................................................... Policies & Politics
Tilli Tansey ......................................................... Traces of the Past
Susan Wray ............................................................. Special Features
Valerie Cox ........................................................... Young Physiologists
PHYSIOLOGY AT UCL
From Mergers to Expansion

It is with great pleasure that the Departments of Physiology, Anatomy and Developmental Biology and Pharmacology welcome you to University College London. This is perhaps the first time that the invitation to attend a Physiological Society Meeting at the College has come from such a diverse group of departments. However, as a newcomer to UCL (more of that later) it is quite astounding to see how widely physiology is represented throughout the life of Clinical Sciences at UCL, or conversely, the importance of the roles played by the disciplines of anatomy and developmental biology and pharmacology in the research of many of the groups within the Department of Physiology. Indeed many members of the current Physiology Department are as well, or even better known, in Biochemical circles, hence the importance of our joint session on Intracellular Translocation with the Biochemical Society.

This Meeting represents the first to be held at UCL, since the merger of the Department of Physiology of The Royal Free Hospital Medical School with that of University College. Whilst the final institutional merger will not be cemented until a new teaching centre is completed in the former University College Hospital building, (part of the Cruciform Project), the relationship between the two Physiology Departments has been consummated I was appointed as Head of the new joint Department in 1994 and we are currently heavily concerned with planning the organisation, localisation and post-merger role of what will be probably the largest department of Physiology in the U.K. Assuming there are no draconian cutbacks (that is perhaps wishful thinking following the Budget Statement in November), we should have something in the order of 38 academic members of staff, together with joint ventures in academic units elsewhere in the greater UCL campus, or embedded in research units in clinical departments.

Expansion of Physiology at UCL

Physiology at UCL has already had one major phase of expansion in the 1980's with the merger between the Middlesex Hospital Medical School and University College and the incorporation of UCL's Department of Experimental Pathology. To incorporate Experimental Pathology might be considered strange but has brought to the Department considerable strength in cell and molecular biology and in particular an excellent research group (directed principally by Bastien Gomperts and Shamshad Cockcroft), concerned with the processes of exocytosis, a subject of major physiological importance. As a result of these developments, Physiology as a department stretches across Gower Street - a tunnel connects each site but a warren would probably be a better description -nd to The Royal Free at Hampstead, with little prospect of a significant relocation of staff to the UCL site for some years to come. We even have a further outpost adjacent to the M25 where Roger Woledge, my predecessor as Head of Department, has established an Institute of Human Performance within the Institute of Orthopaedics during 1994.

New Appointments

Since the most recent merger with The Royal Free, the Department has successfully filled the Jodrell Chair of Physiology made vacant upon Tim Biscoe’s retirement some years ago, David Attwell being elected to this highly prestigious appointment. We have also established a Bernard Katz Chair of Biophysics - the Department of Biophysics having been linked to Physiology many years ago, and to our great delight, Jonathan Ashmore has accepted this appointment and will be joining us later this year. We have also appointed new Lecturers (proleptic appointment for John Carroll and a Senior Lectureship for Frances Edwards) and intend to make further appointments both as vacancies occur and through joint ventures within the Cruciform Project (directed by Salvador Moncada). In this regard we hope to be able to announce shortly a major coup for the Department.

I could go on at length with news and views about the Department, at this time I imagine every Head of Department knows rather more about his Department or unit of assessment than is usual but I hope that you will learn more about us, the present and the future of the Department, from your direct contacts with us at the Meeting. We expect you to see us as a diverse but lively conglomerate and hope that the task of navigating UCL's warrens of corridors and buildings will not prove too difficult.
Changes at the Administration Office

Jane Ault resigned at the end of October 1995 and Heather Dalitz at the end of January 1996. We are delighted that in addition to Jacquelyn King, now the Administrative Assistant at the Oxford Office, Charlotte Parry joined the office just before Christmas as Secretarial Assistant.

Departure of Heather Dalitz

Heather Dalitz has served the Society in many ways over the last decade. She has for example, probably attended more Committee meetings (and eaten more Committee dinners!) than any individual since Henry Dale. However, her real claim to fame is as the voice at the end of the telephone to whom so many Members of the Society, both in this country and abroad, turned to for advice on every conceivable aspect of the Society’s affairs.

Heather joined the Society as Julian Jack’s assistant when he became Honorary Treasurer in 1986. Immediately she became the voice of reasoned and articulate decision-making in those important times, times which under Julian and Reg Chapman’s combined leadership led to important constitutional developments for the Society. The success of these was significantly dependent on Heather’s attention to detail and impeccable forward thinking.

In 1990 Heather’s role changed. She became the first Administrator (at the Society’s Administration and Publications Office in Oxford). This office, also an innovation for the Society, covered matters which had previously been dealt with by the Society’s previous Officers in an itinerant, and therefore necessarily inefficient, way.

Very importantly, during this time, Heather brought together such crucial functions as publication of the Grey Book and made it the key to Members’ everyday needs. The Society Magazine was fostered by Heather’s input most notably in its early days when Kwabena Appenteng was editor. They were notably effective in their efforts to produce the remarkable and important medium which the Magazine is today.

Together with handling all aspects of the Society’s Membership (including the new developments in Affiliation and Student Associateship) Heather helped with the development of the administrative structure under-pinning the Special Interest Groups. All of these activities were, and continue to be, of very great and obvious need to Members of the Society. However, there were additional activities which she undertook of which Members may be less aware; the Committee of the Society is supported very strongly by the active (and acquisitive) Sub-Committees all of which have their own views about why the total budget available to the Society should be spent on their individual needs; Heather was particularly involved in developments of the Grants Sub-Committee, the Education and Information Sub-Committee and the Animal Welfare Sub-Committee. To all these three Sub-Committees Heather was central, her dedication and intelligent commitment will be sorely missed.

Heather left the Society’s employment at the end of January 1996. All the Membership will be aware that her departure leaves a gap which will not easily be filled. Additionally I am sure that all Members of the Society will wish her the very best for her future and will look forward to seeing her when we can tempt her to return as our guest to meet many old friends, perhaps at Society dinners.

New Administration Office

At the Committee meeting on 9 November after much serious discussion, it was decided that there will be a combined Administration Office (dealing with many of the present functions of the Oxford Office and the Treasurer’s Office) which will be located in London. It is proposed that the office will be near University College London and will be up and running for the new Officers who take up their roles after the 1996 Annual General Meeting. This will allow many of the present functions of the Oxford Office to be run in combination with the relocated Treasurer’s Office. The implementation of this arrangement is being carried out by a Working Group which includes present (and future) Officers and representatives of the Committee. Other items of a less weighty nature were also discussed.

Committee Meetings

Society Meetings

There was discussion of the procedures needed to maintain standards of Communications at Meetings; and of how the Membership’s views on current voting procedures should be carried out. In a pilot study 100 Members, selected at random, will be asked for their views, before a final questionnaire is drafted and sent out to all Members.
Speeches at Society dinners  The question of whether speeches at Society dinners were an anachronism or were a formal and appropriate way of thanking the host department was debated (again!) It is proposed that the appropriate Sub-Committee will produce a magic solution which can be overturned (or not) at the Annual General Meeting in Edinburgh. Prepare your arguments!

Student Associates  The Committee Secretary reported that the new Student Associateship scheme had got off to a good start with some sixty Student Associates having been suggested and approved in the first three months.

Benevolent Fund  The Committee was informed of the significant demand on the resources of the Benevolent Fund. At present demand considerably out-stripped income. Ways of encouraging increased income generation, particularly by informing Members of the Society retiring from full-time appointments of the method of giving by Deed of Covenant (page 195 in the Grey Book) were discussed.

Meeting in Prague  The Foreign Secretary reported that there will be a joint Meeting with the Czech Physiological Society in Prague in June 1998.

ANNOUNCING

ISAN: The International Society for Autonomic Neuroscience

An International Society for Autonomic Neuroscience (ISAN), with Geoff Burnstock as Foundation President, Max Bennett as Executive Vice-President, Joel Bornstein as Executive Secretary and an International Committee, representing all major sub-fields and all continents, has been formed.

The purpose of ISAN is to facilitate communication between those working in this area of neuroscience and to raise the profile of autonomic neuroscience. It will arrange meetings, lobby for an improved representation of autonomic neuroscience in such organisations as IBRO, and aid communication between scientists who work on all aspects of the autonomic nervous system. The Society intends to create formal links with IBRO and IUPS, and possibly with other more generalist societies. We will welcome close association with regional societies that focus on the autonomic nervous system.

The Journal of the Autonomic Nervous System is the Official Journal of ISAN. Members of ISAN will be entitled to a subscription discount.

The first International Meeting to be organised by ISAN will be held in tropical Australia, an area of coral reefs, rain forest and spectacular scenery, from 14 to 20 September 1997. The meeting organiser is David Hirst.

This is an exciting initiative which will yield positive benefits for all who are interested in autonomic neuroscience’s and relevant areas of medicine.

To join the Society, and register for the mailing list, please contact the Executive Secretary, Dr Joel Bornstein, at the University of Melbourne, Australia, by email at joel@plexus.physiol.unimelb.edu.au or by Fax on 61-3-9344-5818.

The ISAN home page is available on World Wide Web at http://128.250.221.48/isan/isan.htm

The following have agreed to serve on the Interim Steering Committee:

J Angus (Australia), T Bolton (UK), A Buchan (Canada), M Costa (Australia), T Cunnane (UK), R Dampney (Australia), WC de Groat (USA), A Dolphin (UK), J Furness (Australia), P Guyenet (USA), D Hirst (Australia), T Hökfelt (Sweden), Y Ito (Japan), W Jänig (Germany), A Jean (France), W Kummer (Germany), N Le Douarin (France), A Loewy (USA), P Low (USA), E McLachlan (Australia), C Maggi (Italy), D Reis (USA), K Sanders (USA), KM Spyer (UK), K Starke (Germany), L Swanson (USA), J Szurszewski (USA), G Wallin (Sweden), L Weaver (Canada).
PROFESSOR TIM HIGENBOTTAM

Tim Higenbottam has been made Professor of Respiratory Medicine at the University of Sheffield in the Department of Medicine and Pharmacology in the Royal Hallamshire Hospital. He trained at Guy’s Hospital London and received a Biochemistry Honours degree in 1967. An MB followed in 1971 and MRCP in 1973. His MD was awarded in 1980 and he gained an MA (Camb) in 1987. As an applied physiologist, he has for the last 14 years directed the Respiratory Physiology Department at Papworth Hospital. He also worked as a consultant physician in the Papworth and Addenbrookes Hospitals in Cambridge.

Tim’s early physiological work concerned the study of human airway reflexes and the respiratory modulation of the laryngeal function. At Papworth, he and his research group considered the physiological disturbance which follows heart-lung transplantation. This led to the realisation that pulmonary innervation is not essential to the regulation of breathing nor to the development of bronchoconstriction. Application of this work led to the use of home spirometers so that lung transplant patients could be monitored at home for the occurrence of rejection, a practise now accepted around the world.

The current studies of his group concern the regulation of lung blood flow, the molecular basis of the actions of nitric oxide (NO) and the cellular regulation of its production. On the applied front, the group at Papworth Hospital was the first to describe the therapeutic potential of inhaled NO in pulmonary hypertension which in turn has led to the development of novel delivery systems for ambulatory patients.

PROFESSOR JIM PARRATT

Jim Parratt was recently awarded the Gold JE Purkyne Honorary Medal by the Council of the Academy of Sciences of the Czech Republic for merit in biological sciences. It was presented by the President of the Academy during a meeting of the International Society for Heart Research in Prague last July. This is the highest award that the Academy gives; the last UK recipient was Sir Hans Krebs.

Born in 1787, Jan Evangelista Purkyne (usually anglicised to Purkinje) was a fascinating figure, an experimental physiologist as well as a renowned microscopist, who analysed the mechanical effects of cardiac muscle shortening (and the ‘sucking power’ of the heart) and gave his name to vascular fibres, to germinal vesicles in the ovum, to axial cylinders of nerve muscle, to certain cells in the cerebellum, to ‘images of the eye’ and of course to certain fibres in the heart.

Jim Parratt graduated in both physiology and pharmacology from the University of London and taught physiology to medical students at University College Ibadan, Nigeria; at that time one of three Commonwealth Medical Schools which had a special relationship with the University of London, and the students doing London MBBS degrees. During his 8 years in Nigeria (1958-1966) he worked on the regulation of myocardial blood flow (with John Grayson) and on endomyocardial fibrosis (with Olaniyan Ajo). He joined the Department of Physiology and Pharmacology at the University of Strathclyde in 1967, was awarded a DSc degree in 1974, a Personal Chair in 1975 and became the first holder of an established Chair in Cardiovascular Pharmacology (the first in the United Kingdom), in 1986. The same year he was also elected a Fellow of the Royal Society of Edinburgh. For many years he worked in the Department of Surgery at the Western Infirmary in Glasgow with Professor lain Ledingham on aspects of hyperbaric oxygenation and as a member of the ‘shock team’, an experience which stimulated a long-standing interest in endotoxaemia and sepsis.

He has been involved in long-standing collaborations with the University Louis Pasteur in Strasbourg (which led to the discovery that nitric oxide is involved in the loss of vascular responsiveness during endotoxaemia, results first communicated to the Society in December 1989) and the Institute of Physiology of the Academy of Science in Prague, and, especially with the Albert Szent-Gyorgyi Medical University in Szeged, who awarded him an honorary MD in 1989. This collaboration has involved spending extended periods in Hungary exploring the mechanisms of the cardioprotective effects of ischaemic preconditioning with particular emphasis on delayed myocardial protection, which appears to involve endogenous myocardial protective mediators derived from endothelial cells. He gave his first communication to the Physiological Society in 1953, together with Geoff West, on histamine, 5 hydroxytryptamine and mast cells and became a Member of the Society in 1963.
I want to inform you of two major and exciting events taking place during The Physiological Society Meeting at University College London (16-19 April).

First, I am delighted that Professor Michael de Burgh Daly will be presenting the Designated Lecture to our Special Interest Group on Thursday 18 April. The title of his lecture is “Respiratory Modulation of Cardiovascular Reflexes”. It is a great honour that Professor Daly is making this presentation and I am sure it will be a truly memorable occasion.

Second, following the scientific Meeting, the first Cardiovascular / Respiratory Control Special Interest Group symposium entitled: “Neural Aspects of Cardiovascular and Respiratory Regulation” will take place on Friday 19 April at University College London. The symposium is divided into three sessions - each with two speakers presenting a 30 minute lecture. There will be ample time for in-depth discussion and audience participation is strongly encouraged.

The sessions include:

- Anatomical Considerations & Reflex Control
- Rhythm Generation
- Cardiovascular Motor Control

The programme is as follows:

**Professor Arthur D Loewy**, (St Louis, Missouri, USA)  
“Pseudorabies virus - the “cruise missile” for neuroanatomical studies of CNS autonomic circuits”

**Professor Janice M Marshall**, (Birmingham, UK)  
“Peripheral chemoreceptors in cardiovascular-respiratory integration”

**Dr Jeffrey C Smith**, (Bethesda, Maryland, USA)  
“The respiratory oscillator in mammals: neurones, networks, and new models”

**Professor Diethelm W Richter**, (Goettingen, FRG)  
“Serotonergic modulation of respiratory neurones”

**Dr Michael P Gilbey**, (London, UK)  
“Central respiratory drive and rhythmic discharges in sympathetic supply to blood vessels”

**Dr David C Randall**  
(Lexington, Kentucky, USA)  
“Insights into vagal control of heart rate from selective cardiac parasympathectomy”

As you can see it looks to be a day packed full of interest. I would like to thank in advance all the speakers for agreeing to participate in this symposium. In addition, thanks to Mike Gilbey who has jointly organised this event. The symposium is sponsored by The Physiological Society and British Heart Foundation. Finally the next Cardiovascular/Respiratory Control Special Interest Group venue will be at the Leeds Meeting (11-13 September). The period for submission of abstracts is 17-30 May.

Julian F R Paton

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**CARDIOVASCULAR REGULATION**

Edited by D Jordan and J M Marshall

Studies in Physiology No 2

This book provides an up-to-date account of our current understanding of the control of the cardiovascular system which is not covered by existing student textbooks. Each chapter has numerous summary boxes and also ‘Essential Reading’ suggestions for additional reading for undergraduates and ‘Further Reading’ suggestions to cover the subject to postgraduate level. It will be of interest to students of cardiovascular and exercise physiology, and medicine.

Contents: Central nervous integration of cardiovascular regulation, D Jordan; Some aspects of the integration of the respiratory and cardiovascular systems, M de B Daly; Cardiovascular changes associated with behavioural alerting, J M Marshall; Cardiovascular changes associated with sleep, J M Marshall; Regulation of blood volume, R Hainsworth and M Drinkhill; Cardiovascular responses to exercise: central and reflex contribution J H Coote; Metabolic control of blood flow with reference to heart, skeletal muscle and brain, M D Brown; Changing perspectives on microvascular fluid exchange, J R Levick.
HUMAN PHYSIOLOGY

The annual meeting of the Human Physiology Special Interest Group took place during the lunch interval of the "Control of Tissue Blood Flow and Metabolism" symposium at the King's College Meeting on Wednesday 20 December 1995. The symposium was well attended, with between 120 and 140 people present through the day. The preceding two days had seen a total of 35 Oral and 18 Poster Communications in the Human Physiology Designated Sessions. The Group therefore continues to grow and to be among the most active of the Society's Special Interest Groups. It was particularly pleasing to see strong representation from both Scandinavia and Italy at the Meeting.

It was agreed that the next Designated Sessions should take place at the Edinburgh (4-6 July 1996) and Sheffield (7-8 January 1997) Meetings. A Group Lecture will be arranged for the Edinburgh Meeting, and suggestions on possible lecture topics are sought. The only suggestion made at the Meeting was for a historical lecture on the early developments in some aspect of human, muscle or exercise physiology. The window for submissions for Edinburgh Meeting is 1-14 March 1996.

It was also agreed that a symposium should be organised for the Sheffield Meeting, subject to the agreement of the Society and the host Department. Tony Sargeant suggested a symposium on energetics of skeletal muscle contraction: this to be held in conjunction with the Muscle Contraction Special Interest Group if possible. Abstract submissions for Sheffield should be with the Meetings Secretary's Office between 4-17 September.

A request had been received for the Group to participate in a meeting of the Irish Section of the Nutrition Society - at a meeting to be organised in Dublin to coincide with the Eighth European Congress on Obesity. The ECO meeting takes place from 18-21 June 1997, and the proposed date for the meeting with the Irish Section of the Nutrition Society is 16-18 June. There was support for this being recognised as an official Session of the Human Physiology Special Interest Group which would allow access to funding for attendance. It was agreed in principle that the Group should participate in this meeting, and possible topics for a symposium that would be of mutual interest are being explored. Subsequent to this meeting, Bengt Saltin suggested that the Group may wish to attend the next meeting of the Scandinavian Physiological Society in Copenhagen, but the date for this is not certain at present.

Following the success of the Workshop "Blood Sampling and Analysis" held at Easter 1995, it was agreed to proceed with plans for a similar event on the topic of Cardiovascular and Respiratory Physiology in 1996. Unfortunately, the dates that had been identified (1-3 April) were a direct clash with the Alternative Muscle Club meeting. To avoid this conflict, it was agreed that another date should be sought, and fixed, in September. The Society has allocated funds to support the costs of this meeting.

- Moves are under way to develop a Laboratory Safety Manual for use in human physiology laboratories. This is being pursued in association with the British Association of Sport and Exercise Sciences. The intention is to cover the major issues relating to laboratory safety, with some additional material on ethical issues and on good laboratory practice. A number of people have volunteered to help with the preparation of individual sections of this manual, and Group Members willing to help with this should contact Ron Maughan.

There being no other nominations, the current Chairman of the Group agreed to continue for a further year.

Ron Maughan

MICROVASCULAR & ENDOTHELIAL PHYSIOLOGY

The December 1995 symposium on "Impaired Endothelial and Smooth Muscle Cell Function in Oxidative Stress", organised jointly by the Microvascular & Endothelial Physiology and Smooth Muscle Special Interest Groups, was a great success and extremely well attended. A large number of Oral and Poster Communications were scheduled during the course of the two-day symposium, the proceedings of which will be published in Experimental Physiology. The remaining Communications were held on Wednesday and resulted in further excellent discussion.

Seven nominations for a Pfizer Prize were submitted to the Meetings Secretary and you will be pleased to know that Luis Sobrevia from the Vascular Biology Research Centre at King’s College and David Andrew from the Department of Physiology, University of Bristol were awarded Pfizer Prizes for their Communications in the joint Microvascular & Endothelial with Smooth Muscle Session.

A joint national vascular meeting will be held at the University of Exeter, 17-19 April 1996. This joint meeting involves the British
Microcirculation Society, British Society for Cardiovascular Research and the Royal Society of Medicine Forum on Angiology. Although the abstract deadline has now passed, further information can be obtained from Professor John Tooke, Department of Vascular Medicine, tel (01392) 403045, fax (01392) 403027.

As regards the next Designated Session, I propose we hold this at either the Newcastle (20-21 November 1996) or the Sheffield (7-8 January 1997) Meeting. I welcome any further suggestions.

Giovanni E. Mann

MUSCLE CONTRACTION

Those of you who attended the Meetings would agree that the last two Designated Sessions of the Muscle Contraction Group were very successful. The one at Oxford, in particular, was very well attended and both the Oxford and the King's College Sessions included abstracts from a wide range of fields on muscle physiology. I thought that each presentation received adequate discussion, and hope that these trends will continue. The next Designated Session of the Group will be at the University College Meeting (16-18 April, 1996); others planned for the future are at Leeds (September, 1996) and at Bristol (September, 1997).

There is a proposal to hold a symposium on the general area of "Energetics of Muscle Contraction (from molecular to whole body level)"; the suggestion is to have a joint symposium with the Human Physiology Group. I would welcome views from Members on this proposal, and indeed on the contents of such a symposium, if it is considered worthwhile.

There is one further issue that I would like to raise at this stage; soon, it will be three years since I became the Convenor of the Muscle Contraction Group and I would like to hear from any Member who may wish to take on this responsibility within the next year or so. I look forward to seeing many of you at the UCL Meeting.

K W Ranatunga

NEUROENDOCRINOLOGY

At the Meeting of the Society held at King's College London just before Christmas there was a general session on neuroendocrinology and neurophysiology with a number of interesting papers and some lively discussion. The next Meeting to have a Designated Neuroendocrine Session and symposium will be the University College London Meeting. The symposium on the non-reproductive effects of gonadal steroids, chaired by Professor Julia Buckingham, will take place on the morning of 17 April, followed by a Poster Session in the afternoon. On the following day will be the Designated Session with 11 Communications and Professor Iain Robinson will give the G W Harris Prize Lecture on the neuroendocrine control of growth.

There will be another Designated Session at the Meeting in Edinburgh on 4-6 July. Preceding this Session the British Neuroendocrine Group will hold its annual meeting at which there will be symposia on "Seasonal Rhythms" and "Hormones and Emotions". Also, the Mottyn Jones Memorial Lecture will be given by Dr M Hastings from Cambridge. For further details please see the world wide web site http://www.phl.ed.ac.uk/bng/bng.html. Any enquiries should be addressed to Dr A J Douglas, Dept of Physiology, University Medical School, Teviot Place, Edinburgh EH8 9AG (email: bng96-organiser@ed.ac.uk).

Mary Forsling

RESPIRATORY PHYSIOLOGY

The King's College Meeting

A 9am start ensured a few bleary eyes as Dr Nye began the Session with his last Communication to be given as Convenor of the Respiratory Physiology Special Interest Group. The withdrawal of two communications, one due to author absence caused by the French 'General Strike' did not impair a lively morning of talks which, as usual, covered a wide range of topics and techniques. These included: a patch clamp study which implicated cytochrome P-450 in the chemotransduction mechanism of carotid body type I cells; a measurement of end tidal gas tensions in 216 Peruvian citizens who had either been born at sea level or had migrated to sea level from high altitude in possibly the only
Physiological Society Communication to have ever begun with a street map of downtown Lima; an investigation of mechanoreceptor localisation in the anaesthetised chicken; further heroic exploits from the London' passive' positive pressure ventilation volunteers and their PET scanner and a fascinating examination of chemoreflexes in the axolotl. The audience were certainly kept interested and the human and animal studies complemented each other on a number of occasions throughout the morning. The Session ended with the election, by show of hands, of the new Convenor and a vote of thanks to Dr Piers Nye, proposed by Professor Brian Whipp, in recognition of his work in establishing and maintaining the Respiratory Physiology Interest Group over the last ten years. Thanks again, Piers.

**Future Meeting:**
**Leeds, 11-13 September 1996**

The next Meeting of the Respiratory Physiology Special Interest Group will be at Leeds in September. If you have not received a letter to this effect then you are not on our mailing list. A simple email (p.kumar@bham.ac.u.k) message to me will guarantee that you are added for future correspondence. As this will be my first one as Convenor I will be very happy to listen to any suggestions for ways in which the Group could develop. Please note that the Cardio-Respiratory Group are also at this Meeting and should anyone be unsure which of the Designated Sessions to submit abstracts for, please contact either Dr Julian Paton or myself and we will probably both say “ours”. More importantly, Dr Paton and I will do our best to ensure that the Sessions do not overlap in time. I look forward to seeing you at Leeds.

**SMOOTH MUSCLE**

**Christmas Meeting, King's College London**

For this Meeting the Microvascular & Endothelial Physiology and Smooth Muscle Special Interest Groups joined forces in a very successful symposium on “Impaired endothelial and smooth muscle cell function in oxidative stress” with associated Oral and Poster Sessions. The symposium is discussed by Giovanni Mann in the report of the Microvascular & Endothelial Group, so we will limit ourselves to a brief synopsis of the Communications.

There were a considerable number of Communications relevant to our Groups over the first three days of the Meeting, with 45 Oral and 31 Poster Communications. It was particularly interesting to see the number of Communications relating to areas not often covered in our Sessions, for example on ischaemia, LDLs, and the endothelium, and it was generally agreed that the joint Sessions were of great benefit to both sides. A high proportion of the work presented dealt with various aspects of either the effects or the synthesis of that ubiquitous compound nitric oxide, which surely shows that this story is far from over. Members of the Smooth Muscle section were reminded that the vasculature does not stop at the level of the resistance arteries by the presence of several interesting Communications on the microvasculature, and microvasculature permeability, although Dr Burn-Murdock’s engrossing work on teeth-lengthening and eruption caused a certain amount of mental gear-shifting by those of us expecting more of the same ilk. There was also a smattering of papers on ionic channels, which was gratifying in the light of an entirely separate Session also running on this subject, and we are grateful that those Members chose to present their work in our Session.

In summary, this proved to be a very successful experiment, and we hope to have a similar joint Session in the future. However we also intend to have Sessions devoted to all those other types of smooth muscle that are not part of the vasculature, and one possibility put forward by our esteemed Meetings Secretary is to have one entitled ‘Smooth Muscle Below the Belt’.
Future Meetings:

We hope to have a Session at the Newcastle Meeting in November 1996, and possibly at the Edinburgh Meeting in July. We will write directly to Members on our mailing list as soon as these dates are finalised.

Jeremy Ward and Lucilla Poston

UK Myometrial Group: King’s College London

We were delighted to see representatives of nearly all laboratories in the UK who are involved in myometrial research at this Session of the Smooth Muscle Special Interest Group. Phil Bennett, from Queen Charlotte’s Hospital, gave a characteristically lively and informative introductory talk on the role of prostaglandins, and particularly of cyclooxygenase-2, in the onset of term and preterm labour. The scientific papers covered many aspects of the control of myometrial contraction, including effects of pH on ion channels (Susan Wray’s group) and the contribution of intracellular calcium stores (Jim Gillespie’s team). Dr Lopez Bernal’s impressive contribution (two Oral Communications and two Posters) included a description of how responses to PGE2 may involve a variety of signal transduction pathways through binding to different EP receptors, and suggested that a change in expression of two isoforms of the GsS proteins could play a role in altering myometrial function at term. Peter Nathanielsz came specially for the meeting from Ithaca, NY, and with his remarkably broad experience and understanding of this field, provided great stimulus to discussion throughout. His own paper showed that the heat shock protein, HSP70, is increased in sheep myometrium in response to oestradiol and he suggested that, in common with other steroids, oestradiol may form a transient complex with HSP70 and that this may play a role in oestradiol receptor activation. Could HSP70 be another potentially important element in myometrial control?

No meeting on the uterus is complete without an investigation on the Barker hypothesis - the fashionable theory which suggests that in utero events are all important in the evolution of adult disease. This was provided by Dr Symonds from Reading, who presented an interesting paper explaining how lambs from light weight sheep were also small. No meeting is complete without NO (nitric oxide) and Griff Jones’ data suggested that there was no functional NO in human myometrial smooth muscle.

The organisers (Jim Gillespie and Lucilla Poston) are most grateful to the charity, Tommy’s Campaign, which provided travel grants to a number of researchers who would otherwise have been unable to attend.

Future Meetings

We are aiming to have a Smooth Muscle Special Interest Group Session on the myometrium at The Physiological Society Meeting in Newcastle, 20-21 November 1996 (deadline for abstracts 1 August 1996). This, fortunately, will coincide with a symposium and Designated Meeting on Cellular Signalling which already has an impressive line up of expert speakers. Anyone interested in the myometrium is also encouraged to come to a symposium “The Problem of Prematurity” to be held at St Thomas’ Hospital, 2-4 September 1996, in association with Tommy’s Campaign’s National Pregnancy Week. There will be a session on myometrial contractility and an international group of speakers. Scientific communications will be by poster only and will not be published. Anyone on the UK myometrial group mailing list will receive information shortly. Anyone else who wants information, please contact Lucilla Poston at the Department of Obstetrics and Gynaecology, St Thomas’ Hospital, London SE1 7EH, tel (0171) 922 8328.

SOMATOSENSORY PHYSIOLOGY

The Workshop on “Techniques in Somatosensory Physiology” at King’s College in December was very well received. The talks were well attended throughout the day and most of the audience appeared to be young scientists, which is a hopeful sign. Steve Hunt made a good start to the proceedings with his timely overview of the functions of immediate-early genes in the nervous system. Sally Lawson and Sue Fleetwood Walker then took us through some of the technical pit-falls (and, more importantly, the ways around them) attendant upon trying to link chemical identity and function in sensory neurones, using immunochemical and in situ hybridization methods respectively. Jose Naranjo rounded up the morning session with a presentation on the use of antisense
oligonucleotides to block the expression of genes thought to be involved in the central progress of inflammation. The method works, but it is important not to overprotect the oligomers as this renders them neurotoxic. These talks demonstrated the potential power of techniques based on the identification and / or neutralisation of molecular events, and how naturally they complement the more traditional electrophysiological approaches employed by somatosensory physiologists.

After lunch the Workshop turned to newer ways of looking at problems via microelectrodes and behavioural observation. Anne King expounded the many virtues of in vitro recording methods (notably stability for intracellular recording; and the use of multicomponent preparations such as the isolated hindlimb-spinal cord); Hans-Georg Schaible provided a comprehensive critique of the popular animal models of human pain states and their applications; and Duncan Banks completed the day with a description of his (now successful) efforts to record from trigeminal sensory neurones in conscious, behaving animals. It is clear that we have yet to exploit the full potential of the in vitro and conscious animal recording methods, which seem to me to provide the most promising ways forward for electrophysiologists in terms of control of conditions for the former and closeness of approximation to real life, of the latter.

The talks were of a high standard throughout the Workshop and all speakers were generous in their provision of trade secrets. I hope those present were encouraged to consider taking a wider view of the technical options open to them when considering how to attack their own particular physiological problems.

After the rich variety of methods described in the Workshop, it was ironic that the Special Interest Group Session was entirely composed of Communications based on unreconstructed electrophysiology. This is not to say that they were not all very good! There were five Oral Communications, one Poster and Klaus Baumann demonstrated some of the spike analysis software he has written for the CED 1401. In the Oral Communications, Klaus Baumann (again) and Solomon Senok provided evidence that mechanotransduction in Merkel cells is dependent on calcium-induced calcium release, while Boris Chizh and Max Headley presented data which suggest that NMDA-type glutamate receptors are important in maintaining the “ongoing” activity of cells in the spinal dorsal horn, but not particularly so in mediating the responses to high intensity stimuli, in which one might predict they should have a major role.

The Group will next be convening at UCL in April, where Pat Wall is giving the Paton Lecture in the History of Physiology, and at Edinburgh in July, for which Sue Fleetwood-Walker has organised a symposium on interactions in somatosensory systems (see the last Magazine). The submission date for abstracts for UCL has already passed, but the Edinburgh deadline is 14 March 1996. Make a note for your diaries. After that, we will probably be on in Bristol next year.

See you at UC.

Rob Clarke
Richard Ribchester and David Price have organised a symposium on “Mechanisms of Synaptic Plasticity”, which will take place on the 2nd-3rd July, just before the main meeting of the Physiological Society in Edinburgh. The Symposium will focus on the regulation of structure and function of neural connections during development and after nerve injury. The main topics for discussion will be the roles of activity, neurotrophic factors and cell adhesion molecules in synaptic plasticity. The speakers represent a wide range of expertise in the field, from neuromuscular development and regeneration, hippocampal plasticity, and visual system development. Each speaker will make a 30-40 minute presentation of their recent work. Speakers include: J.W. Lichtman (St. Louis, USA); M.-M. Poo (San Diego, USA); R.R. Ribchester (Edinburgh, UK); W.J. Thompson (Austin, USA); P.Doherty (London, UK); T. Bliss (London, UK); R. Mainnow (Cold Spring Harbor, USA); T. Bonhoeffer (Munich, Germany); S. Grant (Edinburgh, UK); L. Maffei (Pisa, Italy); D.J. Price (Edinburgh, UK); C. Shatz (Berkeley, USA); D.J. Willshaw (Edinburgh, UK). Registered participants may submit abstracts for the evening poster session which forms part of the Plasticity Symposium. There will also be Designated Sessions on Cellular Neurophysiology and Developmental Neurophysiologist at the main Physiological Society meeting, to which members may submit Poster Communications.

There is a Registration Fee of £40 for the Symposium, payable by non-members of the Physiological Society. Members and Affiliates of the Physiological Society, or of our part-sponsors McDonnell-Pew Foundation, are exempt from the Registration Fee.

For further information contact Dr. R.R. Ribchester or Dr. D.J. Price, (Plasticity Symposium Organisers), Department of Physiology, University Medical School, Teviot Place, Edinburgh EH8 9AG. Fax: (44) 0131 650 6527; e-mail: R.R.Ribchester@ed.ac.uk or DPrice@ed.ac.uk

### FORTHCOMING PRIZE/MAJOR LECTURES

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<tr>
<th>Lecture Type</th>
<th>Date Range</th>
<th>Location</th>
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<tr>
<td>University College London</td>
<td>16-18 April 1996</td>
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<tr>
<td>Paton Lecture in the History of Physiology</td>
<td>17:30 Tuesday 16 April</td>
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<tr>
<td>Professor Patrick Wall (UMDS, St Thomas' Hospital, London). This lecture is being hosted jointly by the History of Physiology and Somatosensory Special Interest Groups. 'The historical perspective on the development of ideas on pain mechanisms'.</td>
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<td>G.W. Harris Prize Lecture</td>
<td>17:00 Wednesday 17 April</td>
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<tr>
<td>Professor Iain Robinson (National Institute for Medical Research, London) Provisional title: 'The neuroendocrine control of growth'.</td>
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<td>G.L. Brown Prize Lecture</td>
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<td>Professor Stuart Cull-Candy will be lecturing on 'Glutamate Channels and Synaptic Transmission' at the following institutions on these dates:</td>
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<tr>
<td>Bristol, Dept of Physiology</td>
<td>24 April 1996</td>
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<td>Leicester, Dept of Cell Physiology &amp; Pharmacology</td>
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<td>Liverpool, Dept of Physiology</td>
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<td>Institute of Neurology, London, Sobell Dept of Pharmacology</td>
<td>7 May 1996</td>
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<td>Strathclyde, Dept of Physiology &amp; Pharmacology</td>
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<td>Anyone wishing to attend should contact the relevant department for confirmation of date and time.</td>
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<td>Edinburgh</td>
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<td>Annual Review Prize Lecture</td>
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<td>Professor Michael Berridge (The Babraham Institute, University of Cambridge) 'Spatial and Temporal Aspects of Calcium Signalling'</td>
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<td>Joan Mott Prize Lecture</td>
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<td>Professor Maria Fitzgerald (Dept of Anatomy &amp; Developmental Biology, UCL) 'Pain and the Developing Sensory Nervous System - a short and long term view'</td>
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<td>The University of Edinburgh Sharpay-Schafer Memorial Lectureship</td>
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<td>Professor Bert Sakmann (Max-Planck Institute, Heidelberg, Germany) 'Excitatory Synaptic Transmission in the Neocortex'</td>
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<td>Leeds</td>
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<td>Keynote Lecture of the School of Medical Sciences, University of Leeds</td>
<td>11-13 September 1996</td>
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<td>Professor Bert Sakmann (Max-Planck Institute, Heidelberg, Germany)</td>
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Manned space flight began in 1961 and after more than three decades, there are still many questions to answer about the physiological responses to microgravity. One way of simulating microgravity in the laboratory is by bed rest with head-down tilt and Thais Russomano reports on cardiovascular studies using this technique.

We now take space flight for granted but exposure to the microgravitational environment of spaceflight (gravitational force $= 1 \times 10^{-2}$ to $1 \times 10^{-6}G$) produces numerous disturbances within the body ranging from effects on bone to fluid balance. However, those adaptive changes which occur in the cardiovascular and vestibular systems are of considerable concern since they are profoundly affected even for short duration flights.

**Redistribution of Blood**

The loss of the hydrostatic pressure gradients which exist in the cardiovascular system on Earth produces major changes in the distribution of blood and extravascular fluids immediately the astronaut is exposed to microgravity. There is a cephalad shift of fluid which reaches a maximum in the first 24 hours of flight. Measurement of lower limb girths and volumes suggest that between 1 and 1.5 litres of fluid migrate from the legs to the upper part of the body. This movement of fluid into the head and chest causes nasal congestion, facial oedema and increases the size of the heart, the resting heart rate, cardiac output and systemic arterial pressure. The increase in the central blood volume gives rise to an increased output of urine and a decreased intake of fluid. These adaptive changes occur during the first 3 to 5 days of flight and, by the end of the first week, the cardiovascular system has attained a new steady state with a reduced blood volume.

**Returning to Earth**

The adaptive changes which occur during exposure to microgravity impair the ability of the cardiovascular system to maintain the blood supply to the head when the individual is re-exposed to normal gravity upon return to Earth. Standing erect immediately after return to Earth produces a higher heart rate and a lower systemic arterial blood pressure as compared with the effect of standing erect prior to the exposure to microgravity. There is a decreased orthostatic tolerance and a reduction in aerobic exercise capacity after exposure to microgravity. This "cardiovascular deconditioning" has affected a number of astronauts on return to Earth, with effects ranging from tachycardia and hypotension to frank syncope.

**Simulating Microgravity**

Unfortunately, the microgravity of space cannot be reproduced on Earth. Many efforts have been made to create ground-based simulations and among them, bed rest is the most widely used. However, bed rest with head-down tilt elicits some of the physiological effects of microgravity with greater precision than does horizontal bed rest. A wide variety of experimental designs using head-down tilt have been employed to simulate microgravity with tilt angles ranging from 4° to 30° head-down with exposure times of the duration

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**Fig 1.**

Experimental Protocol. Valsalva manoeuvres were performed during the last 2 minutes of each position, excepting during head-down tilt.
minutes, hours, days and months. Comparison of the heart rate responses to 70° head-up tilt after exposure to microgravity with those following a 5 day period of bed rest with various degrees of head-down tilt by Kakurin et al. in 1976 suggested that a tilt angle of 60° best simulates the cardiovascular effects of microgravity. This experimental condition has subsequently been widely employed in the United States and Russia to simulate microgravity.

Our Head-Down Tilt Studies

The King’s College Microgravity Experiment was designed to investigate the effects of 6° head-down tilt upon cardiovascular and respiratory function. Studies in the literature of the cardiopulmonary responses to ground-based microgravity simulation are variable because these responses are influenced by the specific angle of tilt, the duration of exposure, and differences of sample size. I and my colleagues at King’s College, London conducted this study in order to explore how well 6 hours of 60 head-down tilt in our hands produces the physiological changes which occur in microgravity.

We used four athletic (A) and four non-athletic (N-A) subjects in order to study the influence of arterial baroreflex sensitivity on responses to microgravity simulation. Heart rate and arterial blood pressure responses to 70° head-up tilt for 10 minutes before and after a 6 hour exposure to 6° head-down tilt were determined (Fig 1). The arterial baroreflex sensitivity was investigated by having the subject raise the pressure in his chest for fifteen seconds (Valsalva manoeuvre), whilst measuring the heart rate and blood pressure (Palmero et al, 1981). The subjects were weighed at the beginning and the end of the experiment and fluid intake and urine output were recorded. Finally, the circumference of the calf at a fixed point on the leg was measured hourly throughout the study.

No important changes in heart rate or blood pressure occurred during the 6 hour exposure to 6° head-down tilt. Three of the subjects, however, lost consciousness and a further 2 subjects developed pre-syncope during the 70° head-up tilt conducted at the end of the exposure to 6° head-down tilt. All the subjects had completed the 10 minute exposure to 70° head-up tilt before the head-down tilt without exhibiting any symptoms or signs of pre-syncope. Three of the subjects who developed pre-syncope/syncope during the head-up tilt did so when they attempted the Valsalva manoeuvre.

The 70° head-up tilt after the 6 hour exposure to simulate microgravity produced a greater increase in heart rate than occurred in response to the procedure before the head-down tilt [Fig 2]. The reduction in arterial blood pressure produced by the 70° head-up tilt [Fig 3] was also more pronounced after than before the head-down tilt. Arterial baroreflex sensitivity tended to be reduced by the 6 hour exposure to 6° head-down tilt, which is in accordance with studies by Convertino et al. (1989) using a neck chamber. Overall the athletic subjects had a higher baroreflex sensitivity than the non-athletes.

The cephalad fluid shift produced by 6 hours of 6° head-down tilt was evidenced by a decrease in calf circumference at the end of the 6 hours. This shift stimulated a compensatory mechanism, via hormones, that increased urine output, causing a negative fluid balance and decreasing body weight. This reduction in total body water content decreased the orthostatic tolerance, when the cardiovascular system was stressed by tilting the subject into a 70° head-up position. The changes in the heart rate and blood pressure responses to 70° head-up tilt produced by the 6 hour exposure to head-down tilt obtained in our study were very similar to those reported by other investigators. The higher incidence of pre-syncope and syncope which occurred during the 70° head-up tilt after the exposure to head-down tilt was almost certainly due to the inclusion of the Valsalva manoeuvre.

Manned space flight began in 1961 when the cosmonaut Yuri Gagarin orbited the Earth in the Vostok-1 spacecraft. In the last three decades the need to sustain life and productive
human function in space flight has challenged scientists and researches in the fields of medicine and physiology. Many questions about the adaptation to microgravity and the post-flight readaptation to Earth’s gravity, however, remain unanswered. Studies have been conducted around the world regarding the effect of microgravity on red blood cell mass, muscle and bone metabolism, liver and renal-humoral function, the neurovestibular system, immune system and psychiatric issues. Extensive measurements have been made in space missions and spaciels of heart rate, blood pressure, blood volume, blood flow patterns, blood vessels characteristics and lung function.

The King’s College Microgravity Experiment allowed us to gain some insight into the effects of weightlessness. The effects of 6° head-down tilt upon respiratory mechanics and gas exchange in the lungs are to be studied during 1996. It is hoped to conduct more extensive studies of the effects of 6° head-down tilt upon arterial and cardiopulmonary baroreceptor reflexes in 1997. The results of this experiment and the ones to come in the near future will contribute to the current understanding of the physiological adaptations to space flight.

Fig 3.
Change of systolic (S) and diastolic (D) blood pressures produced by 70° head-up tilt before and after 6 hours of 6° head-down tilt.

References

UNIVERSITY OF LONDON

Royal Postgraduate Medical School (RPMS)
Department of Histochemistry
Charing Cross & Westminster Medical School (CXWMS)
Department of Pharmacology

MSc IN NEUROENDOCRINOLOGY

Full-time Course (12 months), starting September 1996.

This joint course will provide clinical and basic scientists (with a first degree or equivalent in medicine, dentistry, biological science or veterinary science) with advanced academic knowledge and laboratory training in the field of neuroendocrinology. The course comprises two taught modules, each of 10-12 weeks duration, and a 6 month laboratory based research project.

The course will be of value to both basic and clinical scientists, providing basic training for those wishing to pursue a career in scientific research. For medically qualified students, the course will provide a good background for further research and those aiming to become Clinical Neuroendocrinologists.

Up to three Scholarships (£10,500) may be awarded by the Royal Postgraduate Medical School to UK/EC students applying for this course. Applications must be returned by 30th June 1996.

ENQUIRES AND APPLICATIONS: The Registry, Royal Postgraduate Medical School, Du Cane Road, London W12 0NN, U K (Telephone: 0181 740 3118; Fax 0181 743 6764).
The use of transgenesis to modify the genome of mammalian species is now an established technique that has been with us since the early 1980's. Thousands of different transgenic lines have been generated, and these have been used to answer questions of basic biology and provide insights into the disease processes of animals and humans. A notable early achievement that served to validate the whole experimental approach was the demonstration of oncogene co-operation in double transgenic mice (see Murphy and Carter, 1993). However, for most biomedical scientists the term 'transgenic' is still virtually synonymous with transgenic mouse, and while there are good reasons for this perception - the technique was established in mice and perpetuated in studies of mouse development and genetics - it is important for physiologists to be aware that the rat is a viable alternative. The purpose of this article is to provide a brief update on developments within the field of mammalian transgenesis and also to consider the future of Rattus norvegicus as an experimental model.

The currently accepted approach of making transgenics is through the direct injection of naked, cloned DNA (the transgene construct) into the pronucleus of mouse eggs. This has remained unchanged over the years, and is described in several laboratory manuals including our own (Murphy and Carter, 1993). Based on this conceptually straightforward technique, the field has advanced through the imaginative design of constructs that have now provided numerous mouse models. Examples include binary transgenic systems, the generation of novel cell lines through targeted tumorigenesis, cell-specific ablation and inducible or repressible transgenes (see Murphy and Carter, 1993, Mullins and Mullins, 1991 for discussion of some models).

“Knockouts”

Foremost among the recent advances, however, has been the establishment of related techniques that permit mammalian gene targeting in pluripotent embryonal stem cells (ES cells) derived from the mouse blastocyst, producing the so-called “knockouts”. This powerful technology has attracted interest from across the biomedical research field and the many hundreds of knockout mouse lines that are deficient in specific, targeted genes have now been compounded (Brandon, 1995). Most recently, in the laboratory of Klaus Rajewsky, the technology has been advanced to permit both cell-specific (see Brandon, 1995) and inducible gene targeting.

While the body of research data generated in this area over the last five years is truly impressive, the flood of knockouts is surprising because it has necessitated the use of what is, for many, an unfamiliar and sub-optimal model, namely the mouse. The potential difficulties of working with this small rodent were evident in the early studies of learning and memory knockouts (see Brandon, 1995), and it is clear to many physiologists that the mouse presents manifold problems of experimental manipulation. Added to these practical difficulties, is the fact that in many fields, such as neuroscience, the comprehensive database of rat physiology and anatomy that has been built up over many years is not available for the mouse.

A New Alternative to the Transgenic Mouse

What of transgenesis in the rat? Following the groundbreaking work of John Mullins and colleagues in which a rat model of hyperten-
sion was produced (see Mullins and Mullins, 1991), there has been a remarkable dearth of transgenic rats reported in the literature. Pronuclear microinjection has proven to be somewhat more difficult with rat, compared with mouse eggs (Murphy and Carter, 1993), but an apparent technical obstacle does not appear to explain the fixation with mice.

Our work at the Institute of Molecular and Cell Biology in Singapore on vasopressin transgene expression in mice (Ang, Carter and Murphy, 1993) quickly led us to the conclusion that rats were a preferable model for physiological studies, and we have recently published our initial studies on transgenic rats (Zeng, Carter and Murphy, 1993). An important finding was the colocalization of rat vasopressin transgene mRNA with endogenous mRNA (Fig 1), indicating that we had successfully targeted specific neurons using our genomic promoter sequence. This result has therefore provided us with a strategy to direct the expression of chimaeric genes to specific groups of neurons with the aim of modifying neuronal function—an approach that may be similarly applied to any group of brain cells that exhibits a unique pattern of gene expression.

The potential of transgenic rats for physiological studies has also recently been demonstrated by the production of a new dwarf model in Iain Robinson’s laboratory (N I M R, London, UK: D M Flavell, T Wells, S E Wells, D F Carrignac, G B Thomas, I C A F Robinson; The Endocrine Society, USA, 77th Annual Meeting, abstract P2-239) that will enable exhaustive studies of hormone secretion which would not be feasible in a similar mouse model.

Just That Bit Bigger and Smarter

The constant discovery of new genes, many of which may be pivotal in complex disease processes, will ensure that investigators using mammalian transgenesis will be kept busy for many years to come. Now, it remains to be seen whether rats will be adopted by the transgenic research community. Knockout technology is not yet available for the rat, although ES cells, derived from rat blastocysts, are capable of contributing to chimeras (Iannaccone, Taburn, Garton, Caplice and Brenin, 1994). Rat knockouts cannot be far behind. However, it could be that the increasing sophistication of this approach in mice will ensure that the current trend away from the rat is maintained. The development of miniaturized technology for physiological investigations in transgenic mice, coupled with the rapid progress towards complete genetic maps of the mouse, could be taken as further evidence that the mouse will begin to serve as a general model for biomedical research. Alternatively, it may well prove that a comprehensive analysis of physiological and behavioural variables is simply not possible with the mouse, and that answers to the difficult questions of integrative biology will require a model that is just that bit bigger and smarter.

References.

Due to popular demand, we are following up last issue's article on the World Wide Web (WWW) with another more detailed article to help you find exactly what you are looking for on the Internet. If you remember, in the last issue we went through how to get a WWW browser such as Netscape configured and up and running. By now, you are probably wondering where all this good material is - that's supposed to be on the WWW. In this article I shall try to cover the most popular ways of locating information on any topic.

Perhaps the most frequently quoted concern about the WWW and the Internet in general is that there is no way of knowing where to find the information you want. You've read and heard just how much information is present on the Internet but all you seem to find is junk. One analogy for the Internet that I've heard used more than once is that it is like the world's biggest reference library, only with all the books piled in a big heap on the floor. Whereas that might have been true of the early days of the Internet, I think it is definitely not true today. Fortunately, and as a direct result of the popularity of the WWW, there are a number of well established indexing and abstracting services on the Internet that are literally only a mouse click away.

I think it is fair to say that by far the most popular browser software used to access the WWW is Netscape. Those of you that already have a copy of Netscape will have no doubt spotted the 'Net Search' button on the tool bar. If you haven't already, go ahead and press it and the myth about the lack of indexing the Web will be shattered. On the page that results you will find keyword searching services that index more than 90% of the WWW. Of these services the most popular by virtue of their completeness and speed are Lycos and Alta Vista (Table 1) though bigger and faster databases are increasing in number. I prefer to use Lycos as it's been around a long time so by way of illustration well take a look at a Lycos search.

Fig 1 shows the results of a Lycos search for the word 'physiology'. As you can see the search has turned up nearly 10,000 'hits', that is nearly 10,000 individual documents that contain the word 'physiology'. The Lycos system also returns a small 'abstract' from each hit which gives you some idea of the context of the search results. Rather than swamp you by returning all the hits at once, Lycos returns a few at a time. Usually you find what you are looking for in the first few dozen or so, so there is rarely a need to view all 10,000! Of course as with most good database search options, you can narrow down your search by combining keywords. A search for 'physiological' and 'society' turned up 40 and a search for 'physiology' and 'birmingham' turned up 24 so you can see that by carefully combining your search terms you can quickly find what it is you are looking for.
There is another way of browsing the WWW that doesn’t rely on keyword searches that can be just as useful as using large databases such as Lycos. These are the so-called ‘virtual library’ services and by far the most popular are the Virtual Library itself and Yahoo (Table 1). Both of these services present you with a hierarchical list of WWW sites categorised by subject. By traversing through the list of topics you can quickly arrive at the subject that most interests you and link directly to specific sites. The advantage of using these sites is that the individual speciality pages are maintained by individuals in that regularly work in that area or have that particular interest so that a number of sites that might otherwise be missed by a more general approach can often by picked up. A typical page from the medical subsection showing a list of physiology links taken from the Yahoo system can be seen in Fig 2. Each of the lines on the page contains a link to the relevant site.

So hopefully you can now see that armed with the knowledge of where to find abstracting and indexing services such as those described in this short article, you can quickly find just what you are looking for. There are a great many other ways of finding your way around the WWW and the Internet and hopefully this article has given you the confidence to seek them out. Happy hunting!

David Davies
Department of Physiology
The University of Birmingham

Table 1

Here are the URLs for all of the services mentioned in this article. You can also find online versions of these links at the NetWatch WWW Home Page (http://medweb.bham.ac.uk/netwatch.html).

- Lycos - http://www.lycos.com/
- Alta Vista - http://altavista.digital.com/
- The Virtual Library - http://www.w3.org/hypertext/DataSources/bySubject/Overview.html
- Yahoo - http://www.yahoo.com/
THE DO'S AND DON'TS OF GRANTSMANSHIP
A Guide for the Young and Not So Young

There can be few scientists in the UK who are not aware of the fact that funding for biomedical research is becoming increasingly difficult to obtain. With the pressure on University Departments to improve their research ratings, young investigators are encouraged to apply for ever more grants. As a result the Research Councils and Charities are receiving more and more applications every year. In the absence of increased budgets the proportion of successful applications every year. In the absence of increased budgets the proportion of successful applicants is necessarily falling.

As the scientific manager of a number of schemes at the Wellcome Trust, including the Physiology and Pharmacology Panel, I see a vast number of proposals every year - many of which are from young scientists with little experience of applying for grants. In the following paragraphs I have set out what, in my experience, constitute the 'do's' and the 'don'ts' of successful grantsmanship.

Avoid the 'Fishing Expedition' Approach

Whatever agency is dealing with your application, the most important consideration is that of scientific merit. Is the work novel, exciting, necessary? Inexperienced applicants often think that the more good ideas they put in their applications the better. This is not the case. What is needed is a highly focused, hypothesis-driven, question which is answerable in the time available. Expressions such as 'fishing expedition' are frequently used at panel meetings to describe applications such as 'fishing expedition' are frequently used at panel meetings to describe applications which, for example, a vast number of agents are to be applied to several different tissues and a variety of effects are to be investigated. Avoid studies which are diffuse and unfocused.

Having chosen the question which is to be addressed, you need to present some evidence that the project is 'do-able'. Pilot data, to demonstrate the feasibility of your approach, is always helpful, if not essential, especially when the experiments planned are somewhat speculative. This does not mean that you have to have almost completed the project before you apply, but just that you have undertaken a few preliminary runs. If this is not possible then you can always apply for funding for the pilot study with a view to putting in a larger application later.

Backgrounds and Plans

You are usually invited on the application form to describe the background to the work. This aspect should be well researched and documented. Modern computer data-bases makes this task much easier than previously. Make sure you are not repeating experiments that have already been undertaken, and that when you quote the work of others you are not parochial in your choice of examples. Do not just quote the work of your own laboratory. Don't forget that the application will be sent to experts in the field who can feel very aggrieved if they are not referenced or perhaps even worse, incorrectly quoted.

In the section outlining your experimental plan you should explain concisely, but explicitly, how you will carry out your experiments. Do not assume that the person reading the application is an expert on all the techniques you propose - the external referee may be, but the Panel members almost certainly won't. If you feel that the approach is so novel that it can really not be fully explained in the space available then I would ask the person handling the grant if you can include a short technical Appendix.

Not a Matter to Be Taken Lightly

Wellcome Trust application forms includes a number of pages where you are asked to justify various aspects of the funding requested. This section should be treated as seriously as the main body of the proposal. If you are using experimental animals then it is important to explain why the model you have chosen is appropriate and how you have arrived at the number of animals needed. It is not good enough to say that you can perform experiments, for example, on three days a week for forty weeks a year using three animals each day. Clearly you cannot know precisely how many animals will be required, but you need to show that your have paid careful attention to experimental design in your calculations. If you need research help then you should consider the scientific task in hand and request a level of expertise appropriate to that task. If you need additional expensive equipment then you really need to demonstrate that what you have in mind is do-able on that equipment. It seems everyone would like a confocal microscope, but few recognise the strengths and limitations of the technology involved. Try and obtain access to someone else's set-up and do a few pilot studies if at all possible.
Make sure that you have filled in the ‘housekeeping’ aspects of the form. It is very irritating for administrative staff to have to chase you on issues such as ethical permission, animal licences and whether you have applied elsewhere. If you have done the latter then own-up - we always find out in the end! The grant administrators in any organisation are crucially important to the smooth handling of your application so it is better for everybody’s sake to keep them on your side.

**Last But Not Least**

Finally, and this may seem glaringly obvious, check your form before you send it in for spelling mistakes, etc. Panel members and referees are infuriated if the date you put for a given publication is incorrect and they have to go rooting around in the library to find the correct article. Sloppy presentation is often equated with sloppy science! It is helpful to ask a colleague, not necessarily in the same field as yourself, to read your proposal before the final submission. This is useful, not just to check spelling and punctuation but also to ensure that you have presented a coherent scientific argument.

This is a brief guideline to help you with your application. I cannot guarantee that if you follow these instructions you will obtain funding, but if you ignore them you almost instantly won’t. My colleagues and I at the Trust are always available for advice if you need further assistance on any of the issues raised. Good Luck.

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**WHAT MAKES A GRANT APPLICATION GOOD AND WHY DO SO MANY FAIL? A PERSONAL VIEW.**

I am in my third year of serving as a member of the Wellcome Trust’s Physiology and Pharmacology Panel. Far from being just another time-consuming committee, it has been a real educational experience. Most applicants produce a good review of their particular field of interest, and I now know much more about what is happening in physiology generally than I did when I started. Indeed, I suspect the Trust has the raw material for publishing a high quality journal of current topics in physiology should both it and the applicants so desire!

**Essential ingredients**

So, what makes a grant application good? There seem to me to be three essential components. The first is a clear statement of the aims of the project. The second is a clear explanation as to why the aims of the project are worth achieving, I do not mean this in the narrow sense that they must be practically useful, but if they are not, then the intellectual interest must shine through, with a clear exposition of how the work will advance understanding within the field. The third essential ingredient is a clear description of the methodology that will be employed. In this, the applicant(s) need to convince both expert referees and panel members that the approach is appropriate, that it stands a reasonable chance of success, and that, if successful, it will achieve the stated aims. Other components are more peripheral. Some applicants are kind to referees by using a font size that is not a marvel of miniaturisation, by following the instructions on the form and by being detailed and reasonable in the support requested. Other applicants are less careful in these respects. While these factors may colour a referee’s view as to the care with which the project might be undertaken, they are not as fundamental as the first three points.

**Creativity and Failure**

So, why do so many grants fail? Well, first it is important to realise that funding is essentially competitive in nature. A perfectly good application may just not make it in the competition at a particular meeting. However, most grant applications fail in one or more of the three essential requirements outlined above. This is not, in general, any reflection on the abilities of the applicant, but rather because writing a good application which meets the points above is very hard. Doing science is a very creative occupation - this is probably why so many of us enjoy it so much. However, it also has many problems in common with other creative occupations. It is accepted that writers mostly produce mediocre books, artists mostly produce mediocre paintings and composers mostly produce mediocre compositions. Thus it is surely not surprising if scientists mostly produce research proposals that are not quite
of top quality. Critics and reviewers have the (much easier) task of pointing out these shortcomings, and of course the reactions of scientists to the comments of the reviewers can be very similar to those of writers, artists and composers to the critics.

How can applicants succeed? I believe that, as science relies so much on the creativity of individuals, there can be no recipe for this. My own approach, which I can testify is far from infallible, is to let things gestate for a considerable length of time, discuss ideas and proposals with colleagues, and allow the time I find necessary to spot the projects shortcomings before it goes anywhere near a grants panel. However, I have noticed other colleagues, probably more successful, who have a very different approach, and lock themselves away in a library for a few days, not surfacing for any other activities until the process is complete. Whichever is your approach, take heart from the fact that one or two flops does not mean that you cannot produce an application which succeeds.

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SHOULD ETHICAL COMMITTEES INITIALLY REVIEW SELF-EXPERIMENTATION?

An article by Philip Harrison entitled "Informed Consent in Human Experiments" (The Physiological Society Magazine (1995) 20:23-24) was of personal interest because, though not at the Keele Meeting, I have often asserted at other Meetings that approval by an Ethics Committee was, in principle, unnecessary for self-experimenters-a topic introduced but hardly resolved in the first paragraph of the cited article.

The Rise of Ethical Committees

It is unnecessary to refer at length to the remarkably creative period of physiological self-experimentation in the UK in the 1930's and 40's, as pioneered by Sir Thomas Lewis and his colleagues, J B S Haldane and others. Ethical issues hardly arose, much less were debated during this era. However, after World War II, Ethics Committees multiplied as a reaction clearly to the Nazi experiments on humans. Initially, little was publicly revealed of the Japanese experiments on prisoners of war. Also, later revealed, were ethically unjustified experiments in the USA, the Soviet Union (exposure to atomic radiation) and elsewhere. In the rush to dissociate themselves from the Nazi era, Ethical Committees rarely, if ever, differentiated between experimentation on oneself and on other groups such a healthy 'volunteers' (including prisoners) and patients. I believe the failure to make this distinction has replaced a practical reality by the superficial and false comfort of a uniform ethical code governing all human experimentation.

Testing for 'Informed Consent'

As an example, transcranial magnetic stimulation was first demonstrated in humans (Barker et al., 1985, J. Physiol, 369:3). Ideally, an Ethics Committee would initially have been provided with information accurate enough for a sound evaluation. That is, information related to both the feasibility and safety of this proposed new technique for stimulating the unexposed human brain. The safety issue was convincingly addressed by Barker and at least partly resolved by comparing energy transfers in ECT and with magnetic stimulation. The unanswered question would have been (and still is) whether very large magnetic pulses have delayed effects on the brain; i.e., apart from the acute effects of the induced electric field. The feasibility issue would have required knowing both the distribution of the induced electric field in a bounded, inhomogeneous volume conductor - the human brain - and the existence of low threshold, axonal excitation sites, e.g., at bends. However, such information did not exist in 1985 prior to the first successful human test. In general, the more novel the technique, the greater the difficulty in providing an Ethics Committee with all the information needed for their 'informed consent'. Putting the coil on the head of a self-experimenter and energising it resolved the issue.

I suspect that in many, if not all laboratories using transcranial stimulation, experiments are first worked out on a collaborating group, which only later reports to their local Ethics
Committee. Otherwise, how could one justify proposing experiments initially on volunteers or on patients, which could previously have been tested on oneself and collaborating colleagues? Often, major improvements in the original design stem from an initial testing.

**A Collaborator or Volunteer?**

The problem arises of defining a collaborator versus a volunteer. Clearly, one can be a volunteer without being a collaborator. Collaboration implies enthusiasm for and an intellectual interest in the experiment, which includes a critical attitude towards its design, execution and in the subsequent data analysis. Can one be a collaborator without truly volunteering? I suggest that in these politically correct (and litigious) times, it is more difficult for senior faculty to press gang their juniors than it is for senior faculty to refuse gracefully to be subjects in a project of a junior faculty member.

Not all types of research are suitable for self-experimentation. Few oncologists would entertain taking a full course of cytotoxic drugs before proposing chemotherapy for patients. Initial testing on animals or animal tissues necessarily has to replace self-experimentation and is indeed unavoidable. Happily, many experiments in human physiology are safely performed on oneself and colleagues; there, the problems include the biases of age, sex and more subtly, when higher cognitive and emotional functions are studied, the personalities of the self-experimenters and their expectations may influence the results.

Finally, should not self-experimenters be protected from themselves? In democratic societies where freedom of choice is treasured, the absurdity of such a paternalistic attitude to regulating human conduct is soon apparent. For example, adult smoking and drinking alcohol in private would also have to be regulated as potentially self-destructive acts, which self-experiments by experienced investigators have rarely been. Clearly however, an institution would have no liability to self-experimenters for self-inflicted damage in experiments which had not been authorised by an Ethics Committee.

**The Personal Experience Factor**

In summary I propose that we try to prevent the spread of a ‘Gresham’s Law’ diluting ethical decisions on human experimentation. Pilot self-experiments by experienced investigators need not be initially reviewed by an Ethical Committee, but should be later reported to the Committee, especially if harm results. Otherwise, compromises made in the interest of ‘creative flexibility’ can too easily infect the process when later applied to volunteers and patients. Wherever feasible, such pilot experiments should precede the development of a protocol for volunteers and patients, thereby ensuring an increase in detail and, overall, a stricter protocol that can only come from personal experience.

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**LETTER TO THE EDITOR**

**Guidelines for the Conduct of Human Experiments**

Dear Editor,

In a recent issue, Dr Philip Harrison provided a timely description of the dilemmas involved in checking that local ethics committees had approved the studies of human physiology communicated to the Society. He noted that the provision of informed consent is paramount. Increasingly, at least in Australia and Canada, courts have taken the view that all potential risks must be explained to the recipient of a procedure. This includes those serious risks which have a very low probability of occurrence. Often the precise probability cannot be known accurately. Experimenters must be particularly careful not to fail to warn of such risks. This places a seemingly greater burden on those performing such experiments, but it is required for the term ‘informed’ consent to have any useful meaning. The threshold for what constitutes a material risk has been lowered and, in some countries, the former defence that the disclosed risks were those judged to be relevant by a group of ‘reasonable’ physiologists or medical practitioners would no longer hold.

As a result of these trends, a working party of the Editorial Board of the Journal of Physiology (Simon Gandevia, John Rothwell, Janice Marshall and David Jones) has reviewed the guidelines for the conduct of human experiments. A summary of this material is published in the Notice to Contributors in the first issue for 1996. While they cannot do much more than clarify some aspects of the Declaration of Helsinki, their intent is to remind experimenters of their somewhat onerous responsibilities.

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A hundred years ago Ernest Starling published his seminal paper on the forces which determine fluid movement across the capillary wall. How did he reach his conclusions and have they stood the test of time?

STARLING’S HYPOTHESIS - THE PROLOGUE

1996 marks the centenary of Starling’s paper on ‘The absorption of fluids from the connective tissue spaces’ (Starling 1896). Here he suggested that differences in the hydrostatic and protein osmotic pressures across capillary walls determine the direction and magnitude of fluid movements between the blood and the tissues. As the years have passed, the explanatory power of Starling’s proposal has grown. Its confirmation in many different circumstances has led to it being regarded now as Starling’s principle rather than Starling’s hypothesis.

Starling’s 1896 paper was really the culmination of a series of investigations on the formation of lymph. Lymph was a ‘hot topic’ in the second half of the last century. It was seen as the fluid which bathed the cells and carried the secrets which kept them alive. Medicine, also, provided an incentive to discover the nature of lymph formation. Dropsy (or oedema) was a clinical sign of a number of fatal diseases and to discover how oedema developed offered the promise of a better understanding of these conditions. In the early 1890’s, lymph was believed to be a secretion of the capillaries into the tissues but twenty to thirty years before this, a simpler mechanisms had been considered.

The Ultrafiltration Hypothesis: Ludwig and Cohnheim

Around 1860, Carl Ludwig (1858-61) proposed that lymph was formed by filtration through capillary walls. In support of this hypothesis, lymph flow from a perfused organ could be increased by increasing the perfusion pressure and in intact animals, lymph flow could be increased by increasing local venous pressure. There was, however, no correlation between lymph flow and arterial pressure. This did not perturb the experimental pathologist, Julius Cohnheim, from expounding the filtration theory in his Lectures on General Pathology (Cohnheim, 1889). He reasoned that because the major variable resistance to blood flow in the circulation lay between the arteries and the capillaries, the relations between the arterial pressure and the capillary pressure are not simple in the intact animal. Thus, the failure of lymph flow to correlate with arterial pressure was not inconsistent with the filtration hypothesis since this required that capillary pressure, not arterial pressure, would determine lymph formation.

There were, however, difficulties with the filtration hypothesis. While there was a continuous flow of lymph from visceral organs, lymph flow from the limbs of a resting animal, (although present in venous congestion) was negligible when venous pressure was low, even when the tissues were obviously well perfused with blood. What was preventing the appearance of lymph under normal resting conditions? Cohnheim (1889) considered the possibility that the ‘albumen’ (protein) concentration of plasma might be responsible. He quoted experiments by Runeberg who had shown that ‘solutions of albumen filter more readily, the less concentrated that they are’ through membranes of rabbit intestine in vitro. Without using the term osmotic pressure, Cohnheim suggested that albumen (proteins) reduced the ‘diffusibility of the blood’ inhibiting exudation of fluid from the blood vessels.
Cohnheim then discounted the importance of "albumen" as the factor opposing filtration. Two experiments led him to do this. First, he found that diluting the circulating blood of a dog by infusing large volumes of 0.6% NaCl lowered the plasma protein concentration, gave rise to oedema of the viscera but did not promote lymph flow in the limbs. Second, he observed that when he perfused an organ such as a rabbit’s ear with diluted plasma, oedema would not develop if he kept the perfusion pressure low enough. Cohnheim concluded that the primary reason why no lymph formed in the tissues of the resting limb was because the capillaries here had low permeabilities to fluid. In the viscera, capillary permeability was much greater, hence the continuous flow of lymph from these organs.

Cohnheim’s speculation about the different permeabilities of visceral and limb capillaries was correct but it appears to have deflected him from understanding the role of the plasma proteins. In summarising his views, he acknowledges that ‘hypoalbuminaemia’ may predispose the tissues to oedema but suggests this may be because prolonged hypoalbuminaemia increases permeability. There is no indication that he appreciated that the difference in protein concentration across the vessel walls could be responsible for a force which opposed filtration.

It is at this point that Starling appears in the story. In 1892, he worked for a few months in Heidenhain’s laboratory in Breslau. He was obviously not convinced by the secretory hypothesis of lymph formation and returned to London to repeat and extend Heidenhain’s experiments. Through experiments with Bayliss (Bayliss & Starling, 1894) he clarified the relations between arterial venous and capillary pressures (estimated very indirectly). This information enabled him to reinterpret Heidenhain’s observations of increased lymph flow in terms of increased filtration through different capillary beds either as a result of increased microvascular pressures or increased microvascular permeability. Furthermore he identified the error of comparing simultaneous concentrations of a substance in the lymph and the plasma under conditions when the plasma concentration is falling.

A beautiful account of the experimental basis of Heidenhain’s theory and Starling’s reinterpretation of it can be read in Henry Barcroft’s Bayliss Starling Lecture (Barcroft, 1976).

**Filtration and Reabsorption: Starling Alone**

Before Starling’s 1896 paper, most physiologists believed that tissue fluids were formed by filtration or secretion at capillary walls and after percolating through the tissues, were drained away in the lymphatics. Having satisfied himself that filtration (not secretion) was the mechanism of lymph formation, Starling now examined whether tissue fluids could be absorbed directly into the blood. Some experiments carried out by Starling himself and by his colleague at Guy’s Hospital, J B Leathes (1895), showed that intravascular injection of hypertonic solutions of glucose and...
saline could shift fluid from the tissues into the circulation. But Starling was thinking of more physiological or pathophysiological events. Cohnheim had argued that the fall in haematocrit and plasma protein concentration, which are seen after an experimental animal has been severely bled, are a result of the absorption of fluid from the tissues into the blood.

Starling was convinced by this and it was one of the starting points in his 1896 paper. He pointed out that the dilution of the blood after haemorrhage could not be accounted for in terms of increased lymph flow, since thoracic duct flow was reduced in this condition. He also showed that dilution of the blood occurred after removal of the abdominal viscera, concluding that absorption of fluid by the blood vessels takes place throughout the body.

Starling then described experiments demonstrating the relatively rapid absorption of a 1% sodium chloride solution from the tissues of a dog hind limb into the blood perfusing it. He showed that serum cannot be absorbed rapidly from the tissues and after considering the possibility that absorption was driven by a higher hydrostatic pressure in the tissues than in the capillaries, put forward his hypothesis that fluid absorption into the circulation was determined by the protein osmotic pressure of the plasma. The paper finishes with a description of his measurements of the osmotic pressure of serum proteins and a succinct statement of the physiological implications of his hypothesis.

Starling saw the importance of his discoveries to medicine and had the opportunity to publicise them in the Arris and Gale Lectures to the Royal College of Surgeons. These were published in the Lancet in 1896 and 1897. He also wrote a scholarly review of the subject of Lymph Formation in Schäfer’s Textbook of Physiology (Starling 1898). Today his experiments and his arguments seem convincing but his contemporaries were not persuaded so readily. The English translation of Luciani’s Textbook of Human Physiology, (published in 1911) (Luciani, 1911) devotes a substantial section to Lymph Formation. The writer sets out Heidenhain’s secretory hypothesis at length and while admitting Starling had corrected some of Heidenhain’s interpretations, does not support Starling’s conclusions. It seems that initially Starling’s hypothesis appeared too mechanical and too simple!

Fortunately one or two important principles in physiology are simple. It may take an unusual figure such as Starling to identify them but, in this case, one hundred years later, we appreciate his achievement.

References

History lessons predict a less than golden age
Tom Wilkie observes that state funding of science has diminished dramatically over the last 16 years of “abusive neglect” by a Tory government, but warns that a change of government is unlikely to restore science to a “Golden Age”. Three recent analyses of science suggest that we are moving into “an age of post-academia science” in which most research will be paid for by commercial companies.

Independent 9 January 1996 Section 2 p.15

Source: SPIN
One hundred years ago Ernest Starling, then 30 and a lecturer in the Physiological Laboratory at Guy’s Hospital, published a key paper which still underlies our understanding of fluid distribution between plasma and the interstitial compartment, and hence clinical oedema. Starling’s paper was seminal, (albeit with antecedents from Ludwig, Cohnheim and others (review, Michel, 1984)), because it established the basic rules governing fluid movement across the walls of capillaries. A later interpretation, however, which is widely reproduced in most of today’s textbooks, is open to serious doubt and, it should be noted, was not proposed in the paper of 1896. This centennial article briefly traces what Starling actually did and said in this his first major research area, describes how the longitudinal (axial) filtration-reabsorption figure of our textbooks (Fig 1a) subsequently arose, and how work on interstitial forces over the last two decades has cast doubt on the longitudinal near-balance concept (but not on Starling’s original hypothesis), raising many other questions.

What Starling Did

The key paper being celebrated here (and by the Starling Centennial Symposium; see notice in this issue) appeared in 1896, in volume 19 of the young Journal of Physiology (pp 312-326). It was entitled ‘On the absorption of fluids from the connective tissue spaces’. In it Starling, the sole author, described what happened when isotonic saline was injected into the connective tissue spaces of a dog hindlimb, while the limb vasculature was perfused artificially with recirculating blood at 65-85 mmHg arterial pressure. Haemodilution developed in the isolated blood circuit, showing that capillaries can directly absorb isotonic fluid, rather than it returning via the lymphatic system. This did not happen when serum rather than saline was injected interstitially; and in a non-oedematous, perfused control limb there was slight haemoconcentration, revealing net capillary filtration.

Thus Starling established that the microcirculation can directly absorb an isotonic crystalloid solution but not a colloid-rich solution. He then argued as follows. Since the capillary wall is ‘more or less impervious to proteids’, it is essentially a semipermeable membrane and the plasma proteins (colloids) must exert osmotic pressure across it. This enables capillaries to absorb interstitial fluid by osmosis when conditions are right, i.e. when interstitial colloid osmotic pressure is low, as in the oedematous dog leg and in ‘dropsical fluids’. To support this argument quantitatively, Starling made the first ever...
measurements of serum colloid osmotic pressure (a slow business, a measurement taking 3-4 days as opposed to 3-4 min with modern electro membrane osmometers) and found that it was of similar magnitude to capillary blood pressure. He concluded: 'Here then we have the balance of forces necessary to explain the accurate and speedy regulation of the quantity of circulating fluid'.

How Views on 'Starling Balance' Developed

Starling's hypothesis was confirmed quantitatively in 1927 by Landis, then a medical student at the University of Pennsylvania, who devised an elegant experimental method involving micropuncture of frog mesenteric capillaries (a tissue with an honorable role in capillary research) to measure pressure directly. Landis showed that capillary filtration rate, calculated from red cell movement along a blocked capillary, is directly proportional to the difference between capillary pressure and plasma colloid osmotic pressure. Quantitative confirmation for mammalian tissue was provided by Pappenheimer & Soto-Rivera in 1948 (see Landis and Pappenheimer’s classic review of 1963). This quantitative work in the U.S.A. led to the now familiar, and correct, algebraic statement of the Starling principle (no longer a hypothesis), namely that filtration rate per unit capillary surface area, \( J_v / A \), depends on wall conductance, \( L_w \), and on the sum of four pressures acting across the wall at a given point in space and time-

\[
J_v / A = L_w \left[ (P_c - P_i) - \sigma (\pi_t - \pi_i) \right]
\]

where \( P_c \) and \( P_i \) are the pressures of capillary blood and interstitial fluid respectively, \( \pi_t \) and \( \pi_i \) are the osmotic pressures of plasma proteins in plasma and interstitial fluid respectively, and \( \sigma \) is the osmotic reflection coefficient of the capillary wall to protein. The latter is less than 1, because the wall is 'leaky' to protein i.e. is an imperfect semipermeable membrane, just as Starling had recognized. This turns out to be of crucial importance, because it means that the colloid osmotic pressure of interstitial fluid attains a substantial magnitude in most tissues. Starling recognized this too, yet many textbooks contain statements to the contrary (see later).

Fall In Pressure Along a Capillary, Leading to Idea of Exchange 'Balancing' Out Axially

On a visit to Sir Thomas Lewis's laboratory in London, Landis applied his frog micropuncture method to human skin capillaries and showed that capillary pressure falls with distance along the capillary axis. For vessels at heart level \( P_c \), at the arterial end of the capillary exceeds \( \pi_P \), at about mid-capillary the two pressures are equal, and at the venous end \( P_c \) is less than \( \pi_P \) (Fig 1a). However, this does not apply below heart level (the majority case in upright man), because gravity raises capillary pressure.

The implications of the longitudinal pressure gradient for heart-level capillaries seemed clear, and led to the version of 'the Starling hypothesis' that is currently widely taught. In this form, it is argued that interstitial hydrostatic and colloid osmotic pressures are small and negligible, and that the downstream (venous) segment of the capillary bed must therefore be in a state of sustained absorption (because \( P_c \) is less than \( \pi_P \)), reabsorbing most of the filtrate generated by the upstream (arterial) segment, where \( P_c \) exceeds \( \pi_P \). This 'spatial' view of fluid balance was not proposed by Starling in 1896, but two years later, in an account for Schäfer’s Textbook of Physiology, Starling did suggest the idea briefly, in a two-sentence paragraph.

Importance of Interstitial 'Forces'

The axial balance hypothesis has two flaws, namely the neglect or underestimation of interstitial forces (Starling himself pointed out that lymph protein concentration is not negligible, being typically 25%-38% of plasma concentration), and the neglect of gravitational effects below heart level. Relatively little was known about interstitial forces at the time of the landmark Landis-Pappenheimer review of 1963, and the axial, out-and-back-in version of Starling's hypothesis was advanced in their influential article, with \( P_c \) taken as 1-9 mmHg (we now know it is subatmospheric in many tissues), \( \pi_t \) as 1-5 mmHg by indirect estimation, and \( P_i \) as 32 mmHg (arterial end) to 15 mmHg (venous end) as measured by Landis in human skin. The authors carefully pointed out that this scheme was proposed 'with equal or greater licence', but their caution was often ignored by others subsequently. Soon after this, the results of new methods began to emerge for measuring interstitial Starling terms, begin-
ning with Guyton’s seminal demonstration of subatmospheric $P$ values in many (not all) tissues. This led to a gradual recognition that the influential Landis-Pappenheimer diagram utilized interstitial values that were substantially incorrect for many tissues.

Sums and Doubts Following Direct Interstitial Measurements

Chronic, implanted capsule methods to measure interstitial pressure were developed by Guyton’s group in the U.S.A., while Aukland’s group in Norway contributed acute wick-based methods applicable to man, both to measure interstitial pressure and to sample interstitial fluid for colloid osmotic measurements (Reed et al., 1995). Some of the findings have been dramatic, notably the recent discovery of hugely negative (subatmospheric) $P$ values immediately after a burn injury, contributing to the very rapid formation of oedema (see Reed, in Reed et al., 1995). In normal tissues, more and more groups around the globe began to note, often in passing, that the Starling sums did not add up (literally) to a net absorption pressure in the venular segment, even at heart level.

A few years ago I reviewed fourteen sets of data where values for $P$, $\sigma$ and $\pi$ were available within the same tissue (Levick, 1991). Discounting certain specialized sites (e.g. renal peritubular capillaries, see later), it emerged that the net pressure opposing blood pressure and promoting absorption, namely $\sigma P + \pi$, was smaller than the filtration-promoting venular blood pressure in every case. Fig 1b shows the same result for a fifteenth case reported recently, namely the integument of the human arm. Thus, simple Starling sums based on published data provide no support for the widespread belief that downstream vessels are in a state of sustained fluid absorption in most tissues at heart level. On the contrary, a slight net filtration pressure seems the general rule. The reason is primarily that the hydrostatic and osmotic pressures of interstitial fluid are not in fact negligible in most tissues.

Theoretical Predictions; Exchange Buffering by Interstitial Colloid Osmotic Pressure

The generality of the above finding implies an underlying reason, and by 1984 Michel had already shown by a theoretical analysis that the reason is the finite protein permeability of the capillary wall, for most tissue architectures. His analysis indicated that downstream reabsorption should only occur, in most tissues, as a transient event (e.g. after haemorrhagic hypotension, as Starling noted) and not as a sustained, steady state. Without going into the governing equations the reason is, essentially, that $\pi$ is not a constant but a variable (as indeed is $P$) whose magnitude is linked to capillary filtration rate - see Fig 2. Protein is continuously escaping across the capillary wall, and is diluted in the interstitium by the concomitant flow of water across the wall. So if water filtration rate falls, interstitial $\pi$ rises (less dilution of the leaking protein). Put another way, the wall is a leaky macromolecular sieve, and the slower the filtration rate, the less effective is the molecular sieving, because the protein ‘leak’ increasingly influences concentration in the filtrate. This effect had already been demonstrated by several groups in the U.S.A., notably those of Taylor and Granger, and of Renkin, and is illustrated in Figure 2. Extending this line of
Direct Transcapillary Flow Measurements Back Up Theory

Perhaps even more persuasive than theory for many of us is experiment. To be anecdotal for a moment, I remember that when I began to work on single mesenteric capillaries in Charles Michel’s laboratory in the late 1960s, observation of red cell movement after blockage of autoperfused capillaries commonly revealed filtration or else negligible fluid transfer rate, but rather to our surprise we never convincingly saw absorption. Michel and Phillips studied this much more systematically in 1987 and their results strongly supported the theoretical argument above. They showed, experimentally, that absorption in a single, directly observed capillary cannot be sustained by lowering \( P_c \) below \( \pi_D \). Using a modification of Landis’s red cell method to measure filtration/absorption rate in individual capillaries of the frog mesentery, they found that lowering \( P_c \) below \( \pi_D \) produces an initial transient absorption, in some minutes of perfusion at low pressure, when interstitial forces have adjusted (steady state). Frog mesenteric capillary results of Michel & Phillips (1987) J. Physiol. 388, 421-435, by permission. Inset sketches represent capillary-interstitial system in cross-section, with dot density representing concentration of plasma proteins. Intestinal protein concentration was initially low (due to a prior filtration state), allowing fluid absorption (straight arrows). Protein reflection (hooked arrow; reverse molecular sieving) then leads to a rise in interstitial concentration which abolishes absorption (steady state sketch). The lung is a major example of this very situation; the lung produces filtrate (lymph flow) even though pulmonary \( P_c \) is much less than \( \pi_D \).

If the ‘Textbook Diagram’ of Fluid Balance is Rejected, What Then?

Putting together the evidence - Starling sums that include interstitial values, theoretical considerations and direct fluid flux measurements on single capillaries - it seems that the popular concept of a spatial, longitudinal fluid balance creating a steady state (the out-and-back-in hypothesis) may fall into the realm of ‘factoids’ for many tissues. (A factoid looks like a fact, is respected as a fact, and has all the properties of a fact except that it is not true”; Oliver Rackham in ‘The Illustrated History of the Countryside’). If downstream reabsorption cannot be sustained, however, we are left with the fascinating puzzle as to how tissues achieve fluid balance. Part of the answer is, of course, lymphatic drainage. But quantitative considerations indicate that lymph flow is too low to provide a complete answer. It is conceivable that active vasomotion of precapillary resistance vessels might also contribute to fluid balance, by intermittently lowering capillary pressure and so generating transient absorptive episodes. In that event tissue fluid balance would have a
temporal rather than spatial basis. Other problems still to be fully resolved include the nature of the crucial macromolecular transport process across the capillary wall (large pores or vesicular transport?), and the nature of 'pores' responsible for the semipermeable properties of the capillary wall. The current model of the latter, namely a fibre matrix superimposed on intercellular clefts and fenestrations, invites further development. It seems that plenty of exciting challenges remain for Starling's successors well into the next century of research.

How Might Starling Have Viewed These Developments?

Perhaps without surprise, as indicated by the following quotation from his 1896 paper, ‘With diminished capillary pressure there will be an osmotic absorption of salt solution from the extravascular fluid, until (my underline) this becomes richer in proteids; and the difference between its (proteid) osmotic pressure and that of the intravascular plasma is equal to the diminished capillary pressure.’ Starling thus clearly recognized, in 1896, the importance of interstitial forces and their readjustment as a buffering mechanism to counter the effects of low or high capillary pressures.

References


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A Hundred Years after Starling

Thursday 25th April 1996
at the Wellcome Building, 183 Euston Road. London NW1 2BE

One hundred years ago, Ernest Starling suggested that the blood is held in the microcirculation by a small osmotic pressure which arises from the greater concentration of proteins in the plasma than in the interstitial fluids. Throughout this Century, Starling’s hypothesis has been challenged, confirmed and extended so that now it can be regarded as Starling’s Principle though aspects of fluid balance in some tissues still present problems. Speakers at this symposium will describe some of the more recent advances: from the unexpectedly large changes of interstitial pressure in injured tissues and the cellular modulation of microvascular permeability to the potential role of ‘Starling forces’ in specialised body cavities and in the kidney in the regulation of blood volume and blood pressure.

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A DAY IN THE LIFE OF A PhD STUDENT

The day begins abruptly by the sound of my alarm clock blasting out "Yankee Doodle Dandy...". I bolt upright and remove the offending noise from my ears. Peace at last, but not for long, as it goes off again nine minutes later. The brain cells then start to slowly recall that if the alarm has gone off then it must be a work day. AHHH!!!!. Fall out of bed, stumble downstairs into the kitchen and head straight for the kettle, a serious caffeine fix is required before I leave the house. Fifteen later I leave the house and join the rest of the population of Leeds contemplating the day ahead.

Eventually the lift arrives at Level 11 of the medical building after stopping at every floor. Only eight hours of pure chaos before I can go home. Time for another caffeine fix. All I have managed to do is make it into work and switch on the light in my office so The Boss will know that I am around somewhere! Having taken a gulp of my second cup of coffee for the day I take a deep breath and venture towards Val’s office. I remember Val rubbing her post-doc hands with glee when she discovered that I had got funding for my PhD. Her devious brain was thinking that now she had a menial job to do all the little jobs that she never gets time to do. I also double up as scapegoat when anything goes wrong. Never mind maybe I’ll be a bossy post-doc myself one day.

It is an easy day today as we’ve only planned one experiment. We trot off to the physiology lab and set up for another day of observing twitch in skeletal muscle. I first got interested in muscle when I did an Honours project in this lab. Now I find the mix of different techniques refreshing. I’m doing some histology, looking at the location of various enzymes within the muscle after several days or weeks of treatment. I’ve recently embarked on some molecular biology, measuring the expression of oncogenes after just a few minutes or hours of treatment.

Today I’m doing some work measuring power and force from muscles in vivo, using a relatively new technique, known as the oscillatory work loop technique. This method takes into account the normal, physiological behaviour of the muscle, such as shortening induced deactivation and stretch enhancement of force generation, which classical techniques like isometric and isotonic cannot do. It’s quite nice to actually see the muscle’s move rather than just measuring things in a test tube or an organ bath.

One of the reasons why I chose to do physiology as my first degree, and also to continue with it for my PhD was that I enjoyed finding out how the body works and being able to link this knowledge to real life. My project is looking at the effects of eccentric and concentric exercise and, unusually for a first year PhD, we’ve got a pile of results. Knowing what to do with them now is a bit of a problem, though and I’m trying desperately to understand some advanced statistics. This term there’s also an honours student working on a project related to mine. Of course I’ve been roped in to help with the supervision. Having to explain everything from first principles to a new-comer has certainly made me think a lot about the basic science behind my project.

At last the end of the experiment. My stomach lets out another huge growl, and by now it’s past one o’clock and the delightful selection of sandwiches from the medical school canteen has dwindled down to egg salad. In preference I opt for a healthy, nutritious lunch consisting of a pack of Hula Hoops and a Mars bar.

Sitting back at my desk, I try to make sense of the pages of mind blowing numbers, when my heart stops beating as the door from The Boss’s office opens. He wants to know how my work is going, what the results suggest, and why there is no draft copy of a paper on his desk? I’ve been desperately trying to avoid this latter issue as he has a thing about scribbling in pencil on everyone’s work. You have to be on an emotional high to cope with that much ‘constructive criticism’ at one go. I tell myself its all good practice for the dreaded thesis writing.

I leave the Boss’s office and go to beg the other Lab occupants to let me on the much oversubscribed computer. I’m supposed to be sending off an abstract within the next two day
for the Phys Soc meeting and it’s still about twice as long as its allowed to be. Not even sure why I’ve agreed to send it. I’ve given two talks on my work before and was terrified for both, especially when people started asking questions. However, it is quite pleasing to know that you survived and managed to defend your own work. Val assures me that pre-talk nerves diminish the more talks you do - but I’m not convinced. By the time I’ve edited my masterpiece its time to tidy up my desk, put on my coat, switch off the light, lock the door, and go home. The end of another day in muscle research. One or two ups and a fair few downs, but then again, isn’t that what research is all about?

(Editors Note: And in ten years time....?)

Zoe Ashley
PhD Student
Muscle Research
University of Leeds

A DECADE IN THE LIFE OF A PHYSIOLOGIST

From Post Doc to Becoming a New Science Lecturer in the UK in the 1990's

Who am I?

I have gained a broad training in cardiorespiratory and exercise physiology starting from the second year of my undergraduate degree at The University of Birmingham in 1981. As a result of completing this degree and a Ph.D. at the same Institution, I ventured further afield. The first of my three grant funded postdoctoral positions was at the Institute of Anatomy, University of Bern, Switzerland with Professors Ewald Weibel and Hans Hoppeler. I returned to the Departments of Medicine and Physiology, University College London to work with Professor David Jones. My last postdoctoral sortie was to University of Wisconsin - Madison, USA to work with Professor Gordon Mitchell in the School of Veterinary Medicine. In October 1994, I took up the position of lecturer here at Leeds on a 3 year rolling contract and under probation.

This rather dry account of my professional to date life belies the enormous professional development that I feel that I have made as a researcher, teacher, administrator, business person, manager, and scribe to name but a few. I now stand at the beginning of a new phase of my career and life and it seems reasonable to stand back and take retrospective, present and prospective views of what it means to be a young Lecturer (as defined by many funding and administrative centres). I guess that I should not apologize for what is obviously going to be a personal view and I hope that my thoughts help strengthen the links between two distinct tiers within the scientific establishment; namely grant supported, short term appointments and those based on more established University/HEFCE funding.

Retrospection: Did I Achieve What I Wanted and What Were the Surprises?

I actively pursued each of my three postdoctoral positions. What do I mean by this? Towards the end of each soft money appointment, I felt driven to promote myself through departmental seminars, Physiological Society meetings and much correspondence. In this sense I achieved my short term aims, that is employment and a continuing training in related specialist fields of physiology. Looking back on the process of “self promotion” in general, I found it to be somewhat mentally wearing but overwhelmingly exciting. Every move was accompanied by many surprises that I had not foreseen, from coping with multilingual laboratories and skiing in Switzerland to experiencing an excellent working ethos and unbearably cold winters in the wilds of Wisconsin.

Of course, the main objectives for each postdoctoral position are to maximize one’s learning of a new unfamiliar technique or approach, on the one hand, whilst on the other, be as productive as possible normally as a result of being familiar with a technique or approach. I think that these somewhat polarized objectives are not mutually exclusive, but optimizing them to your own best advantage takes some skill. My advice (Oh oh!) from my own experience is to a) not be afraid to learn new related techniques that widen one’s experience, b) choose laboratories and supervisors that will allow and nurture a degree of
freedom of expression and c) seek to maximize one's cultural experience both professionally and personally. This optimization process appears somewhat obvious in retrospect, but certainly at the time I found it rather elusive, probably as a result of being left-handed and non-logical of thought!

I have undertaken three postdoctoral positions which have lasted for roughly 8 years in total. Is this more or less than one can reasonably expect in the present economic climate? Certainly, in terms of some degree of financial security, becoming attractive to mortgage institutions and raising a family, such a period of employment is rather too long in my opinion. My worry has always been that the rate of career (financial) development within this portion of the scientific career ladder is too low and may lead to a loss of attractiveness of science as a career. However, to return to the question in hand, I think that the academic career structure is *having* to deal with some very acute, dynamic attitudinal, political and socioeconomic changes which are forcing it, kicking and screaming, into line with a more "competitive market driven" economic environment. This is a global event in my opinion and so must be viewed as such. Consequently, I think it is realistic to expect this sort of time scale for postdoctoral employment. Therefore, I think it is important to plan to optimize the time as I have detailed above.

There are of course always exceptions to the rule and I applaud those who have shortened the postdoctoral stage in their career. Personally, whilst fully recognizing the precarious position most postdoctoral fellows find themselves in, I decided quite early on that a scientific career was for me and I think that this may have been a "survival" factor which propelled me through. More advice then, I think a working knowledge of the departmental profile is worth investigating, not only for your interview success but also because it can give you a very clear perspective of the environment you may find yourself in for many a year. Besides, it is your professional life that you would like to develop and I think it is important to recognize the potential of a department in terms of how you will develop as an academic. Good departments will nurture this view, because your own productivity and well-being will help illuminate their prowess.

Did I achieve what I set out to 8 years ago? The answer to this was undoubtedly yes and the process was highly enjoyable. I was ready to take on the next stage of my career and I personally felt that I was eager to become a Lecturer/Assistant Professor; it was a global search incidentally.

**My Present Status and How I Got Here**

I am still not sure what factors helped me into the position I now find myself; was it unflailing curiosity, obsession, having a specialized education, success and productivity, a well-tuned self-promotional portfolio or being in the right place at the right time? I think it probably was a result of all of the above!

So having had a number of attempts at convincing appointment committees that I was their person, I arrived at Leeds. I would like to think that the experience of a number of interviewing procedures helped in the final instance, but it is very difficult to know for sure. I have always asked for feedback about my interviewing skills as *this is at present not often forthcoming as a matter of course* — it should be. I had the peculiar and enlightening experience of sitting on both sides of the interview table within one year. A sense of purpose, clear goals and objectives and productivity may all play a role in successful interviews. Suitability to the advertised post is often important it appears, because I believe departments are becoming more business-like in their approach to developing a "departmental personnel portfolio". Again, *this may appear obvious to many with experience of faculty life, but this view has not explicitly entered the career training of postdoctorates and for that matter undergraduates*. Advice again, I think a working knowledge of the departmental profile is worth investigating, not only for your interview success but also because it can give you a very clear perspective of the environment you may find yourself in for many a year. Besides, it is your professional life that you would like to develop and I think it is important to recognize the potential of a department in terms of how you will develop as an academic. Good departments will nurture this view, because your own productivity and well-being will help illuminate their prowess.

**Time for Prospection: Where to Now?**

It is hard to come to terms with actually switching from a precarious short term professional existence to one of reportedly more stability. I suppose that, I for one, had become used to the "rules" of the game and become somewhat efficient and successful at
producing the right products. Now I face a totally new working environment and a battery of new responsibilities, opportunities and importantly, a new sense of time. I manage and teach an undergraduate degree course in Sports Science and Physiology, I am in the process of setting up a new research laboratory and group and have entered the hallowed halls of faculty administrative life. It has not been possible to keep the same pace of research that I enjoyed as a postdoctoral fellow (i.e. nearly 100% of my time). This, I have found frustrating, remembering that this is where all my experience and expertise has been developed for nearly ten years. I think this is probably a common experience amongst most new lecturers and has forced me to reconfigure how I partition my time.

Lectureship Contracts

As far as I am aware there are now three types of lectureship appointment: fixed term, usually for 3 to 5 years; rolling contract, usually 3 years with annual review and the rarest, a permanent appointment. I have the second type with probation (....sounds like a jail sentence). Once again, in the present and future economic environment it is hard to imagine how academia can enjoy the traditional style of appointment that it had become synonymous with. Many outside academia have been become used to a less secure working environment for a long time, whether anyone feels comfortable with this situation is another question. What then does the new style of appointment mean for both the individual and the host department?

In essence in most cases, the initial duration of appointment is not that dissimilar to a typical postdoctoral contract. However, there is great difference in what is expected. I personally have not a great deal of experience in teaching or administration and welcomed taking a Certificate in Learning and Teaching in Higher Education in my first year of appointment. I highly recommend this to any new lecturer and believe that universities would greatly benefit from having their new and not so new lecturers becoming versed with modern, ever changing styles of multimedia teaching. This year I am putting those skills into practice and have a sense of guarded confidence that certainly would not have existed without specific training. The nature of teaching in higher education is changing dramatically with talk of truncated undergraduate degree programme length, teaching over three semesters, increased student numbers but lower per capita expenditure etc. The formation of formal departmental teaching committees would appear to be a prerequisite to economic and progressive teaching strategies in the future. It is hard to respond to such a dynamic situation, but I am sure I (and others) will nevertheless feel the impact of such changes.

The World at my Feet?

The other ongoing task is to establish myself as a nationally and internationally respected researcher. This again can not be achieved overnight, at least not by me! For the first time, I have the research world at my feet; I can do anything. Well not quite. Suddenly and not unexpectedly, all or most research costs must be met by my ability to successfully attract grant funding. Now, this is what I have been trained for over the last 8 years so it should be relatively straight forward. What do you mean, ‘it’s a great idea and is valuable research but we can not fund your application on this occasion.....'? This is a harsh introduction to this new level of research management and one that must not be taken personally.... apparently! This is an obvious area where new lecturers are on a steep learning curve and support and guidance are necessary. I am too close to this subject to be able to view it with objectivity.

As I look towards the turn of the century, I can say that I have finally achieved what is regarded as one of the most important transitions in academia. I can now look forward to a relatively more obvious career path. In conclusion my thoughts would be that I have found a scientific career to be highly rewarding so far. I must say however, that new approaches to achieving success are needed by both an individual scientist and institutions (ultimately fund managers and government). Individuals need to actively plan and optimize their careers from an early stage, partly because there is only a fledgling career structure to offer support. Institutions must recognize the changing pressures placed on young scientists and ultimately be responsible for better rewards in financial and other terms.

I have tried to resist the temptation to point out my views. I'm sure many other colleagues would like to vociferously lobby for better salaries, start up funds, in house technical support teams, smaller staff-student ratios and worry about suggestions of introducing a third semester of teaching to shorten undergraduate degree programme length etc...... but I couldn't possibly comment!
Latin-American nations are underdeveloped countries with the common characteristic of the state's low priority in science and technology. Colombia is a country with an extraordinary potential in terms of its natural resources and what it can offer the international scientific community; but its participation in the international market is currently limited by the lack of a coherent scientific and technological infrastructure, able to incorporate scientific advances for the modernisation of the country. However, during the last few years, the Colombian Government has understood this limiting factor and started to develop what is called “The Aperture” in order to promote science and technology. Scientists have applauded this move as it signals a significant shift in government commitment to scientific research and development.

Postgraduate Programmes for Science Training

Research in Medical Science in Colombian universities is very recent, starting with the creation of the Department of Sciences of the University Nacional in Bogota during the 1940’s, and in 1950 with the creation of the School of Medicine of the University del Valle in Cali, from where the idea of educator/scientist started and then spread to the other universities in the country. The formation and training of scientists is done mostly through postgraduate programmes. Colombia has at least 15 MSc programmes, of which 8 are in medical sciences with one in the specific area of physiology. Since 1967, the University del Valle has been running different programmes in postgraduate education in Basic Medical Sciences; the areas covered are physiology, biochemistry, pharmacology, morphology and microbiology. MSc’s in Biology are also offered by the universities of Antioquia, Andes, Javeriana and Nacional.

A common factor in all Colombian MSc programmes is personalised education, according with the motivation and investigative needs of the postgraduates. The programme includes theoretical and practical courses, reading of scientific literature, and practical work which is developed under the supervision of a Professor with MSc or PhD degree and research experience. The number of graduates on these programmes is small. As an example, during the 25 years of the postgraduate courses at the University del Valle, only 125 people obtained an MSc degree. Most of them are actually working as educators in different medical schools of Colombian or international universities. The concept of educator-scientist, which presupposes that the full-time educator is also a full-time scientist, means that the universities currently cannot offer a good number of scientist fulfilling their real function as sources of knowledge. At the same time, the onerous educational duties discourage the formation of research groups. However, some research groups have been able to participate in the international scientific community either through their members’ contacts, established during their education overseas, or through their own publications. In terms of exchange, a lot remains to be done between Latin-America and Europe.

Funds For Research

In the past, the funding of research programmes in basic medical sciences came from international foundations and world organisations. Nowadays in Colombia, three kind of funds are available: governmental, private and institutional. The Governmental institutions are the Colombian Institute for Science and Technology: “Francisco Jose de Caldas” (COLCIENCIAS) since 1968 - and the Colombian Institute for the Promotion of Higher Education (ICFES). Colciencias is developing a major programme for the improvement of science and technology in Colombia, and is the main policy-making and funding agency for a national programme which involves Colombia’s main universities and industries. It is the implementing body for the National Committee in Science and Technology, worth a total of US$200m, to be financed by the Inter-American Bank, which is aimed at financing projects for scientific research and technological development, strengthening human resource capabilities, and disseminating information on science and technology. One of its interest is the development and implementation of the Colombia Network of Scientist Overseas. Colciencias is integrated by three Ministries.
and representatives of private and public universities. Evaluation of the projects in Medical Sciences is done by both Colombian and foreign representatives. The recommendations of the evaluators are considered before the presentation of the project at the National Committee for final evaluation. ICFES has a small budget which is utilised more for the initiation of projects or supplementary funds. Private funds can be obtained by the Bank of the Republic and the Foundation for the Higher Education (FES). Other institutions such as UNESCO, OMS, EU, the French government, etc. have assigned funds for research in medical sciences of more than US$3.5m per year. For several years the level of financing by the National Government in scientific research and technology was around 0.2% of the GDP. However, the Government is now budgeting for a level of 0.5% of GDP. This values remain relatively low compared to other Latin-American countries -around 1% of their GDP - or to developed countries with values between 2-4% of their GDP. The development of “The Aperture” should significantly enhance this situation, whilst also offering the possibility of collaborative projects with other institutions.

Together with Colciencias programmes, but also in their own right, Colombian universities are showing greater interest in links and contacts with overseas institutions with the capacity to do co-operative research in basic medical sciences. Development projects drawing on EU, World or Inter-American Bank are providing the funds and motivation for research programmes involving foreign counterparts.


For those interested in equine physiology this book spans the subject of race horse training from physiology to stablecraft, from training to lameness. The author has combined his expertise in physiology with his father’s hands-on practical knowledge of race horses, (Bill Marshall has been a trainer across four continents for over 40 years), and written a book with an unusual mixture of science, racehorse biomechanics, a practical guide to training and advice on how to produce a fitter and faster horse and how to repair injuries. No one subject is covered in any depth. But, it is a readable book and will provide a good introduction to the practices and problems of racehorse training in the context of what is known of equine physiology. At the same time the book also deals with the importance of the trainer’s intuition and a ‘feeling for animals’. As stated on the flyer sheet, “training is neither art nor science - it is a complex mix of both”.

S W
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No notice is carried for more than three successive editions. Notices are starred so that readers can see at a glance whether this is the first (one star) or final (three stars) appearance of the notice. Notices for the Summer 1996 edition (to be distributed on 24 May) should reach the Administration Office by 27 March.

Biological X-ray Microanalysis Group
IONS IN CELLS: MICROSCOPICAL MEASUREMENTS & BIOLOGICAL ACTIVITIES
31 March - 2 April 1996
Dyffryn House Conference Centre, Cardiff, UK
Covers techniques for studying ions in cells ranging from X-ray Microanalysis to Ion sensitive Flurochromes, and also the biological significance of ions in cells. Contributed talks and posters will be encouraged. Further details from: Dr A J Morgan, School of Pure and Applied Biology, University of Wales College of Cardiff, PO Box 915, Cardiff CF1 3TL, tel (01222) 874 000 ext 5872, fax (01222) 874 305, Email sabcw@cardiff.ac.uk * * *

NEUROLOGY FOR NEUROSCIENTISTS
1-2 April 1996
Magdalen College, Oxford
How clinical neurology can illuminate neural function and help neuroscientists, subjects include AIDS, Alzheimer’s, Stroke and prospects for Neurotransplantation. Sponsored and subsidised by the Guarantors of Brain. Nominal registration fee of £20, some graduate students’ travel expenses available. Further details from: Prof J B Clark, Neurochemistry, National Hospital, Queen Square, London, tel (0171) 829 8722 * * *

Symposium on DIABETIC ANGIOPATHY
17-19 April 1996
St Luke’s College, University of Exeter
A one and a half day symposium will consider all aspects of Diabetic Angiopathy including the basic pathogenesis of large and small vessel diseases in this condition, retinopathy, peripheral vascular disease and cardiopathy. Further details from: Mrs Cathy Maguire, Dept of Vascular Medicine (Diabetes Research), Postgraduate Medical School, Barrack Road, Exeter EX2 5AX, tel (01392) 403 045, fax (01392) 403 027 * * *

CLINICAL MICR O VASCULAR RESEARCH WORKSHOP
Wednesday 17 April 1996, 0900-1230
Dept of Vascular Medicine, Postgraduate Medical School, University of Exeter
The Department of Vascular Medicine will be running a Microvascular Workshop which will include an introductory talk outlining theory and pitfalls followed by demonstrations. Further details from: Mrs Cathy Maguire, Dept of Vascular Medicine (Diabetes Research), Postgraduate Medical School, Barrack Road, Exeter EX2 5AX, tel (01392) 403 045, fax (01392) 403 027 * * *

2nd European Meeting on GLIAL CELL FUNCTION IN HEALTH & DISEASE
21-25 April 1996
Arcachon, near Bordeaux, France
Mainly focused on poster presentations, this international meeting will include 12 plenary lectures covering major fields of glial cell physiology, the cell biology of neurone-glia interactions and glial involvement in pathological states. Further details from: Dr Dymissia Theodosios, INSERM U378, Universite de Bordeaux I, 33076 Bordeaux cedex, France, fax (00 33) 56 98 19 15, Email glia@bordeaux.inserm.fr * * *

The Royal Society
THE LEGACY OF JENNER: VACCINATION PAST, PRESENT AND FUTURE
14-15 May 1996
6 Carlton House Terrace, London
Organised jointly with the Royal College of Physicians of London, Royal College Pathologists and Wellcome Institute for the History of Medicine (Registration and fee required). Includes a guest lecture by Prof Donald Henderson entitled The Miracle of Vaccination. Further details from: The Science Promotion Section, The Royal Society, 6 Carlton House Terrace, London SW1Y 5AG, tel (0171) 839 5561, fax (0171) 930 2170 * * *

EBBS - workshop
DEVELOPMENT OF POSTURAL CONTROL
6-8 June 1996
Dept of Medical Physiology, Groningen, The Netherlands
A three day workshop aiming at presenting and discussing recent results on postural control. Focus is on developmental mechanisms. It will be a conference where scientists and clinicians will meet. Further details from: Dr M Hadders-Algra, University Hospital Groningen, Developmental Neurology, CMC IV, Hanzeplein 1, 9713 EZ Groningen, The Netherlands, tel (00 31) 50 361 4247, fax (00 31) 50 363 6403, email m.hadders-algra@med rug.nl * * *

Micro 96
INTERNATIONAL MICROSCOPY CONFERENCE & EXHIBITION
2-4 July 1996
Hammersmith, London
Main themes of Probes in Light, Electron and Digital Microscopy. Deadline for submission of contributed abstracts for oral or poster presentaion is Friday 5 April 1996. Further details from: Royal Microsopical Society, 37-78 St Clements, Oxford OX4 1AJ, tel (01865) 248 768, fax (01865) 791 237, Email rmsg@vax.ox.ac.uk * * *

dy Dystrophic Mice
The Dept of Physiology, Trinity College Dublin, has a breeding colony of Dystrophic Mice which is no longer needed. Further details from: Prof C Bell, fax (00 353) 1 679 3545, email physiol@mail.tcd.ie *

4th IUBMB Conference
THE LIFE & DEATH OF THE CELL
14-17 July 1996
Edinburgh International Conference Centre
Topics include: cell death mechanisms; cellular stress & protection mechanisms; signal termination & compartmentalisation. Further details from: The Conference Assistant IUBMB 1996, The Biochemical Society, 59 Portland Place, London W1N 3AJ, tel (0171) 580 5530, fax (0171) 637 7626, Email meetings@biochem-soc.org.uk * * *

European Society for Comparative Physiology & Biochemistry
17th Annual Conference
ADAPTATION TO STRESS IN AQUATIC AND TERRESTRIAL ECOSYSTEMS
27-31 August 1996
University of Antwerp (RUC), Belgium
Major themes include Membrane Organisation and Functioning; Defence Systems and Stress Pollutions. Further details from: Dr R Blust, Congress Chairman, Dept of Biology, University of Antwerp (RUC), Groenenhoegelaan 171, B-2020 Antwerp, Belgium, tel 32 3 218 03 44, fax 32 3 218 04 97, Email Blust@ruca.ua.ac.be * * *

International Society for Mountain Medicine
2nd World Congress of HIGH ALTITUDE MEDICINE AND PHYSIOLOGY
16-21 September 1996
Cusco, Peru
Sessions include: physiology of acute and intermittent exposure to high altitude; endocrine and reproductive physiology; exercise, sports training at high altitudes; cardiovascular and respiratory physiology and pathophysiology. Further details from: Dr F Leon-Velarde, Universidad Peruana Cayetano Heredia, Dpto de Fisiologia, Apartado 4314, Lima 100, Peru, fax (00 51) 14 482 34 35, Email fabiov@upsch.edu.pe * * *

5th International Symposium on RESISTANCE ARTERIES
25-29 September 1996
Cambridge, UK
Sessions based around clinical conditions in which the function and the pathophysiology of the microcirculation is critically involved. Topics include Hypertension, Diabetes, Pre Eclampsia, Angiogenesis and the Microvasculature. Deadline for abstracts, April 1996. Further details from: Hampton Medical Conferences Ltd, Hofer House, 185 Uxbridge Road, Hampton TW12 IBN, tel (0181) 783 0810, fax (0181) 783 0292 * * *

Overseas Members
Overseas Members receive their Meetings packets only a short time before a Scientific Meeting. As a consequence, making travel arrangements and reservations can be a problem. To help Overseas Members, booking forms for Meetings can be requested from the Meeting’s Secretary’s Office.
Information for applicants

The workshop provides intensive practical experience of a number of microelectrode, patch clamp and optical techniques applied to single cells. It is intended for postgraduate students, post doctoral workers or established scientists wishing to apply these techniques in their research.

The following basic techniques are offered:

- Two electrode voltage clamp
- Patch clamp
- Single electrode voltage-clamp
- Dye injection
- Ion-sensitive microelectrodes
- Fluorescent indicators

In addition there are lectures and demonstrations of electronics, computing, microscopy, bilayer recording, flash photolysis, single cell RT-PCR and capacitance measurements.

There are 16 places. Participants work in pairs and have the opportunity to do three 3-day experiments in the two weeks. In addition, lectures and practical sessions of electronics, data aquisition and computer analysis, and microscopy will be given. Daily lectures given by teachers and visiting lecturers cover the basic techniques taught and certain specialised topics. A copy of the Plymouth Microelectrode Handbook will be provided.

Accommodation (for 14 nights- arrive & depart on Wednesday) is close to the laboratory and includes breakfast, lunch is provided in the lab each day and an allowance is given for an evening meal.

The course fee of £975 includes accommodation, meals and tuition. Participants are responsible for their own travel arrangements.

THE CLOSING DATE FOR APPLICATIONS IS 15 APRIL 1996

Applications will be acknowledged on receipt. Please provide 2 self-addressed envelopes. A meeting to assess applications will occur during May and all applicants will be notified of the outcome.

HOW TO APPLY:

There is no application form.

1. Please give a concise description of your research, your reasons for wishing to attend and your experience of techniques taught on the workshop. List in order of priority four techniques you would like to learn.

2. Provide a brief CV (2 sides maximum), including list of publications (no reprints please).

3. The application must be accompanied by a letter of recommendation from an academic referee, preferably PhD supervisor or Head of Laboratory. This letter should indicate how your career, the laboratory in which you work and the area of research that you intend to pursue will benefit from your participation in the workshop.

4. What is your likely source of funding?

FUNDING

MRC and BBSRC Studentships - applicants with Research Council studentships are funded once accepted for the workshop - simply state you have a studentship in your application. Do not apply to the Research Council directly.

Dale and Rushton Funds of the Physiological Society - help with funding (upto £500) is usually available for young physiologists working in the UK. If you wish to apply please indicate in your application to the workshop. There is no need to apply directly to the Dale and Rushton funds before workshop applications are assessed.

Bursaries - The workshop can provide some half bursaries - if you think you will have difficulty finding the full fee please indicate in your application.

Applications should be sent to:-
David Ogden, Microelectrode Techniques, NIMR, The Ridgeway, London NW7 1AA, U.K.
E-mail d-ogden@nimr.mrc.ac.uk
Information on internet
http://www/nimr.mrc.ac.uk/Events/micro-electrode.htm
HANS KUYPERS MEMORIAL LECTURE

by

Dr PETER STRICK

DEPARTMENT OF VETERANS AFFAIRS
MEDICAL CENTER
SYRACUSE, NY
U.S.A.

NEW CONCEPTS ABOUT BASAL GANGLIA AND CEREBELLAR LOOPS WITH THE CEREBRAL CORTEX

on

WEDNESDAY 24TH APRIL 5.00 FOR 5.30 P.M.

WOLFSON LECTURE THEATRE
NATIONAL HOSPITAL FOR NEUROLOGY AND NEUROSURGERY
QUEEN SQUARE
LONDON WC1N 3BG

CONTACT: ROGER LEMON TEL: 0171 837 3611 EXT. 4184

Lottery fails to dent giving

Claims that the National Lottery would strangle donations to medical research are contradicted in the 1995 financial results of major research charities. The incomes of the Imperial Cancer Research Fund, the British Heart Foundation and the Arthritis and Rheumatism Council for Research have all increased.

THES 1209 5 January 1996 p.1

Ageing centre rejected

At a meeting at the Royal Society of Medicine last month, 60 senior people representing groups such as researchers, industry, carers and the aged, welcomed the idea of a network to help coordinate research - but rejected setting up a national research centre in gerontology. The meeting was called after the Government's Technology Foresight programme made ageing a priority area for research and suggested that there might be a need for such a centre.

THES 1210 12 January 1996 p.6

Source: SPIN

Source: SPIN
APPLICATION FORM FOR AFFILIATION TO
THE PHYSIOLOGICAL SOCIETY

Surname (IN CAPITALS) .........................................................

Forenames (IN CAPITALS) ........................................................................

Special Scientific Interest: (eg thesis title or postdoctoral project) .................................

Interests: IU PS classes ................./ ........../ .......... Groups: ........................................................
(See overleaf for codes) (See overleaf for codes)

Work address ....................................................................................................................................................

Tel ................................................................................................ Fax ..................................................................

Email address ................................................................................................ Date of Birth ............/ ........../ ..........

Present Course/Postdoctoral Position ............................................................................................................................

Qualifications:

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<th>Degree</th>
<th>Date</th>
<th>Subject</th>
<th>Awarding Institution</th>
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I enclose a cheque for £10 payable to The Physiological Society.

I confirm that the information given above is accurate and up to date and that I hereby authorise The Physiological Society to hold this, and such other personal information as is supplied to the Society by me or my authorised agents or representatives in future, in machine-readable form for use for the purposes registered under the Data Protection Act 1984.

Signed ................................................................................................ Date ......................................................

Members of The Physiological Society proposing Candidates should read the Guidelines overleaf and sign the following statement.

I hereby confirm that the Candidate:
(a) is either a postdoctoral worker or registered for a higher degree in Physiology or a cognate subject, and
(b) is a person suitable for admission to Society Meetings.

Name (IN CAPITALS) ................................................................................................ Signature of Proposer ......................................................

Tel ................................................................................................ Fax ..................................................................

Address ................................................................................................ Date ............/ ........../ ...........

On completion, please return this form to: The Physiological Society (Affiliation), PO box 506, OXFORD OX1 3XE, (UK).
GUIDELINES TO MEMBERS OF THE PHYSIOLOGICAL SOCIETY
PROPOSING CANDIDATES FOR AFFILIATION

This form of association with the Society is intended for physiologists still in the early stages of their careers working in laboratories in the UK, Eire or abroad. It is open to postgraduate students registered for a higher degree in Physiology or a cognate subject and to postdoctoral workers who are not yet Members of the Society. It is expected that postdoctoral workers proposed as Affiliates will normally be (a) within the first five years of attaining a first professional qualification (PhD or medical degree) or (b) awaiting the outcome of their proposal for nomination for election to Membership of the Society.

The Committee has authorised the Committee Secretary to consider and accept or reject proposals for Affiliation to the Society as they are received throughout the year, so that these can be processed quickly. The Committee Secretary regards himself as free to withdraw a proposal and return the papers to the Proposer.

Affiliation is for a term of five years in the first instance. Affiliation must be renewed by payment of the appropriate fee at the start of each year (which for this purpose is the academic year, ie October to September). For administrative convenience, Affiliates registered after October will have to pay for the full year. The fees are determined from time to time by the Treasurer; they are currently:

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All Affiliates receive copies of programmes, notices and the Society’s Magazine. Affiliates can attend Meetings in their own right but must be introduced by a Member of the Society when giving a Communication or Demonstration. Affiliates are not Members of the Society and do not have the right to vote at its General Meetings.

Field of Interest:

01 Anaesthesia
02 Anatomy & Embryology
03 Anthropology
04 Biochemistry
05 Biophysics
06 Biomedical Engineering
07 Blood
08 Cardiovascular
09 Cellular & Tissue
10 Comparative Physiology
11 Electrolytes & Water Balance
12 Endocrines
13 Energy Metabolism & Temperature Regulation
14 Environmental
15 Enzymes
16 Gastrointestinal
17 General Physiology
18 Gerontology
19 Immunology
20 Liver & Bile
21 Lipids & Steroids
22 Microbiology
23 Minerals, Bones & Teeth
24 Molecular Physiology
25 Muscle & Exercise
26 Neuroscience
27 Nutrition & Food
28 Pathology
29 Pharmacology
30 Renal
31 Reproduction
32 Respiration

You may specify up to three fields of interest.

Special Interest Groups

Current Codes

AF Autonomic Function
BB Blood-Brain Barrier
CC Cardiovascular Control
CI Comparative & Invertebrate Neuroscience
CN Cellular Neurophysiology
CP Comparative Physiology
DP Developmental Physiology
EM Epithelia & Membrane Transport
GI Gastrointestinal Tract
HC Heart & Cardiac Muscle
HI History of Physiology
HP Human Physiology
IC Ion Channels
ME Microvascular & Endothelial Physiology
MC Muscle Contraction
MP Molecular Physiology
NE Neuroendocrinology
PP Placental & Perinatal Physiology
RP Renal Physiology
RE Respiratory Physiology
SC Sensorimotor Control
SF Sensory Functions
SM Smooth Muscle
SP Somatosensory Physiology

NEW
11/11/95
The King's / Bristol Meeting

At the Bristol Meeting...

The Physiology Department at Kings

Discussing science over coffee

The entrance to the Meeting

The Physiological Society stand

Winter sunset over Kings

Photography by Saffron Whitehead

Interesting poster sessions

Bruce Matthews and friends enjoying a drink before the dinner

Catching up on news at the Society dinner

And... eating, drinking and being merry!

Photography by Hiroshi Ishihata
