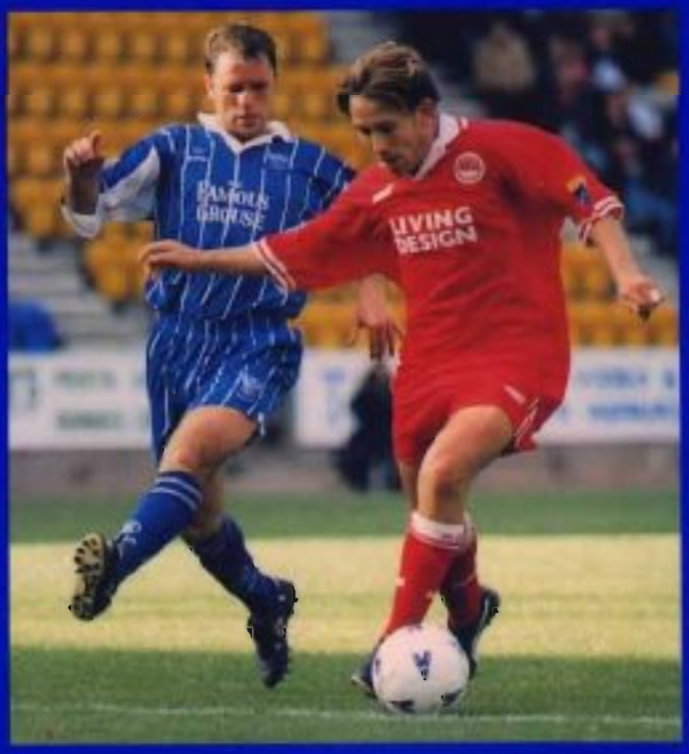
The Physiological Society Magazine



Spring 1998
No 30

The Liverpool Meeting

East Wing of the Physiology Department

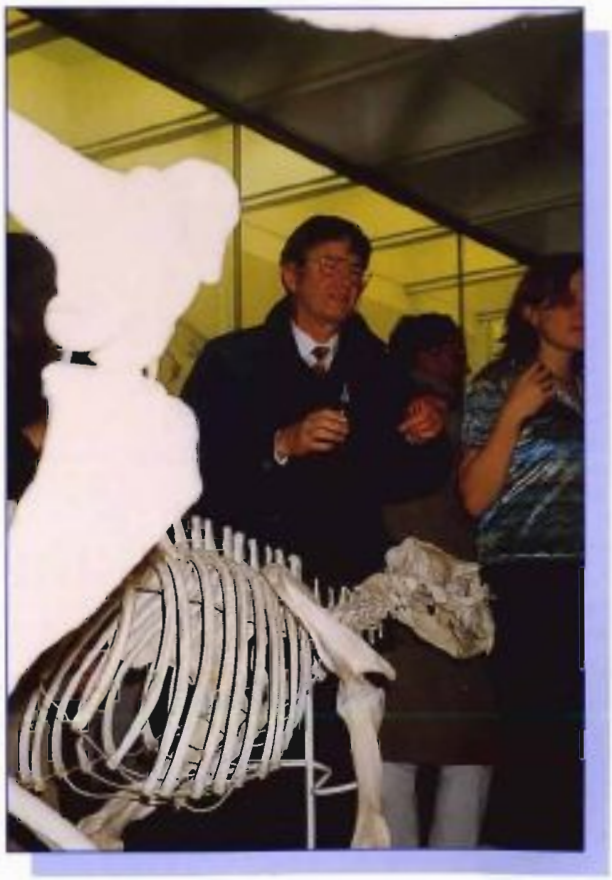
Damien Deavall

Andrea Varro

Photography courtesy of Mark Houghton

The reception at the Cambridge Meeting

Richard Keynes



Roger Thomas

Photography courtesy of Saffron Whitehead

Front cover: Footballers courtesy of Raymond Besant
Back cover: Courtesy of The Wellcome Institute Library, London

Contents

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Action Points

- Affiliate Travel Grant Scheme: The next two deadlines for receipt of applications are 31 March 1998 and 31 May 1998.
- Change of Address: Please can Members inform the Administration Office of any changes of address, telephone or fax numbers.
- E-mail Addresses: Please can Members inform the Administration Office of new email addresses, or changes to existing ones. Changes can be e-mailed to admin@physoc.org.
- Experimental Physiology: Rapid Communications for the July 1998 issue of Experimental Physiology should reach the Distributing Editor's Office in Newcastle by 4 May 1998.
- Magazine: Letters and articles for inclusion in the Autumn issue should reach the Editor by 1 June 1998. Advertisements and Notices should reach the Administration Office by 2 July whilst items for the Special Interest Group Forum should reach the Meetings Secretary's Office by 2 July and items for Committee News should reach the Committee Secretary's Office by 2 July 1998.
- MSc Bursaries: The deadline for receipt of applications for MSc Bursaries is 31 May 1998.
- New Application Forms: New application forms are available for Membership, Affiliation, Student Association and grants. Please contact the Administration Office or e-mail cparry@physoc.org.
- Southampton Meeting: Abstracts should be submitted to the Meetings Secretary between 25 May and 4 June 1998.
- Subscriptions: Members are reminded that annual Membership Subscriptions for 1998 were due on 1 January 1998. Members are advised that they are liable to sanctions if they do not pay their Membership fees.
- Vacation Studentships: The deadline for receipt of applications for Vacation Studentships is 30 April 1998.

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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 a 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 dénouement 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 200 words 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 re-typing. 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

Contact the Editors office or the Administration office for submission dates. 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 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 left).

Artwork & DTP - Denise Young, Academic Services, St George's Hospital Medical School, London.

WELCOME TO LIVERPOOL

The Society last met in Liverpool four years ago. As on that occasion, this meeting is jointly organized by the Department of Physiology (Faculty of Medicine) and the Department of Veterinary Preclinical Sciences. The joint invitation reflects the increasing collaboration between these departments. A major joint project is the Wellcome Trust 4-year duration PhD scheme in Cellular and Molecular Physiology. This scheme, which was in its infancy at the last meeting, was the first such scheme in the UK Students spend their first year rotating between different laboratories before deciding on their PhD project.

Department of Physiology

The Department is one of the relatively few Physiology Units in the country that, in more than a hundred years of existence, has escaped involvement in institutional restructuring. The Department's strong international research reputation was confirmed by the 5* (top) rating in the 1996 National Research Assessment Exercise.

New Appointments and Promotions

- Andrea Varro was appointed Lecturer in the department in 1994, became Senior Lecturer in 1995 and was recently promoted to Reader. She works closely with Graham Dockray and Rod Dimaline. Her work has led to many important insights, including the recognition of glycine-extended progastrin processing intermediates as physiologically relevant peptides, and the observation that phosphorylation can alter the post-translational processing of progastrin.

- Alan Morgan was appointed to a Lectureship in 1995. He received his research training in the department (PhD with Bob Burgoyne). Alan's research group is closely linked to Bob Burgoyne's, as they both work on molecular aspects of exocytosis. Alan was awarded a medal by the European Society for Neurochemistry in 1996 and gave The Prize Lecture at The Society's Meeting in Groningen, Holland last year.

- Michael Taggart, who holds a Wellcome Trust Research Career Development Fellowship in the department, has been appointed Lecturer and will take up this position in May, 1999. His research is linked to work done by Sue Wray's group. Michael's primary research work deals with the control of uterine contractility by $[Ca^{2+}]_i$ during normoxia and hypoxia

- Sue Wray was promoted to Professor (personal chair) in 1996 on the basis of her outstanding record in research and teaching. Sue has established a reputation as one of the world's leading authorities on pH and smooth muscle control, as well as the control of uterine contraction. Sue is a member of *The Journal of Physiology* Editorial Board and also serves on The Society's International Sub-Committee.

Professor Sue Wray

- Alexei Tepikin was promoted to Senior Lecturer in 1997. He works closely with Ole Petersen on calcium signalling in exocrine cells. He has recently invented an imaging technique for localisation of Ca^{2+} release sites in single cells and characterised the Ca^{2+} tunnel function of the endoplasmic reticulum.

- Ole Petersen has recently been selected for an MRC Research Professorship Award, effective from 1 October 1998 for a period of at least five years.

Research Funding

The principal investigators in the department mainly receive external grants from the MRC and the Wellcome Trust, although there are also grants from the BBSRC, the European Community, the British Heart Foundation and some other bodies. Over the 5-year period 1992-1997, the average annual research grant income per full time member of staff was £130K. There are two MRC Programme Grants in the department. One deals with `Ion Channels and Pumps in Secretory Cells' (OH Petersen, AV Tepikin and DV Gallacher) and the other with `The Neuroendocrinology of the Upper Gastrointestinal Tract' (GJ Dockray, R. Dimaline and A Varro). Both these grants have very recently been renewed for the 5-year period 1998-2003 with awards of £1.3 and £1.15 million, respectively.

International Role

Members of staff play important roles internationally. Graham Dockray and Ole Petersen are members of Academia Europaea and Ole Petersen is currently Chairperson of the Academy's Physiology and Medicine Section. He also serves on a number of other international committees advising, for example, the Max-Planck Society and the German Research Council. Graham Dockray is a member of the International Steering Committee of the International Symposia on Gastrointestinal Hormones.

On the publication side, there is involvement in many editorial boards. As examples of this activity, it can be mentioned that Bob Burgoyne is Deputy Chairman of the *Biochemical Journal's* editorial board, Graham Dockray is Senior Editor of the new journal *Genes and Function*, Ole Petersen is Executive Editor of *Pflügers Arch - European Journal of Physiology* and international correspondent for *Annual Review of Physiology* and Sue Wray is an editor of *The Journal of Physiology*.

Department of Veterinary Preclinical Science

The most recent arrival in this department is Soraya Shirazi-Beechey who has joined us from Aberystwyth. The work of her group is focused on the molecular mechanisms by which nutrients present in the lumen of the intestine regulate the activity and the expression of intestinal nutrient transporters. Although it is well established that the activity of most intestinal nutrient transporters are adaptively regulated by the type and the levels of nutrients entering the lumen of the small intestine, the cellular transduction mechanisms are unknown. The group has shown that monosaccharides in the lumen of the ovine intestine, including membrane impermeable glucose analogues, regulate the expression of the ovine intestinal Na^+/glucose co-transporter (SGLT1) at both transcriptional and post-transcriptional levels. Work is currently underway to determine the site of transcription of sugar-induced SGLT1 expression along the crypt-villus axis of the intestine and also to identify the important regulatory regions of the SGLT1 promoter in order to determine the specific sugar-induced transcriptional factors involved. In other ongoing work they are studying butyrate and phosphate transporters.

This group is accommodated in newly refurbished space which was liberated by the the University's policy of centralizing animal houses. Soraya is accompanied by Brian Beechey who has recently stepped down as Treasurer of the Biochemical Society and is now the Treasurer of the International Union of Biochemistry and Molecular Biology.

At the time of the last meeting, John Gibson had only recently taken up his lectureship. Since then he has established an active group studying cation fluxes across red cell membranes, both during normal physiology of the red cell and also in pathological conditions. As a veterinary surgeon, part of his work concerns veterinary situations in which red cell transport is relevant to the function of the circulatory system. Another project concerns the dimorphic cation content of ovine red cells and its regulation by the L and M antigens via control of membrane transporters. Much of his work concerns transporters with volume regulatory functions, in particular the KCl cotransporter, and his broader interest is elucidation of the signal transduction pathways which mediate cellular volume regulation.

As well as reaching the exalted heights of organizing the Heart Special Interest Group of the Physiological Society, Stephen O'Neill has recently been promoted to Senior Lecturer. His research interests concern the regulation of cardiac contraction with special emphasis on regional differences within the ventricle.

Finally, Colin Finn will be retiring at the end of this academic year from the Chair of Veterinary Physiology. As well as his own research interests on implantation, Colin is the Editor in Chief of the *Journal of Reproduction and Fertility*.

The Joint Meeting with The Spanish Physiological Society

We are absolutely delighted that the 1998 Meeting in Liverpool is held in conjunction with The Spanish Physiological Society. This is a good opportunity to celebrate the remarkable resurgence of Spanish Physiology that has occurred in recent years. This is exemplified by the recent election of Jose Lopez-Barneo, who is organizing one of the minisymposia at the Liverpool Meeting, to membership of Academia Europaea. Jose is the youngest physiologist ever elected to membership of this body.

The 5 minisymposia, covering a wide range of topics, form a very important part of the meeting, but there are many other interesting events. In accordance with tradition, The University of Liverpool Sherrington Lecture will be given during the meeting - this time by Eric Kandel. His recent work has provided new and exciting information about synapse-specific, long-term facilitation. There are several other major lectures to be given by Janice Marshall (Joan Mott Prize), Dan Todes (Paton Lecture) and Ernst Niggli (Heart and Cardiac Muscle Lecture) as well as a Molecular Techniques Teaching Day organized by Janet Allen, Rod Dimaline and Graham Dockray.

We hope you will enjoy the Meeting and the City.

David Eisner and Ole Petersen

The Physiological Society Meeting at the Sherrington School of Physiology, UMDS, St. Thomas' Hospital - the end of an era.

Work in progress; entrance to the Sherrington School of Physiology

The Society visited the Sherrington School on 6th to 8th November, 1997. This occasion was 100 years after the first visit of the Society in 1897 and reflected the change in Physiology over this period. At the first meeting the dinner was the centre piece with nineteen members in attendance. Sydney Ringer gave one of the four communications and I expect the meal was more sumptious and the wines more elegant. At what will be last visit of the Society to St Thomas's some 400 people attended the meeting with over 100 communications and demonstrations.

On the Thursday the meeting was held in four theatres with an international symposium on the Neuroendocrine Control of Fluid Balance. This was organised by Mary Forsling at which Daniel Bidet from Canada received the 9th Mortyn Jones Memorial Medal for his lecture on 'The Clinical and Molecular Insight into Diabetes Insipidus'. There were two other symposia in parallel, one on sensory physiology, the other on teaching with an emphasis on information technology. There were also the usual communications at which Abe Guz gave a fascinating lecture on respiratory control.

On Friday the Blood-Brain Barrier Special Interest Group had a well attended meeting with the first Hugh Davson Lecture given by Pierre-Oliver Couraud from Paris. After lunch Tony Taylor enlightened us with a lecture entitled "We are doing our best Sir Charles". Tony was the head of the department until 1995. After a busy programme of communications, demonstrations, including an invitation to visit 'The Cyber Café', Ian Roddie gave the Sherrington Lecture on 'Attitudes and Opportunities, Henry Barcroft and the Human Peripheral Circulation'. This was a fascinating account of Henry's life illustrated with many photographs of his former colleagues and students. It was of considerable interest to hear that Henry was the sole academic in the Department of Physiology at Belfast and expected to give all the lectures to a large number of medical students and teach the same practical three times in a week to cope with the student numbers! It makes us wonder how he could still do first class original research at the same time. What made this an especial occasion was that Henry Barcroft at the age of 93 attended the lecture. Although a little hard of hearing he obviously enjoyed seeing all the photographs of his old students many of whom are now august senior scientists or have retired!

Viewing posters at the meeting

After sherry, kindly donated by the Medical School, some 118 members and guests dined, and with both Henry Barcroft and Tony Taylor being present, represented some 50 years of Physiology at the Sherrington School. The meeting continued in four theatres on Saturday morning with much lively discussion. Fred Imms and Bob Burton are to be congratulated for organising the staff and BSc students so ensuring a successful meeting.

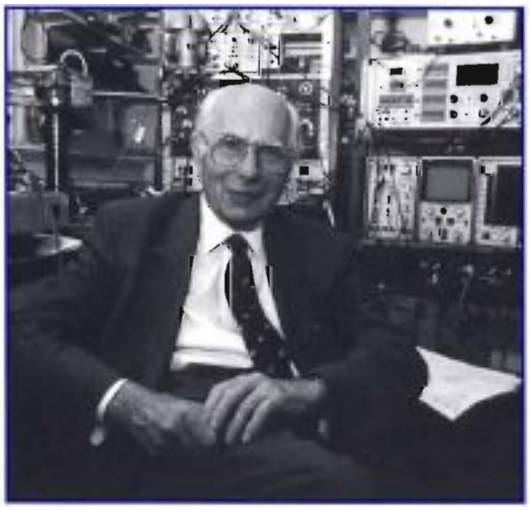
Fred Imms

In 1998 we formally become part of King's College London and in June 1999 we move to the Guy's Campus into new or refurbished buildings so marking the end of more than 100 years on this site. Physiology at St Thomas's started over 300 years ago where London Bridge Station now stands so it will be nice to continue the tradition across the road with our old rivals on the Guy's Campus.

Malcom Segal

Sadly Henry Barcroft, Honorary Member of the Society, passed away on January 11th.

THE HUXLEY SYMPOSIUM



Sir Andrew Huxley

On Saturday 22nd November - Sir Andrew Huxley's 80th birthday - a highly successful symposium was held in his honour. The programme started on Friday evening with a dinner for the speakers and their wives, held in Downing College on the Friday evening. Everyone had arrived by the time we reached the main course. The symposium itself was on Saturday morning in the light and airy Geography lecture theatre, and was devoted to a discussion of muscle contraction and its regulation. Martin Morad gave a fascinating and data-filled talk about Ca^{2+} fluxes in cardiac myoctyes. It appears that Ca^{2+} entering the channel does inactivate the channel significantly (35%) but the major contribution to inactivation is carried out by Ca^{2+} release from the stores via ryanodine receptors. Lee Peachey then described his analysis of irregularities in the striations of muscle fibres, based on the fine structure of diffraction patterns - work in which Andrew Huxley had taken part for a few days.

After coffee, Vincenzo Lombardi showed how the tension responses of a stimulated muscle fibre to a series of shortening steps might be explained if a cross-bridge could perform several working strokes for the use of a single ATP molecule. Malcolm Irving described the work of a large number of collaborators with a fluorescent marker attached to the cross-bridge, by molecular magic, in various attitudes. Finally Yale Goldman showed us intriguing pictures of the way the cross-bridges might move. He compared cross-bridge motion with that of a hitch-hiker's arm. In his concluding summary Bob Simmons pointed out how the careers of all the participants had depended in significant measure on the contribution of Andrew Huxley to the field over forty years.

Lunch was held in the Physiology Department after which the experts retired to a meeting room for detailed discussions of very recent work on the molecular basis of force generation in muscle. The day ended with a celebratory dinner in Trinity College attended by 120 fellows and guests, including most of the speakers. Andrew Huxley gave an autobiographical speech in which he described how his early plans to become an engineer were subverted by fellow students who persuaded him to try Physiology instead. He emphasised the important influences on his life from many Fellows of the College who were members of the Society, notably Alan Hodgkin, ED Adrian, AV Hill, David Hill, William Rushton, Jack and Glen Milliken. He also thanked the Department of Physiology for organising such an enjoyable birthday symposium, and the Physiological Society for supporting it.

Roger Thomas

Entrance to Cambridge Laboratory

1,180 fellows - and just 39 women

An article reporting on research showing that able women scientists are not moving into positions of seniority and influence.

***TELEGRAPH** 28 January 1998 p.16*

Source: SPIN

Nominations for the Committee 1998

The 1998 AGM will be held in conjunction with the Southampton Meeting in September. Members are reminded that nominations for candidates should be made with the agreement of the nominee and supported by 5 Members of the Society. It is hoped that Members will ensure a reasonable field of candidates proposed.

NB Committee nominations and any items for the AGM agenda should reach the Committee Sec by 15 May 1998.

Australasian Visiting Lecturership Scheme

The Meetings Secretary, Professor Chris Fry is delighted to report that Professor Nick Standen has been selected for the Australasian Visiting Lectureship Scheme. Professor Standen will spend 2-3 weeks in Australia and New Zealand visiting various departments and will also deliver a lecture to the joint meeting of the Austalasian and South East Asian Physiological Societies which is being held in Brisbane from 27 September to 1 October 1998.

Grants

Please note that the formerly suspended grants, Postgraduate Support Fund and MSc bursaries, have now been reinstated. The deadlines are as follows:

- Postgraduate Support Fund 31 July
- MSc bursaries deadline 31 May and 30 November.

New 1998 forms are available from the Administration Office on 0171 631 1458 or cparry@physoc.org.

Congratulations

And finally congratulations to Professor Sir Michael Berridge FRS on his award of a knighthood in the New Year's Honours List.

Christina Docchar

CAPITAL PUNISHMENT

Please note that Oridinary Members' e-mail addresses, as printed in this year's *Grey Book*, nearly all start with a capital letter. Although in some cases addresses may not be case-sensitive, most will follow the convention of lower case lettering for the whole address and Members should therefore bear this in mind in the event of any difficulty getting through to a colleague.

Keith Newton

Keith Newton

In February, Keith Newton, the Senior Administrator to The Physiological Society, left to take up an appointment with the World Federation of Neurology. Keith joined the Society some two years ago and was responsible for setting up, with Phil Harrison, the new Administrative and Treasurer's offices at Dilke House, just across the road from University College. Since the move Keith, along with Fiona Catherines and Charlotte Parry, have streamlined the running of the Society and made it the seamless operation which it is today. Many Members will remember Keith from the Society's stand at Scientific Meetings but it was behind the scenes where his influence was most apparent. In particular he provided an effective link between many activities of the Committee and the Administration, as well as carrying out research on matters which allow The Physiological Society to interact more effectively between other learned societies, grant bodies and quasi-governmental agencies.

A more limited number of people will be even more grateful to Keith, namely heads of department and their secretaries who have hosted Scientific Meetings over the past year. The keenness to play host to a Society Meeting was often tempered by the thought of having to arrange for the registration of Members. In setting up a system for registration to be handled centrally at the Administration Office a great burden was lifted from host departments.

We all wish Keith well in his new appointment and thank him for his contribution to making The Physiological Society the effective organisation that it is today. Personally he still owes me a few pints from our summary sessions we used to have at the end of a hard day at a Scientific Meeting but I am sure we will meet again.

Chris Fry, Meetings Secretary

BLOOD-BRAIN BARRIER

There will be a Designated Blood-Brain Barrier Special Interest Group Session at the SmithKline Beecham Meeting to be held during 2-3 November 1998. A Blood-Brain Barrier symposium will also be held in association with this Session on the afternoon of Monday 2 November. Abstracts for the BBB Session must be submitted between 17 and 27 August 1998.

The new Convenor for the BBB Group is Dr David Begley, Department of Physiology, King's College London, Strand, London, WC2R 2LS. Tel: 0171 873 2477, fax 0171 873 2286, e-mail david.begley@kcl.ac.uk.

I am particularly anxious to update the address list for the BBB Group which has become very out of date. Especially, I would like to compile an e-mail list to facilitate communication between Group members. I would be very grateful if you could update your address and contact details by faxing or emailing them to me. Please do this even if you feel that I might already have them as I am constructing a completely fresh data base and this will ensure that the details are correctly recorded.

David Begley

CARDIOVASCULAR / RESPIRATORY CONTROL

I would like to extend a belated thank you to all speakers and chairmen at the 'Maturation, Modulation & Plasticity' symposium held at the Bristol Meeting last year. My feeling was that it was a fascinating day with a good balance of cardiovascular and respiratory presentations and provided a rare opportunity to put together scientists working in related areas.

This year we have Designated Sessions at the Liverpool (27-29 April) and Southampton (8-11 September) Meetings. There will be a Cardiovascular & Respiratory SIG symposium organised for the Liverpool Meeting entitled 'Cardiorespiratory Integration' in conjunction with the Spanish Physiological Society. This symposium has been organised by Professor KM Spyer. The speakers include Professors M de B Daly (London, UK), J Lopes-Barneo (Seville, Spain), DW Richter (Goettingen, Germany), S Dawid-Milner (Malaga, Spain) and Dr SW Mifflin (St Antonio, USA) and yours truly. Please note that Professor JM Marshall will give the Joan Mott Prize Lecture at this venue.

Looking ahead there will be a symposium on 'Regulation of Breathing' at the Prague Meeting (22-24 June) organised by Professor M Vizek and Dr P Kumar. At the Southampton Meeting I have invited Professor Lawrence P Schramm (Johns Hopkins University, USA) to give the Designated Lecture to our SIG. Professor Schramm has been interested in spinal interactions between the somatic and sympathetic nervous systems. Can I also draw your attention to a relevant symposia at this Meeting entitled 'Sleep & Breathing'.

Please feel free to drop me a line with suggestions for future Designated Lecturers and a symposium theme to be held in 1999 (e-mail:julian.f.r.paton@bris.ac.uk). Alternatively you are welcome to organise a symposium yourself. Although rather an early announcement it should be noted that in the year 2000 there will be the Second International Society for Autonomic Neuroscience (ISAN) meeting to be held in London. The first was staged in Cairns, Australia and provided an excellent forum for scientific interaction on a manageable scale. This will be a major international meeting which will include our research interests extensively. Enjoy the Meeting in Liverpool!

Julian F R Paton

EPITHELIA & MEMBRANE TRANSPORT

It was good to see a healthy turn out for the Designated Session at Guy's Hospital. There were some interesting Communications, and on occasions some very lively discussion. The next scheduled Session will be at the Southampton Meeting in September. In the meantime, however, I expect many will be tempted by the respective delights of Liverpool and Prague. At the Southampton Meeting I hope to have organised a Designated Lecture. There will also be a round of the Pfizer prize.

We are now making steady progress in preparation for the Designated Meeting to be held in Manchester from Monday 29 to Wednesday 31 March 1999. This will now incorporate the G I Tract, Renal, Placental & Perinatal Physiology Groups as well as ourselves. It is hoped that there will be three symposia and proposed topics are 'Anion Channels', 'Placental Transport Mechanisms: Today and Tomorrow' and 'Acid and Base transporters'. We hope to run events in a single lecture theatre on Tuesday and Wednesday (as

we did at the last Meeting in Manchester). This means that there may be a limited number of Oral Communications, and quite large Poster Sessions. We would welcome suggestions as to how we could encourage interaction at these Poster Sessions.

Peter Brown

GI TRACT

There will be a GI Tract Special Interest Group Designated Session at the Liverpool Meeting (27-29 April). The Paton Lecture in the History of Physiology will be given at the Meeting by Prof Dan Todes (Johns Hopkins) and is of particular interest to this Group as the topic is Pavlov's work on gastric secretion.

The next GI Designated Session will be at SmithKline Beecham, Harlow, Meeting (2-3 November) and following that at the Designated Meeting in Manchester (29-31 March 1999).

I would welcome suggestions for Designated Lectures and symposia for future Meetings.

I look forward to seeing you in Liverpool.

Paul Andrews

NEUROENDOCRINOLOGY

A successful symposium chaired by Dr David Potts (Leeds) on the subject of the neuroendocrine control of fluid balance was held at the Meeting at UMDS, St Thomas's, London on 6 November 1997, followed by an afternoon of free Communications on neuroendocrine topics. The symposium was organised jointly by this Group and the Renal Special Interest Group and centred on the modifying effects of reproductive status. It therefore attracted an audience with a relatively wide variety of interests. The reproductive aspects were covered in the first half of the symposium by Dr Jacques Durr (USA), who discussed fluid balance and the release of vasopressin during pregnancy, and Professor Mary Forsling, who described the changes in renal responsiveness to neurohypophysial hormones during pregnancy and lactation. Following the coffee break the possible mechanisms underlying the changes in renal function were discussed. Dr Rolf Postina (Germany) considered the role of neurohypophysial hormone receptors while Profesor Soren Nielsen (Denmark) covered the aquaporin family of water channels. The Session concluded with the ninth Mortyn Jones Memorial lecture. Mortyn Jones was a Member of the Society and worked at St Thomas's from 1971 until his death ten years ago. The tenth anniversary of his death was celebrated by a superb lecture by Professor Daniel Bichet (Canada) giving clinical and molecular insights into diabetes insipidus. Interest in the neurohypophysis continued into the afternoon with five presentations on oxytocin and vasopressin. Another theme running through several papers was that of diurnal variation in neuroendocrine function.
There will be two Designated Neuroendocrine Sessions in 1998, one at the University of Liverpool Meeting (Monday 27 - Wednesday 29 April) and the other at the Cardiff Meeting (15-17 December). The Liverpool Meeting is in conjunction with the Spanish Physiological Society and there will be a number of mini-symposia, including one on steroid hormone action and the central nervous system and another on cytoplasmic Ca^{2+} signals and secretion in endocrine and exocrine cells. At the Cardiff Meeting there will be symposia on transgenesis techniques and synaptic plasticity from early development to senescence, in addition to a teaching symposium The deadline for submissions to the Liverpool Meeting has, unfortunately, now passed, but the submission period for the Cardiff Meeting is 28 September - 8 October. Members of the Group are also encouraged to submit abstracts for the Meeting to be held in Prague this summer.

Mary L Forsling

RENAL PHYSIOLOGY

The main focus of news from the Renal Physiology Special Interest Group has been the change in Convenor. During the summer months David Potts had been actively seeking a successor to take over after his three years of leadership. Two contenders came forward and after an informal ballot of members of the Group, there was a dead-heat for both individuals. At the business meeting in November an equitable solution was agreed in which I would act as Convenor for two years until the Birmingham Meeting in December 1999 and then hand over to Stan White who would lead the SIG for a further two years. This arrangement, which has the agreement of the Society, means that the leadership will be assured for the next four years.

The SIG has been active over the past few months. At the November Meeting at St Thomas' there was a joint symposium with the Neuroendocrine Group on the control of fluid

balance which ranged from consideration of receptor activated processes, cellular mechanisms to integrated responses and finally clinical experience and management. The associated Renal Designated Session was lively with interesting contributions on fluid reabsorption at both a cellular and whole kidney level. The Designated Session at Guy's Hospital in January was slightly smaller but had a good representation of molecular biological, micropuncture and pathophysiological approaches to the study of kidney function which generated an active discussion.

The next Designated Session will be at the September Meeting in Southampton and we should be planning to attend and contribute. At present it is intended to have a specialist lecture incorporated into the Session and any suggestions for speakers would be appreciated.

Edward J Johns

RESPIRATORY PHYSIOLOGY

UMDS, St Thomas's, London Meeting, November 1997

The last ever Meeting of The Physiological Society to be held on the UMDS, St Thomas's site was appropriately marked with much reference to the past and even I was not immune to the mood of retrospection. Now, they tell me that nostalgia ain't what it used to be but as I lay in my hotel room watching an endless loop of CNN and MTV broadcasts I realised that I was beginning to miss staying in student Halls of Residence.

Sentimentalism was, however, not allowed to get in the way of a lively Respiratory Physiology Session held on Thursday 6 November and by the end of the day evidence had been presented by Dr Dorrington and Professor Guz to cause, respectively, some re-assessment of work by no-lesser worthies than Starling and Broca. Professor Abe Guz gave the Designated Lecture entitled 'Higher control of breathing - a neglected subject'. In his own inimitable way, he provided evidence gained primarily from the use of increasingly sophisticated, non-invasive, imaging techniques in human subjects to reveal a role for such higher control - at least in conjunction with speech and exercise. Although now somewhat less of a neglected subject due to the efforts of Abe and his colleagues, it was clear from the ensuing discussion that, to some, the 'Higher' of Professor Guz's title may refer more to the anatomical position of the cortex with respect to the brainstem rather than to any hierarchical control.

The remainder of the day was taken up with 16 Communications and 4 Posters and the discussion, I felt, was keener than usual leading to an interesting Session that wasn't impaired by the occasional projector malfunction. The range of topics was, as usual, wide although a recurring theme was chronic hypoxia - applied either in Dr Robbins' deluxe chamber in Oxford rather reminiscent of (but perhaps cheaper to stay in) than my Westminster hotel room or in what, from Dr Collier's description, sounded like a modified broom cupboard in St Barts. One study, arising from the Oxford group, that I found particularly interesting was presented by Dr Pedersen which showed yet more ways in which dopamine might not be involved in carotid body function. In the afternoon we moved to and filled a small lecture theatre for the final five Communications. In this, JM Thornton described clearly the influence upon breathing of believing you were cycling whilst under hypnotic suggestion. The authors had considered demonstrating this study but the thought of being under hypnotic suggestion whilst surrounded by your peers would certainly have reduced the potential volunteers. The pattern of breathing elicited during imagined exercise was qualitatively different to that observed during real exercise and as no tachycardia was noted in the hypnotised subjects, this lead to a discussion as to whether hypnosis was simply susceptible people doing what they felt was expected of them. Measures of involuntary variables are to be performed in the future and I look forward to following this study with my eyes open. Finally, Dr Turner paid the back-handed compliment of the day when in replying to Professor Saunders he began his answer by stating 'You may not realise it but that is a pertinent question'. If the ensuing laughter seemed a little nervous I'm sure it was because a few of us felt a bit uneasy at never having had that reply to any of our questions.

Future Meetings

There will be a Respiratory Physiology Special Interest Group Session at the Prague Meeting (22-24 June 1998) where we will also be hosting a Symposium entitled 'Respiratory Control: From Mechanics to Models' which I have organised with Drs Martin Vizek and Jan Herget. Invited speakers are Henry Gautier, Luc Teppema, Duncan Turner, Martin Vizek and John Widdicombe. Further details should be posted on the Society web page. I know my co-organisers in the Czech Republic are keen to make this a memorable occasion and I hope many of you have arranged to make the trip.

We will meet again in Southampton (8-11 September 1998) so please try to submit an abstract (submission dates 25 May - 4 June 1998). This is a joint Meeting with the British Pharmacological Society who have showed an interest in co-sponsoring our 'Sleep and Breathing' Symposium which Dr Doug Corfield has been instrumental in organising. Invited speakers for this are Peter Calverley, Doug Corfield, Neil Douglas, Mary Morrell, Phil Nolan, John Orem and Allan Pack. Again details should be available on the web page.

I hope to see you in Liverpool shortly. I can recommend the mini-symposia on 'Cardiorespiratory Integration' and the one on 'Ion Channels: Structure, Function and Modulation' as well as the Tate Gallery and the round trip on the Mersey ferry.

Prem Kumar

SENSORIMOTOR CONTROL

You will see from the details of the Liverpool Meeting that we have a full and varied programme for the first Sensorimotor Control Session of '98. Two further Sessions are planned for this year; one at the Meeting in Prague in June and the other in Cardiff in December.

The Meeting in Prague (22-24 June) is a Joint Meeting with the Czech Physiological Society and will feature a mini-symposium entitled 'Regulation of muscle tone and tension', organised by Pavel Hnik and Peter Ellaway. This will be a three hour symposium which will include four contributions from the principal speakers - Martin Lakie, John Riddell, Arthur Prochazka and Uwe Proske, and four communications selected from abstracts submitted for the Meeting. There will be a summary/conclusion by Sir Andrew Huxley.

At the Meeting in Cardiff (15-17 December), a Pfizer Prize round will be held. This is an award (£150) made to postgraduate students for Oral Communications presented in Designated Sessions (further details can be found on page 172 of the new *Grey Book* and on the Society's Web site). If you have a postgraduate student then please encourage them to consider presenting their work at this Meeting.

For those who didn't get to the St Thomas's Meeting, the following are a couple of points discussed at the Business Meeting. Firstly; the Society can no longer bear the cost of postal mail shots to members and so communications about the Group will in future be via email. Information on members' e-mail addresses should now be up to date and you should have received e-mail messages about the Group's activities. Should your e-mail address change then please let the Society know. Secondly, the Society has set up page markers on the Web site for Special Interest Groups to utilise. As a start, I intend to organise a Notice Board page. This will contain information about the activities of the Group and will be updated as new information becomes available. Another of the possibilities discussed was to have a list of members' interests with links to members own Home Page where applicable. Any other suggestions would be welcome.

John Riddell

SOMATOSENSORY PHYSIOLOGY

UMDS, St Thomas's, London Meeting, 6-8 November 1997

The Somatosensory Physiology Special Interest Group celebrated the last Meeting to be held at the Sherrington School of Physiology with a symposium and a busy Designated Session that was split over two days. The symposium, which was held on the Thursday before the main Meeting began, dealt with 'Parallel regulation of somatosensory processing with other physiological systems', and featured excellent talks from John Coote, Peter Redgrave, Thelma Lovick, Alex Waters, Al Randich, Peter Thoren, Dave Bennett (standing in for Steve McMahon) and Pat Wall. The first five talks considered the behavioural context of somatosensory control and the interactions between the somatosensory, cardiovascular and immune systems. Appropriate physiological and behavioural responses to noxious stimuli are essential to survival and sensory systems are regulated within the overall remit of responses to threat. Coote, Lovick and Waters covered some of the integrating centres co-controlling sensory and cardiovascular parameters (the PVN as a homeostatic centre for extracellular fluid volume control and the PAG as a general coordinator of defensive physiology), while Redgrave considered the role of the superior colliculus as a locus for production of integrated behavioural reactions to pain and Thoren showed how endogenous opioid peptides regulate sensory and immune responses in stressful situations. Al Randich explored how signals emanating from the

cardiovascular system influence somatosensory processing, in particular the inhibitory effects of vagal afferent stimulation. He showed how this may involve 'on' and 'off' cells in the rostral ventromedial medulla, and suggested that these cells may be primarily cardiovascular in function. The last two talks dealt with peripheral and spinal factors that regulate sensory, autonomic and somatic motor function. Dave Bennett showed how the neurotrophins have major (and similar) effects on somatosensory and autonomic spinal systems, while Pat Wall revived a subject that has rather gone out of fashion in recent years: presynaptic inhibition at the primary afferent terminal and how it is effected. His evidence suggests that neurones in the superficial dorsal horn with axons in the tract of Lissauer are responsible for the generation of PAD. I found the symposium to be very exciting and highly encouraging. It seems that there is life in the old dog of integrated physiology yet. I am grateful to all of the contributors for making the event a terrific success.

The Designated Session started after the symposium on Thursday evening and carried over to the Friday morning. There were 11 Oral Communications and two Posters. Two of the most interesting dealt with visceral matters. JDD Allan and colleagues showed how irrigation of the renal pelvis with capsaicin was able to relieve otherwise intractable renal pain for 3 - 4 months. Apparently (and unsurprisingly) application of the capsaicin treatment itself caused heart rate and respiration rate to increase by 50% and blood pressure to rise by 20 - 30 mmHg. If this makes your eyes water, you will be soothed to learn that the irrigation was performed under general anaesthetic! This paper was followed by one from Andrea Houghton and colleagues, in which evidence was presented to suggest that nociceptive afferent signals from the pancreas follow a specific pathway to the thalamus via the dorsal columns, an unusual route for visceral information to follow. We had one entry for the Pfizer Prize, who was considered in competition against some presenters at the Cambridge Meeting, and won one of the two prizes awarded! The victor was Russell Monhemius, from Malcolm Roberts' lab, who gave a stimulating Communication on the nature of a possible negative feedback pathway for nociceptive signals, involving neurones in spinal lamina I and the paragigantocellular neurones of the medullary reticular formation. Many congratulations to him. All the talks in the Session were excellent, and I am sorry to not to mention everyone.

Future Meetings

The Group will be convening in 1998 at the Liverpool Meeting, for which this Magazine has been produced, and at Cardiff in December. We will definitely be having a social evening in Cardiff, although I am not sure what form it will take as yet. There will be Designated Lectures at both Meetings. For Liverpool, Carlos Belmonte from Alicante will be giving a talk entitled 'Primary nociceptive neurons: what makes them nociceptive?'. In Cardiff, our lecturer will be Jonathan Cole, from Poole General Hospital who is consultant to Ian Waterman 'The Man Who Lost His Body'. He is going to talk about large fibre neuropathies. There will be another Pfizer Prize round in Cardiff, and it would be nice to have lots of entrants! I hope to see you at the Liverpool Meeting.

Rob Clarke

Pfizer Prize

At the Society Dinner in Cambridge on Tuesday 16 December, Dr Clive Long the representative from Pfizer Ltd, Sandwich, Kent presented a prize cheque for £150 to Mr Graham Christie of the Department of Physiological Sciences, University of Newcastle upon Tyne for his winning presentation at the Bristol Meeting in September 1997. For information, there was another winner at the Bristol Meeting - Miss Anneli Conway from the Department of Physiology, The Medical School, University of Birmingham - and she was presented with her prize cheque at the UMDS, St Thomas's Meeting in November this year.

Graham Christie (left) and Clive Long

TRICKS OF THE TRADE

A ONE DAY TEACHING SYMPOSIUM on PCR AND EXPRESSION SYSTEMS IN PHYSIOLOGY at University of Liverpool on Thursday 30 April 1998

ORGANISERS: Janet M Allen, R Dimaline and G J Dockray

Details of the Teaching Symposium for the Meeting of The Physiological Society in Liverpool are given. This Symposium builds on the successful meeting 'Jargon-free Molecular Biology for Physiologists' held in Sheffield in January 1997.

This Teaching Symposium will focus on two techniques used in physiology. As for the Sheffield meeting, speakers have been asked to keep talks as jargon-free as possible and to demonstrate the flexibility of these techniques rather than give research presentations.

9.00 - 9.15 Introduction - aims of the teaching day (Richard Boyd, Oxford)

PCR - Basic principles - Chair Richard Boyd, Oxford

9.15 - 9.55 The Polymerase Chain Reaction (Rod Dimaline, Liverpool)

9.55 - 10.15 Reverse transcription PCR (Janet Allen, Glasgow)

10.15 - 10.45 COFFEE

Uses of PCR (20 mins each) Chair - David Eisner, Liverpool
(i) measurement/characterisation of mRNA species

10.45 - 11.05 Quantitative RT-PCR (Stan White, Sheffield)

11.05 - 11.25 In situ PCR (Fraser Lewis, Leeds)

11.25 - 11.45 Single cell RT-PCR (Thierry Capiod, Paris and Abdul Sesay, NIMR)

Uses of PCR
(ii) molecular engineering

11.45 - 12.05 Introduction of restriction sites to make receptor chimeras (Paddy Harrison, Edinburgh)

12.05 - 12.25 Mutagenesis/probe synthesis (Rod Dimaline, Liverpool)

12.25 - 12.45 Differential display (Tony Jackson, Cambridge)

1.00 - 2.00 LUNCH

EXPRESSION SYSTEMS Chair - Graham Dockray, Liverpool

2.00 - 2.30 Expression in Mammalian cells: (i) Cell lines (Annette Dolphin, London)

2.30 - 3.00 (ii) Primary cells - viral vectors (Russell Thompson, Glasgow)

3.00 - 3.30 TEA

3.30 - 4.00 Expression in oocytes (Malcolm Hunter, Leeds)

4.00 - 4.30 Overexpression of proteins (Bob Burgoyne, Liverpool)

Brain-drain warning over UK lab facilities

Baroness Blackstone, Britain's government minister responsible for universities, warned whilst giving evidence to the House of Commons Select Committee on Science and Technology that unless research facilities are improved an increasing number of Britain's brightest graduates will seek research positions in the United States.

NATURE 391 29 January 1998 p.422

Source: SPIN

Labour flatlines UK science spending

The 1998-99 science budget will rise only slightly in cash terms and will decline about 2.3% in real terms, as the Labour government sticks to the spending plans of its Conservative predecessor at least until the spending review is complete this summer.

SCIENCE 279 23 January 1998 p.469

Source: SPIN

Polarisations

Dear Editor

What interesting polarisations of opinion the recent issues of the *Magazine* have thrown up! In the Autumn issue, on the one hand, we see Maynard Case having a throwdown about the inclusion of historical articles; in the Winter issue, on the other hand, we find a plea from two younger members for more attention to traditional imperatives.

I once, for my sins, ran an institutional library-users' committee and Maynard's reaction had a ring of *déjà vu* about it. I was reminded of the statement made to me by a prominent microbiological colleague that - 'the way to save library space and money is to throw out all journals after 5 years, since nobody would read anything older than that'.

The concern of Affiliates Andrew Binks and Annick Moon, that systemic physiology is being eroded by reductionist molecular techniques, was more refreshing. With the large number of training programmes in molecular biology and its high public profile, it it nice to be reassured that at least some younger scientists recognise the centrality of *in vivo* studies. I suspect and hope that their fears are exaggerated. Certainly molecular approaches are at the forefront of research in many areas, but even the molecular biologists are beginning to realise that they provide a tool rather than a philosophy and that finding the important questions to ask (as well as validating the apparent answers) relies on people who understand the whole organism.

To this extent, I would suggest that the current preoccupation with molecular studies is analogous to other, recurrent preoccupations with new analytical tools as they become available - for example, intracellular recording in the 1960s and immunolocalisation in the 1980s. And maybe the current situation has not changed all that much. I have just scanned the December 1997 issue of the Journal (vol 503, no. 3); of the 25 papers, 2 report human studies and 6 deal with intact animals. This is not notably different to the equivalent issue in 1987, where 2 of 48 papers concerned human studies and 10 of 48 reported intact animal experiments.

Nothing I have said negates the problems that Binks and Moon identify. Of course it is essential to have adequate training programmes in systemic physiology. Of course there is a danger to this training if an undue emphasis develops on reductionism. And undoubtedly the current fashions dictate that funding for expensive molecular research is easier to obtain than funding for cheap systems research. Nevertheless, ample training opportunities in systems physiology are available (contacts can be made through the appropriate Special Interest Groups) and a large amount of productive systems research is carried out and published. Finally, physiology graduates trained in cellular techniques should have no difficulty in adapting to *in vivo* research and would be doubly marketable by virtue of their broad background.

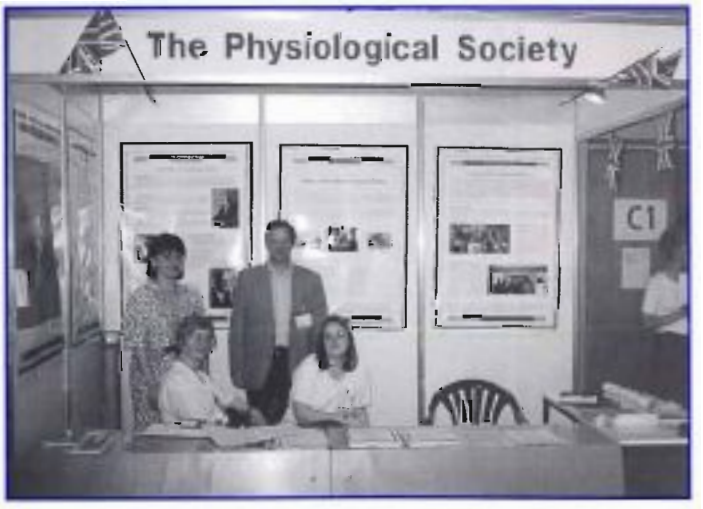
With best wishes and thanks for maintaining the high standard of the *Magazine*.

Christopher Bell

The Physiological Society's Exhibition at the St. Petersburg 1997 International Congress

Dear Editor

In the Article 'Catch 33 - From Russia with Physiology' (*Magazine*, Winter 1997 issue No 29), The Physiological Society's Exhibition Stand is referred to as having been 'impounded in the customs shed' and it said that it 'never' actually made it to the meeting'. Let me set the record straight: The posters for the exhibition stand and associated material did not make it to the first half of the congress, not because of any inefficiency in Russian customs, but because the material was mistakenly unloaded by the carrier in Helsinki rather than



Nina Burdakova, Joan Abbott, Philip Harrison and Charlotte Parry at The Physiological Society's Exhibition Stand

St Petersburg. As soon as Nina Burdakova and Charlotte Parry arrived in St Petersburg, on the day before the Congress opened, they made enormous efforts first to locate the missing stand and then arranged for its transfer to St Petersburg. The local organisers were extremely helpful and the customs officials cleared our material very rapidly, as a matter of extreme urgency, when it finally arrived. The fault was entirely with the company responsible for organising the transport from London to St Petersburg (and for the record: it was not a Russian airline).

The stand did actually make it to the meeting, as seen on the photograph taken by me on Friday 4 July. During the last days of the Congress, Charlotte and Nina, ably assisted by many Society Members welcomed a large number of visitors to the complete stand and distributed a very substantial number of leaflets and Society publications.

Ole Petersen (Foreign Secretary)

Apologies

Apologies to Ole Petersen and all concerned. I reported events (erroneously, it turned out) as I had understood them. Apologies also to Professor Stanley Salmons for the editorial mistakes in his letter which appeared in the last issue of the *Magazine* 'critisising' was spelt 'critisizing' and there was an omission of a comma after the parenthetic phrase "encouraged by journals..... number of references,".

Saffron Whitehead

Trust me, I'm a scientist

In an opinion piece, Dr Paul Wymer, Science Communication Consultant, argues that despite 10 years of the public understanding of science (PUS) movement, there is no clear agreement on what is meant by 'public' 'understanding' or 'science'.

BIOLOGIST February 1998 Vol. 45 No. 1 p.48

Source: SPIN

Multidrug resistance-associated proteins (MRPs) physiological or pathological functions?

Atticus Hainsworth and Stephen Hladky give their up-to-date news on MRPs and discuss how these transporters may be cytoprotective in both normal and abnormal cells.

Six multidrug resistance-associated proteins are now known, each with a distinct pattern of tissue dependent expression. MRP1 is associated with resistance to cytotoxic drugs in tumour cells, but is also widely expressed in normal cells. MRP2 is localised primarily in the canalicular membranes in the liver, where it functions as the multiple organic anion transporter. The thiol compound glutathione (GSH) appears to be intimately involved in both MRP1 and MRP2 activity. MRPs 3-6 are proteins in search of a function. One possibility is that they are glutathione-S-conjugate (GS-X) pumps and play a cyto-protective role, removing toxic species from the cytoplasm as GS-conjugates.

MRP1 is an ATP-binding cassette protein

The first of the MRP proteins to be identified (MRP1) was cloned by Cole and Deeley in 1992. Based on its primary sequence, the 190kD MRP1 is clearly a member of the large family of ATP Binding Cassette (ABC) proteins. Yeasts, plants, protozoal parasites and bacteria all have ABC-type transporters for ions, amino acids or peptides; some remove xenobiotic (i.e. foreign, toxic) compounds and heavy metals from the cytoplasm, often in thiol-conjugated form. Examples of mammalian ABC proteins are the multidrug transporter P-glycoprotein, the cystic fibrosis transmembrane conductance regulator (CFTR) and the sulphonylurea receptor (see Table 1). Thus it seems likely that MRP1 either is, or modulates, a transporter molecule. Transfection of the MRP1 gene into sensitive tumour cells alters cytotoxic drug accumulation, further supporting a transport-related role for MRP1. Its detection in various malignant cancers *in vivo* makes MRP1 a tempting target for strategies designed to circumvent clinical resistance. The other five known MRPs have strong sequence homology to MRP1 (>55% C-terminal identity).

MRPs, glutathione and heavy metals

Both MRP1 and MRP2 transport glutathione-S-conjugates (GS-X), formed when reduced glutathione (GSH) is covalently linked to molecules via the thiol group. The conjugations are catalysed by cytoplasmic glutathione-S-transferase enzymes, various isoforms of which are present in most tissues. The GS-conjugated leukotriene LTC_4, oxidised glutathione GSSG (but not GSH itself) and GS-dinitrophenol are all transported with similar rank-order of efficacy by both MRP1 and MRP2.

Amino acid sequence identities for MRP's and other ABC proteins

ABC protein	*% identity for the carboxy terminal 124 aa's relative to MRP1*[a]	*% identity for the entire sequence relative to MRP2*[b]
MRP1	100	49
MRP2	67	100
MRP3	75	
MRP4	60	
MRP5	55	
MRP6	58	
human SUR	48	33
Leishmania ltpgpA	42[c]	
yeast YCF1		41
MDR1 human P-glycoprotein		25
human CFTR		31

[a]Kool et al., 1997; [b] Keppler & König, 1997; [c] Cole et al., 1992.

Table 1

MRP1-dependent expulsion of anticancer drugs also appears to require GSH. For some of these agents, the conjugates (e.g. GS-melphalan) can be handled by MRP1 but it has not yet been proven that such conjugation takes place in vivo. Alternative hypotheses are that GSH and unconjugated drug are co-transported by MRP1, or that GSH modifies the drug and/or the MRP1 protein such that drug transport can occur. In any case glutathione is clearly important for the function of MRP1 and MRP2. GS-X pump activity is found in many normal tissues: erythrocytes, liver, intestine and kidney. A highly intriguing possibility is that these GS-X pumps may also be MRPs.

One of the closest sequence homologues of MRP1 is the ltpgpA protein of the protozoan parasite, *Leishmania (Table 1)*. This protein confers resistance to the arsenic and antimony-based drugs used therapeutically to control *Leishmania* infections, accompanied by a reduction in drug accumulation. Another close homologue, YCF-1 in yeast, confers resistance to cadmium. MRP1 itself, when transfected into HeLa cells, confers mild resistance to As and Sb compounds and when overexpressed in human lung tumour cells is accompanied by decreased accumulation of arsenate V. Given the deduced importance of GSH in MRP1 function and the readiness with which heavy metal species interact with thiol groups, it seems likely that GSH or some other thiol compound is involved in the above heavy metal handling effects.

MRP1 in normal tissues

Immunocytochemical staining has shown clearly that MRP1 is present in normal human tissues, including the epithelial cells lining the airways and the gastrointestinal tract *(Table 2)*. Its function there is unknown, but may be protective, akin to the removal of toxic species performed by ABC proteins such as ltpgpA and YCF - 1 in lower organisms. Conversely, the observation that MRP1 can transport peptidyl-leukotrienes raises the possibility of

Expression of MRP proteins in various tissues.

Tissue	*MRP1*	*MRP2 (MOAT)*	*MRP3*	*MRP4*	*MRP5*
Respiratory:					
Lung	HIGH	0	low	low	low
GI/splanchnic:					
Stomach	HIGH	0	low	0	low
Duodenum	low	low	HIGH	--	--
Colon	HIGH	0	HIGH	0	low
Liver	0	HIGH	HIGH	0	low
Gall bladder	HIGH	--	--	low	low
Spleen	HIGH	0	low	0	low
Endocrine:					
Thyroid	HIGH	0	0	0	low
Testis	HIGH	0	0	0	low
Adrenal	HIGH	0	HIGH	0	low
Ovary	low	0	0	0	low
Pancreas	low	0	low	0	low
Genito-urinary:					
Kidney	HIGH	low	low	low	low
Bladder	HIGH	0	low	low	low
Excitable tissue:					
Nerve	low	low	0	0	low
Brain	low	0	0	0	HIGH
Skeletal muscle	low	0	0	0	HIGH
Heart	low	0	0	0	low

HIGH = high expression; low = low expression; 0 = no expression; -- = not determined
Adapted from Kool et al (1997)

Table 2

its involvement in inflammatory conditions, such as asthma. In many normal cells, MRP1 appears to be localised to intracellular membranes (rather than the plasma membrane) hence its function there may be different from that in malignant cells. It is possible that overexpression in tumour cells leads to translocation of MRP1 from intracellular sites and thus to changes in its cellular function.

MRP2 is an export pump in the bile duct

The multiple organic anion transporter (MOAT) of the bile duct has recently been shown to have high homology to MRP1 and is now termed MRP2. This protein is largely confined to the apical, canalicular membranes of hepatocytes and contributes to detoxification and bile flow. Many of its substrates are divalent amphiphilic anions; most are glutathione, glucuronide or sulphate conjugates, examples being bilirubin, oestradiol and bile salts. Defects in MRP2 underlie Dubin-Johnson syndrome, a mild hyperbilirubinaemia. Thus at least one MRP homologue has a clear physiological role. MRP2 is also almost certainly the glutathione-S conjugate pump responsible for cisplatin resistance in some leukaemia cell lines, as originally described by Ishikawa and colleagues.

Other MRP isoforms

Each of the MRPs has a distinct pattern of expression in normal tissues (Table 2) and this may give clues to its physiological role. For example, MRP3 is expressed at high level in liver, MRP4 is spread sparsely amongst the tissues and MRP5, present to some extent in most tissues, shows highest expression in skeletal muscle. Why there are so many different forms and what endogenous substrates they transport is unknown. The picture will become clearer as the substrate profiles of these different isoforms are characterised. None of the recently-identified human MRP isoforms (MRP3-MRP6) has yet been associated with drug resistance in tumour cell lines.

At least some of the MRPs may be transporters responsible for protecting normal cells from cytotoxic damage - due to xenobiotics, inflammation or oxidative stress. Far from being targets for inhibition, it may be that the actions of the MRPs should be augmented in normal tissues. For instance they may act to export xenobiotics as GS-conjugates. In normal cells MRP substrates may be transported either into a cytoplasmic compartment for expulsion, or directly across the plasmalemma. The lung expresses several MRPs, with a high level of MRP1. Inhaled pollutants, especially electrophilic species, may be labelled for export by the addition of a glutathione group. Alternatively or in addition, the lung may play a plasma detoxification role similar to that of the liver for some intoxicants, since the lungs receive the entire cardiac output and contain numerous conjugation enzymes.

Another more speculative possibility is that one or more of MRPs 3-6 may export GSH into the extracellular fluid of the lung. The lung airway lining fluid contains 5-10mM GSH. This is a higher level than in other extracellular fluids (plasma contains only micromolar amounts) which may serve to protect against inhaled oxidants.

We would like to thank Dr MA Barrand for introducing us to this subject and for her continuing advice and encouragement. We are grateful to Drs D Keppler and P Borst for pre-prints of their papers and to the MRC and the Wellcome Trust for financial support.

*Atticus H Hainsworth and Stephen B Hladky**
School of Life Sciences
University of Greenwich, London
** Department of Pharmacology*
University of Cambridge

Further reading.

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Keppler D & Koenig J (1997) *FASEB J.* **11**: 509-516

Kool M, de Haas M, Scheffer GL, Scheper RJ, van Eijk MJT, Juijn JA, Baas F & Borst P (1997) *Cancer Res.* **57**: 3537-3547.

Results of the Caption Contest

Readers were invited to compose a caption for the photograph of Chris Fry and Heather Dalitz.

The entries were judged (anonymously) by several Members of the Society.

The winning entry was:

"**Chris:** *I see that you haven't lost your knack for dealing with Members.*
Heather: *It seems the concept of a Meeting has moved on since I worked for the Society."* From Phil Harrison

And *"How can I show you how big it is if you won't give me my hand back?"* Gareth Leng was awarded a meritorious mention.

They will each receive a bottle of wine.

Joint Meeting in Prague. 21-25 June, 1998

The Joint Meeting of The Physiological Society and the Czech Physiological Society was already being planned in 1969. One of us (PH) approached Dr E Denton and preliminary arrangements were on the way, when historical events intervened. The 1998 Meeting will take place in the year of the 650th Anniversary of the Founding of Charles University by Charles IV in 1348. The Opening Ceremony and a reception will take place in the historical building of the Carolinum and the Inauguration Hall (Fig.1).

After tempestuous times in the intervening centuries, the Czech University was closed down during the German occupation on 17th November 1939 and its activities were not renewed until after the end of World War II in 1945. A brief survey of the physiological institutes in our country and in Slovakia was published in the June Issue of *The Physiological Society Magazine* in 1993 (No. 8), pp. 6-7. Here, only the main Prague institutions will be mentioned.

University Physiological Institutes in Prague

- Institute of Physiology, First Faculty of Medicine (head: S. Trojan) was founded by J E Purkyně (known as Purkinje in the literature) in 1851 and was the second independent Physiology Institute in the world. The first institute was also founded by Purkyně in Breslau (Wroclaw) in 1839. Besides pedagogical work, research in this institute is mainly centred on the study of prenatal and postnatal development of the CNS and its reactivity to changes in the internal and external environment (M Langmeier, J Pokorný).

- Physiological Institute, Second Faculty of Medicine (head: J Herget). This Institute is specialized in the field of pulmonary circulation under normal and pathological conditions and has close collaboration with a number of laboratories abroad. Another research group is engaged in studying the basic mechanisms of memory and learning (G Brožek).

- Department of Neuroscience, Second Faculty of Medicine (head: E Syková). Besides pedagogical work, research in this newly-formed department focuses on the membrane properties of nerve cells (A. Chvátal), function of glia, ionic and volume homeostasis in the brain, diffusion parameters in nervous tissue and mechanisms underlying various pathological states.

- Institute of Physiology and Clinical Physiology, Third Faculty of Medicine (head: R Rokyta). Research mainly concerns the mechanisms of pain, central projections and factors affecting pain perception during ontogenesis and adulthood. Furthermore, problems of learning and memory (J Myslivečková), and respiratory functions in sportsmen and in patients with cardiac and respiratory diseases are being investigated.

- Department of Physiology and Developmental Biology, Natural Sciences Faculty (head: J Paleček). The research activities concern the study of temperature control and physiology of fever (L Jánský), phospholipid changes in myocardial cells during hypoxia and overload (O Nováková), peptidergic innervation of the pineal gland (R Novotná) and phosphoinositide metabolism in platelets of schizophrenic patients (A Strunecká). Furthermore, muscle energetics (J Mejsnar) and the release of excitatory and inhibitory transmitters in the peripheral and central nervous system are being studied, especially in relation to quantal and non-quantal release of ACh at the neuromuscular junction (F Vyskočil).

Fig 1. Historical building of the Carolinum (upper) and Inauguration Hall with the statue of Charles IV (lower)

Physiological Institutions of the Academy of Sciences

- Institute of Physiology, ASCR (director P. Mareš) was founded in 1952, has 225 employees, of which 100 are university graduates. The scientific activities cover three main areas of basic medical research.

Molecular and Cell Physiology: This division comprises six departments, three of which are studying the structure and function of mitochondrial energy-converting proteins and the molecular basis of human mitochondrial diseases (J Houštěk), the ectopic mitochondrial uncoupling protein in white fat and thyroid hormone metabolism in premature babies (J Kopecký) and molecular mechanisms of ion transport and atypical ion channels (P Ježek). Amino acid and sugar transport in yeast and animal cells are being investigated in another department (J Horák). Cell cycle kinetics are being studied in glial and smooth muscle cell cultures as well as the neutron-capture reaction in brain tumour cells (V Mareš). Membrane receptor physiology is followed in melatonin receptors in relation to seasonal rhythms, their distribution and functional significance and melatonin action on pituitary gonadotrophs (J Vaněček).

Cardiovascular Physiology: Three departments are concentrated on developmental cardiology, changes induced by chronic hypoxia, the development of cardiac function and adaptation to an increased work load (B Oštádal), the genetic, environmental and metabolic factors involved in the pathogenesis of hypertension (J Kuneš) and genetic aspects of spontaneous hypertension (M Pravenec). The influence of dietary salt and protein intake on the development of renal and intestinal ion transport, and glucocorticoid metabolism is studied in experimental hypertension (J Pácha). Environmentally deleterious compounds especially upon connective tissues are studied by I Mikšik and collaborators.

Departments of Neurophysiology: Control of the synthesis and release of ACh and noradrenaline by presynaptic receptors, muscarinic ACh receptors and their ligand-binding properties (V Doležal). Two departments are involved with models of experimental epilepsy, brain metabolism during ontogeny and neuroprotection in treating epilepsy (F St'astný) with special reference to antiepileptic drugs and the role of the GABAergic system and antagonists of excitatory amino acids during development (P Mareš). Developmental aspects are also being followed in denervation-reinnervation studies of muscle mechanoreceptors and extrafusal muscle fibres (T Soukup). ACh release at the neuromuscular junction and synaptic transmission between hippocampal and spinal cord neurones and peripheral mechanisms of pain are investigated using cultured dorsal root ganglion cells (L Vyklický, F Vyskočil). The mammalian time-keeping system is studied by resetting of the circadian pacemaker by photic and non-photic stimuli (H Illnerová). Behavioural models are employed for analysing neural mechanisms of learning and memory, and regeneration of brain tissue as a model of plastic processes related to memory (J Bureš, J Křivánek).

The institute publishes the journal *Physiological Research* (formerly Physiologia Bohemoslovaca) which was founded in 1952.

- Institute of Experimental Medicine, ASCR (director J Syka) was founded in 1975 by the fusion of several independent laboratories of the Academy of Sciences. The institute has 95 employees comprising 8 departments.

  Two departments are studying cell biology and cellular ultrastructure, namely the identification of the location of DNA and RNA synthesis, organization of the cell nucleus and conditions leading to pathological processes (I Raška) and with nuclear activities in relation to the cytoskeleton (P Hozák). Signal transmission between nerve cells, ionic homeostasis of the

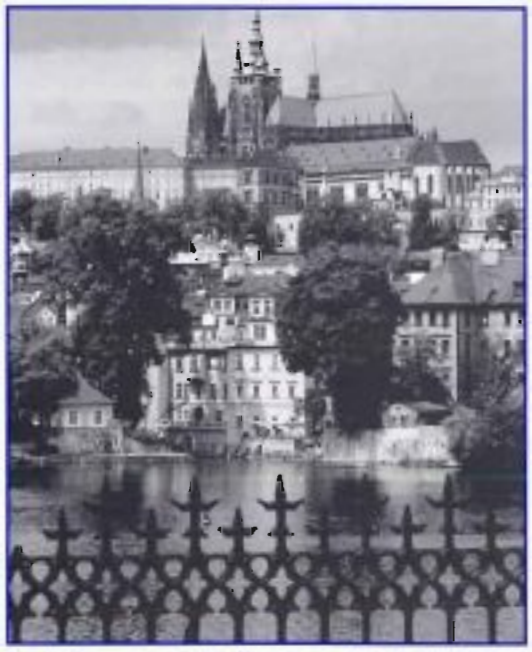


Fig 2. Panorama of the Prague Castle with the river Vltava in the foreground.

extracellular environment during development and pathological conditions and neurone-glia interactions (E Syková) and acoustic signal processing in the central auditory system of mammals are investigated under physiological and pathological conditions (J Syka). The enzymatic basis of the physiological and pathological processes in the eye, particularly the cornea, is being studied (J Cejková), as well as developmental aspects of mouse odontogenesis with the aim of elucidating the causes of several dental defects in man (M Peterka). The genotoxic action of different chemical mutagens is being investigated in relation to their pathological actions in experimental animals and man (R Srám) and in relation to different stages of animal development (P Vodička).

Members of both these Academic institutions also participate in teaching at the University.

It gives us great pleasure to invite members of The Physiological Society to participate in the Joint Meeting in Prague later this year. We all hope that you will find this Meeting interesting and that you will enjoy visiting our beautiful city (see fig 2).

Pavel Hnik
Richard Rokyta
Eva Syková

The Monument to Pavlov's Milk Lady

"They also serve who only stand and wait"

Statue of Pavlov and dog at the entrance to the village of Koltushi

Well, she did rather more than wait, but she certainly served! She served milk (and I would guess eggs and goodness knows what else that she could find in the village) to one of the greatest physiologists of this century, Ivan Pavlov. Katri Peltonen was her name, Finnish in origin as the name suggests.

The Institute that Pavlov established is situated next to the small village of Koltushi, an hour or so drive from St Petersburg. I was rushed there together with the General in charge of the Military Medical Academy towards the end of the St Petersburg Congress last July to represent the world physiological community at the dedication of a beautifully-designed memorial to Katri Peltonen in the grounds of the Institute. The house where she must have arrived each morning with her churn and basket is still there, so it was not hard to imagine the cold and often harsh scene in the periods of famine in the years following the Russian Revolution. Her activities kept Pavlov and his famous dogs alive.

The monument to Pavlov's Milk Lady surrounded by villagers

We arrived in the ample grounds of the park surrounding the Institute to the sound of a young flautist, and were joined by representatives from other organisations. I expected to find representatives of other Societies, such as the Finnish, Russian and American Physiological Societies. What was charming about the event though was the fact that the villagers also turned up in force, clearly proud of the fact that one of their former members was being honoured in this way. It was good to see a Physiological Institute recognise the community in which it lives in this way.

Denis Noble playing Pavlov

The Institute itself is still active as a major research centre. It also houses a museum of Pavlov material, including the famous chamber in which he conducted his dog experiments. In fact, you can still activate the bell that he used, and look through the window into the chamber. Pavlov's experiments could be performed today just as he performed them himself.

What will inevitably come to be called the Milk Lady Monument was financed by contributions from the International Union of Physiological Sciences; the American, Finnish, Nordic and Russian Physiological Societies; The Russian Academy of Sciences; the St Petersburg Foundation (Finland); the Savo Foundation (Finland); and the Savo Language Society (Finland).

Denis Noble
Secretary-General of IUPS

Dearing and the Digital Teacher

John Dempster who has recently joined the Magazine Editorial Group discusses the implications of the Dearing report with regard to physiology teaching.

The past 10 years have seen dramatic changes within the university system - a doubling of student numbers; increasing diversity of type of student; the pervasive spread of information technology within society; increased demands for accountability with assessment and quantification in the form of RAE and TQA; radical changes in teaching styles such as the introduction of the problem-based medical curricula.

"Useful" and "accountable"

The Dearing report can be seen as an attempt to get a handle on these issues. Although most of the publicity concerning the report has focused on the issue of student funding and tuition fees, its reassertion of the importance of teaching (as opposed to research) within the higher education system is bound to impact us as physiology teachers.

In particular, the report draws attention to a number of issues.

- There is a need to ensure the maintenance of degree standards and teaching quality in the face of a rapidly expanding and changing system and that an Institute for Learning & Teaching is needed to promote this.
- Emphasis should be placed on student-centred learning as opposed to more didactic styles of teaching.
- Communications and information technology (C&IT - yet another fashionable acronym) have a lot to contribute in the promotion of student centred learning.
- C&IT cost a lot of money and that universities must have an institutional policy for it.
- The development of 'transferable skills' (which include significant IT skills) should be part of all degrees.

These ideas fit well with the government's views on education being 'useful' and education providers being 'accountable'. The apparent prospect of the use of computer-based tools as a cost-effective means of dealing with the increased student numbers is also likely to have an irresistible appeal.

Defining physiology

The raising of these issues begs the general question of who ultimately defines what 'physiology' is and how it is taught? Ten years ago this process of definition was a semi-private exercise, formed from an implicit consensus within the profession which consisted of those who called themselves physiologists, wrote physiology text books, and designed the courses in universities. Nowadays, and particularly with the changes proposed by Dearing, this process is increasingly carried out publicly with the involvement of other agencies such as quality assurance bodies each with varying agendas.

A degree in physiology may soon be expected to meet certain characteristics that are common to all degrees, eg explicitly containing transferable skills. We may also need to be more specific in defining the exact constituents of the degree. Such changes need not be feared and many are probably positive. However, it may require a more explicit discussion of aims and objectives than in the past.

C&IT - uses and misuses

Dearing concludes that there is a need to develop better procedures for quality assurance and effective implementation of computer-based teaching media. Suggestions include a strong role for the proposed Institute for Learning & Teaching in this area and a quality 'kite mark' for good software. The issue of using computer-based simulations, tutorials and similar packages may no longer be only one for the enthusiast, or for policy making solely at departmental level. Physiology teaching, like many other basic sciences, has an expensive laboratory base. We may ultimately be challenged by proposals that such expensive laboratory experiments ought to be replaced by cheaper simulations.

Computer-based approaches to teaching clearly have their merits, but we need to develop a more considered view on their strengths and weaknesses. Is there, for instance, an upper limit to its use in the curriculum, beyond which it might actually devalue teaching quality? Effective learning is probably best delivered using of a variety of modes of teaching which may include the old fashioned lecture, tutorial, writing essays (even in long hand) and real (not simulated) experimental work.

We also have to deal with the changes being wrought by IT. The Internet, for instance, could open up the possibilities of new and different ways of delivering education. As academics, we might need to get used to cooperating (or competing) with publishers and other commercial operations.

Softly softly

Much of the computer-based teaching courseware that is in current use has been developed piecemeal over the past 10 years or so by enthusiasts. This process has been accelerated by the injection of substantial funds from projects such as the Computers in Teaching Initiative and the Teaching & Learning Technology Programme, but we are a long way from fully exploiting this medium.

Good software certainly does exists and, as Dearing comments, the UK has reason to be proud of its efforts in this area. However, it is by no means clear how best to proceed and consolidate these advances. It's not clear whether we should be cooperating or competing with each other. Our traditional allies the book publishers have found computer-based media difficult to handle, with few CD-ROM products making a profit. The production values (ie content, design, quality of images) of many packages still fall below that of the standard text books. High quality products can certainly be produced (e.g. Andromeda Interactive and ADAM Interactive Physiology CD-ROM tutorial packages) but often cost hundreds of pounds. This is not surprising, since the development of high quality multimedia courseware is an expensive activity, requiring contributions from a multi-disciplinary team of academics, designers, graphic artists and programmers. There may not be a viable market for this kind of software, if it is too expensive for the student to buy individually and not a sufficiently high priority for a university department to buy in significant numbers.

Sharing home-grown

An alternative is to go back to trying to build on the work of the enthusiasts, developing simpler, less fancy, packages within departments. Often a package need not be complicated or highly finished to be useful, if it serves a simple purpose well. There are some remarkable examples of high quality software products being supplied free of charge within the academic community, though most of this seems to be in the research area (eg the NIH Image package, NEURON nerve simulator). There seems to be less willingness to share teaching materials in this way. In some ways, this is rather surprising given that it is relatively easy now to set up a Web page for advertising and distributing software. Consortia of the sort developed by the TLTP might be the answer, but the distributed nature of these projects and their dependence on short term funding creates continuity problems when the funding runs out.

It is my hope that 'Teaching & Technology' can act as a forum for discussion of many of these issues, including not just the views of the enthusiast but those of the sceptics. By airing these issues and developing a consensus within the profession we are much less likely to have unsatisfactory solutions foisted upon us.

John Dempster
Department of Physiology & Pharmacology
University of Strathclyde

A summary of the Dearing report can be viewed at the Web site
http://www.leeds.ac.uk/educol/ncihe

TEACHING VIDEOS

The Education and Information Sub-Committee would like to expand the teaching resources available to members on the Society web site, to include a list of videos that can be used for teaching. If you have, or know of, any videos that are useful for teaching any aspect of Physiology, and that could be available to other Departments, could you please send details of the video (title, brief description of contents, source and cost, if applicable) to:

Fiona Catherines, The Physiological Society, PO Box 11319, London WC1E 7JF

preferably by e-mail: fcatherines@physoc.org. The more people who contribute to this resource, the more useful it will be, so please help if you can.

Second Molecular Techniques Workshop 1-12 September, 1997

The second workshop on Molecular Techniques was held at the University of Glasgow in September, 1998. The number of participants was increased to 16 and the course was modified based on comments from the previous year. Once again the course had an international flavour as one place was reserved for a physiologist from Eastern Europe; this time from the Institute of Physiology in Prague. In addition, this year, a place was awarded to a physiologist from Dublin. All the other participants were from British institutions recruited from all over the UK. This course coincided with the Annual General Meeting of the Society in Bristol and we took advantage of this by persuading two speakers at the Bristol symposium from the United States (Colin Nichols and Burton Horowitz) to come up to Glasgow afterwards to teach on the course.

Loading sequencing gel

The major modification to the course was to include even more practical classes; so the number of talks were reduced and focused entirely in the 'how-to-do' format to cover topics not easily taught in practicals such as transgenesis and gene expression. A new practical to teach the principles of mutagenesis was devised; the sequencing and computer based practical classes were modernised.

A key feature this year was that all the first year participants (1996) were invited back to take part in the course either as teachers or to learn the techniques, such as mutagenesis, that had not been covered last year. Seven of the twelve 1996 students were able to accept the invitation. This aspect proved highly effective as a way of integrating the two years, thereby, hopefully building up a group within the Society. It was also extremely popular with the 1997 year as they were able to hear first-hand experiences of Molecular Physiology. The seven volunteered to give mini-talks on what they had achieved in the last year and one pair (Richard Mannion and Tom Cardy) bravely agreed to run a practical on in situ hybridisation which worked; I think very much to their surprise!

Setting up PCR Reactions

Once again, the course was successful in building friendships between young physiologists which will provide a valuable future support structure within this area of science. Interestingly, we were able to introduce two individuals working in the same Institute at the University of Leeds and two individuals working in the same building at University College. Neither of the two pairs knew each other or the fact that they were each trying to apply molecular techniques to physiology. Hopefully, the international introductions will also prove as valuable.

Reading the NA Sequence

Janet M Allen
University of Glasgow

Members of the 1997 course

Formal Lectures at The Workshop

Dr Susanna Blackshaw - Libraries from single defined neurones

Dr Richard Boyd - Molecular Physiology

Professor Bill Brammar -
(1) Gene expression
(2) yeast two hybrid systems

Dr Rod Dimaline - RNA analysis

Professor Annette Dolphin - Antisense technology

Professor John Mullins - Transgenesis

Dr Matthew Sharp - Transgenesis

Dr Russel Thompson - Use of viruses as vectors

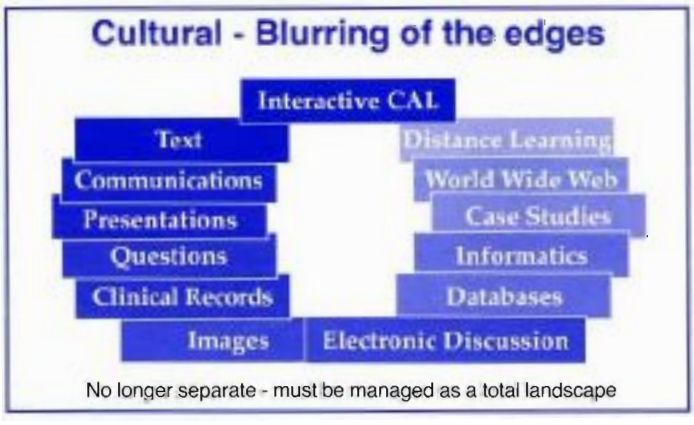
Teaching Symposium UMDS Meeting, November 1997

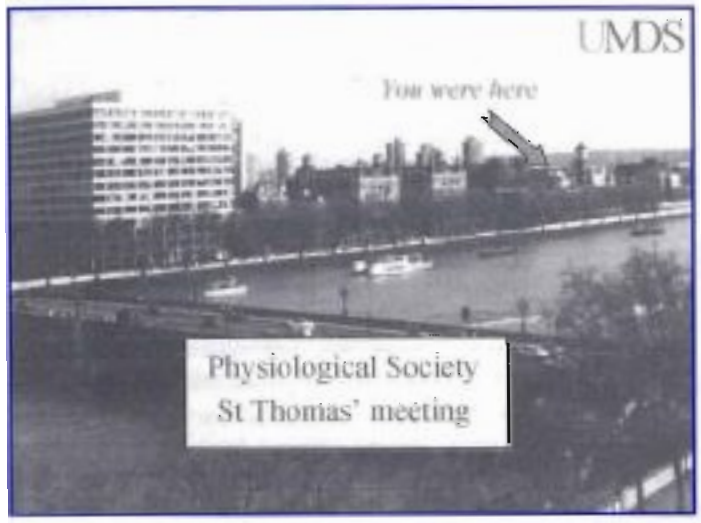
As part of the programme for the Physiological Society Meeting, hosted by United Medical and Dental Schools at the St Thomas' campus last November, a Teaching Symposium was jointly organised by Sue Ward (chairperson of Teaching Special Interest Group) and Jim McGarrick (lecturer in the host Department). The focus was on Information Technology (IT), with the intention of providing the participants with an insight on how IT has featured as a partner in teaching (with emphasis on preclinical science) over the past decade, and where we might be going in the next few post-Dearing years.

The morning session was introduced by Susan Ward who reminded us of the challenges in embracing IT as a partner in teaching. The focus of the symposium was to demonstrate IT in practice and, accordingly, the presentations were delivered in conjunction with PowerPoint and the latest large-screen display technology. For this we were indebted to Visualex who specialise in computer display equipment. They provided a range of equipment for demonstration and use at the meeting.

"A Deering is a carefully planted clump of trees"

The first speaker was Andy Sithers, manager of the Computers in Teaching Initiative (CTI) Centre for Medicine at Bristol. The CTI have been operating since 1989 in their current phase and function to co-ordinate and advise on the application of technology to teaching in all disciplines. As a Physiologist himself, Andy was well in touch with his audience. He emphasised how the IT culture had changed over the last decade: from isolated computers used as information sources, gradually becoming more interactive and interconnected, to the present situation where many courses are reliant on IT for their delivery and presentation.





Location of UMDS meeting

After a brief look at Computer Aided Learning (CAL) and the problems of its creation and delivery, Andy summarised how the Calman Report ...*"Informatics, including the imaginative use of learning materials is vital at all levels"* and Dearing Report ... *"..all higher-education institutions should develop managers who combine a deep understanding of C&IT with senior management experience"* were beginning to bite, and how the CTI could serve in providing information, offer a gateway for collaboration, and provide training in the new skills and techniques required of many teachers.

He finished with a quote from Bernard Naylor of Southampton, speaking at the CTI Dearing forum "...[in the New Forest] a Deering is a carefully planted clump of trees into which you drive a herd of rather timid and frightened creatures against their will with the object of managing them better... Of course, in this context, management is a euphemism for weeding out the weaker specimens". The other speakers for the morning session were Jeremy Ward and David Byrne, both in the Physiology Department at UMDS, and both actively involved in the use of IT for teaching.

The Internet ... Hip or Hype?

Jeremy, in true character, entitled his talk 'The Internet ... Hip or Hype?'. This began with a review of the diversity of learning resources on the Internet (Reference databases, full text journals, virtual patients, Departmental pages, Society pages and 'Lies, Damn lies and How to Cure Cancer by Eating Cyanide'). The latter example illustrated the problems of unlimited student access to Internet information and some practical issues of channelling appropriate material were discussed. Technical considerations were also looked at in terms of

machine and software requirements, video and sound performance, and the mysteries of terms like Java and ActiveX were briefly unveiled.

The presentation made full use of the capabilities of the latest version of Microsoft PowerPoint to demonstrate the versatility of Web-delivered resources which go well past the text and graphics of flat files to semi-interactive and full multimedia. Jeremy showed a number of scenarios in the production of teaching material for the web using a number of available methods and techniques.

Finally, the concept of the Virtual Campus was discussed, and the advantages to a distributed site such as UMDS, where students can already access material from campus, hall of residence or more distant sites on attachment, were emphasised. The Virtual Campus allows flow of information from student to tutor, assignment submission, self-assessment and assessments that count, library and timetable services etc etc, but requires adequate security features. The Internet was compared in its educational impact with the invention of television, and was seen as a key feature of educational material delivery. All new CAL material needs to be Web compatible if it is to gain a wide audience

CAL-ology

The morning session finished with a presentation by David Byrne, an experienced CAL developer (and Physiologist!) who took us through the early days of incorporation of CAL into the teaching of physiology at UMDS to the present. The story began in 1988 with a small cluster of locally networked PCs running some of the Sheffield Bioscience programs on frog nerve and muscle (still in regular use) and moved through the inevitable technology-lead changes that culminated in the present typical installation of networked machines with e-mail and Internet access.

David gave a useful overview of what CAL software is now available for dental and medical preclinical and clinical teaching, and he offered some practical advice for those considering producing their own courseware. The popular authoring packages were described and compared, and, drawing from his own experience of CAL production and student feedback, he discussed the criteria for the effective use of CAL.

After a summing up by Jim McGarrick, the morning session was rounded off by lively discussion between the participants.

Afternoon demos

The afternoon session was run as three parallel demonstrations. The 2 workstation rooms, each with 12 machines and seating for 24 were used to demonstrate selected Internet resources and CAL software respectively. The third area was the lecture theatre that had been used for the morning session, and had been set up to display several types of data projector, including a very large back-projection display with a touch sensitive surface that allowed you to use your finger like a mouse. Here visitors could discuss the technicalities and cost of projecting computer images with Andrew Hawkins, who on behalf of Visualex had provided much of the display equipment. The big touch screen proved very popular and was used for most of the informal 'how-to' demonstrations that took place in the afternoon. Many delegates were surprised at how easy it was to convert and place material onto the web.

This was the first Teaching Symposium run at a meeting of The Physiological Society, and, judging from the positive comments and genial atmosphere throughout, was warmly welcomed. The Teaching Special Interest Group are looking at ways of involving members in future activities relevant to teaching, at a time when we are all being made aware of the need to broaden the ways that we involve and pass on knowledge to today's students.

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PHYSIOLOGICAL RESPONSES TO EXERCISE

Exercise physiology is a truly integrative science but what makes our muscles hurt and our brains tell us to stop at any cost? Mike Gleeson explains.

We all know how it feels to perform a strenuous bout of exercise. Before long the chest is heaving, the lungs are bursting, the heart is pounding, we get hot, sweat profusely, and the previously co-ordinated efforts of our limbs start to flounder; the muscles hurt and our brains tell us to stop (please!). Exercise physiologists are particularly interested in how the body achieves appropriate levels of cardiac output, lung ventilation, blood pressure, arterial oxygen tension and body temperature in the face of the increased demand for oxygen and the increased heat production associated with the elevated energy turnover in active muscle.

Exercise - an integrated response

In adult humans typical values of cardiac output and lung ventilation at rest are 5-6 $l.min^{-1}$ and 5-8 $l.min^{-1}$, respectively. During high intensity exercise cardiac output may rise up to 35 $l.min^{-1}$ and ventilation to 150 $l.min^{-1}$ in elite human athletes. Whole body oxygen uptake may increase up to 20-fold above resting. The main limitation to the maximal oxygen uptake is probably the maximum cardiac output that can be achieved. Thus, the limitation is related to the ability of the cardiovascular system to deliver oxygen to the working muscles rather than the ability of the muscles to extract oxygen from the blood. The maximal oxygen uptake represents a critical factor in a person's capacity to perform prolonged strenuous exercise.

Within minutes of the onset of strenuous exercise body core temperature can rise by several degrees Celsius, and activation of thermoregulatory heat dissipation mechanisms (principally sweating and vasodilation of cutaneous blood vessels) becomes essential. Certainly, exercise is a challenge to homeostasis and a challenge to the physiologist interested in isolating the mechanisms responsible for the inability to sustain performance in different modes and intensities of exercise in both normal and extreme environments. The energy requirements of muscle during exercise are met not only by an alteration in intramuscular metabolism, but also by integrated activity of the cardiovascular, respiratory, endocrine and nervous systems. The functions of other organs including the liver, gut and kidneys are also affected by exercise; thus, the study of the body's response to exercise is truly an integrative science.

Exercise as a model of stress

Some human physiologists are interested in exercise as a model of stress. For example, the effects of prolonged exercise on the immune system appear to be similar to other forms of stress that are known to suppress immunity such as surgical trauma, physical and thermal injury, sepsis and extreme psychological distress. Prolonged exercise can only be performed with appropriate hormonal responses which regulate fluid and electrolyte balance, influence cardiorespiratory responses to exercise, mobilise fuel substrates and modify metabolism. Some of these hormones (e.g. cortisol) appear to be responsible for the temporary suppression of immune function following a bout of strenuous physical activity. Exercise can viewed as a useful model of stress, since its duration and intensity can be accurately controlled and reproduced in the laboratory.

What causes fatigue? ... Muscle

An overriding interest of many exercise physiologists relates to the causes of fatigue. Fatigue has been defined as the failure to maintain force or power. The development of fatigue during exercise could also be taken to include an increase in perceived effort necessary to exert a given force or power. Fatigue is undoubtedly a multifactorial process, involving both peripheral and central mechanisms, which is not surprising given the severe strain imposed on the multiple organ systems, tissues and cells when we perform strenuous exercise.

From the perspective of the motor control system, the co-ordinated, skillful, efficient and successful performance of a particular physical activity requires a precise temporal and spatial recruitment of motor units, both within a muscle and between groups of agonist and antagonist muscles. Within the active muscle fibres the utilisation of ATP - the only source of energy that can be used directly to fuel muscle contraction - is dramatically increased to satisfy the major processes involved in

excitation and contraction of skeletal muscle: namely, cross bridge cycling of the myofilaments, resequestering of Ca^{2+} into the sarcoplasmic reticulum and restoring Na^+/K^+ gradients across the sarcolemma and transverse tubules.

An inability to match rates of ATP use with equal rates of ATP resynthesis will inevitably result in fatigue as the ATP concentration in the cell would fall too low - but this would threaten the very survival of the cell, and rarely seems to occur. Only in very high intensity exercise of short duration is there a detectable fall in intramuscular ATP concentration. Rather, fatigue usually ensues before this undesirable event takes place, and an accumulation of metabolites including glycolytic intermediates, H^+, ADP, AMP, IMP, NH_4^+ and inorganic phosphate have been implicated as potential causal factors. Some of these are believed to disturb Ca^{2+} release and/or reuptake, Ca^{2+} interaction with troponin and actomyosin coupling, as well as inhibiting some of the enzymes of the energy providing pathways of carbohydrate metabolism.

The release of K^+ from active muscle in proportion to exercise intensity may also act as a signal (via sensory nerves and their interaction with spinal motorneurones) to decrease muscle force generation - and hence reduce exercise intensity. Depletion of muscle glycogen is associated with fatigue in exercise lasting about 1-2 hours. It seems that ATP resynthesis from fat oxidation cannot meet the ATP requirement for exercise at intensities above about 60% of the maximal oxygen uptake, whereas both aerobic and anaerobic metabolism of muscle glycogen can.

... Mind

During more prolonged exercise, central fatigue may become an important factor; in other words a type of fatigue associated with specific alterations in central nervous function that cannot be reasonably explained by dysfunction within the muscle itself. It is thought that serotonergic pathways of the limbic system of the brain are involved in the central fatigue process. During exercise in the heat, fatigue occurs sooner than in a cool environment. However, in hot environments, neither fuel substrate availability nor metabolite accumulation seem to be responsible for fatigue. In this situation it appears that it is the rise in body temperature to a critical level (about 39.5 °C) which causes fatigue through some central mechanism. Thus, fatigue can be viewed as a protective process that occurs when homeostasis begins to get out of control. Fatigue prevents a drastic fall in intramuscular ATP or pH from occurring or prevents a potentially lethal rise in body temperature by forcing the individual to slow down or stop.

... Muscle damage

Fatigue and muscle weakness can also occur as a consequence of disruption to internal structures (the sarcomeres) mediated by high forces such as when the muscle is activated while it is being lengthened (termed an eccentric muscle action). Here the fatigue is not metabolic - rather it is due to myofibrillar disorientation - and it is associated with inflammation, swelling, impaired force generating capacity and soreness which can take several days to recover. This type of damage is responsible for one of the feelings the unfit commonly associate with physical activity, namely the sensation of soreness and stiffness in the days following a bout of unaccustomed exercise. However, this should be no excuse for not doing exercise; such effects are largely avoided by training and regular performance of exercise confers health benefits, the most important being a marked reduction in the risk of dying from coronary heart disease.

Michael Gleeson
School of Sport and Exercise Sciences
University of Birmingham

Suggested reading

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Maughan RJ, Gleeson M & Greenhaff PL (1997) *Biochemistry of Exercise and Training*. Oxford University Press, Oxford, UK.

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Shephard RJ (1997) *Physical Activity, Training and the Immune Response*. Cooper, Carmel, IN, USA.

Physiological Adaptations To Training

Clyde Williams explains why training improves stamina, speed and strength

Stamina, (speed) and strength are the main components of fitness. However only a few sports demand that participants fully develop these characteristics in equal measure. The adaptations to training broadly follow a dose-response relationship and so without providing a great detail about the intensity, duration and frequency of training only generalisations can be offered about the changes which follow a programme of exercise-training.

Endurance training - from mouth to mitochondria

Aerobic metabolism is the mainstay of energy provision both at rest and during exercise. The maximum capacity for whole body aerobic metabolism is reflected in the maximum oxygen consumption (VO_2 max) of an individual. A high VO_2 max value is a necessary prerequisite for those individuals who have to sustain prolonged periods of heavy exercise. Therefore, it is not surprising that training-induced adaptations of the oxygen transport system, from mouth to mitochondria, have received most attention from exercise physiologists over the last half century.

Prolonged periods of heavy submaximum exercise over several weeks increases VO_2 max. This improvement is the result of a combination of central and peripheral adaptations. Maximum cardiac output is improved as a consequence of an increase in stroke volume, in spite of a small reduction in maximum heart rate. The number of circulating red blood cells increases with training but the haemoglobin concentration is often decreased as a consequence of a slightly greater increase in plasma volume. Therefore, endurance trained individuals often have haemoglobin values which are towards the lower end of the normal range. Unloading of oxygen from haemoglobin also appears to improve after training as a consequence of an increase in 2,3 diphosphoglycerate in red blood cells. Endurance training increases the number of capillaries around Type 1 fibres and so improves the oxygen transport to these relatively small diameter muscles. These muscle fibres are slow contracting and slow to fatigue. They can resynthesize ATP almost entirely by aerobic metabolism of carbohydrates and fatty acids because of their large complement of mitochondria. By comparison the fast contracting and fast fatiguing Type 2 fibres have a relatively small number of mitochondria and so it is not surprising that these fibres have a high glycogen concentration to enable them to resynthesize ATP by anaerobic glycogenolysis.

The increase in VO_2 max after several weeks of endurance training is of the order of 10 to 30%. These improvements are inversely proportional to pre-training values. However, the more impressive adaptation to training is the increase in endurance capacity. Endurance capacity, expressed as time to exhaustion during submaximal exercise, improves by at least 200% after only three to four weeks of training. These improvements are mainly a consequence of an increase in mitochondrial density in skeletal muscle. This increase in aerobic capacity allows fat metabolism to cover a greater proportion of the ATP turnover in muscle and so spares the limited glycogen stores. A decrease in carbohydrate metabolism is accompanied by a lower lactate production. Changes in blood lactate concentration during submaximal exercise are used to monitor improvements in aerobic capacity because they are more sensitive to training than is VO_2max alone, especially for sedentary people (see Fig 1). Furthermore, the aerobic capacity of skeletal muscle continues to respond to training without parallel increases in VO_2 max. Training-induced increases in aerobic capacity

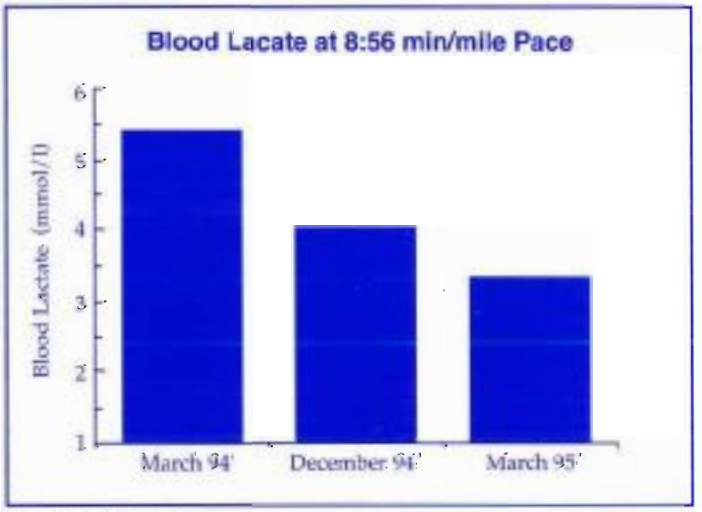

Fig 1. Blood lactate concentrations (mmol/l) during the preparation of Loughborough University's Vice-Chancellor to run the 1995 London Marathon for charity.

are not restricted to the Type 1 fibres. There is also a modest increase in the mitochondrial density in some of the population of Type 2 fibres which makes these fibres less fatiguable after endurance training. In order to distinguish the difference, these fast contracting fibres are described as Type 2a and Type 2b, the former having a greater aerobic capacity than the latter. Although complete transformation of fast to slow muscle fibres occurs in animal muscles following either prolonged electrical stimulation or thyroidectomy, similar changes do not appear to occur in human skeletal muscle as a result of training *per se*.

Sprint Training - buffering and breakdown

Improvements in sprinting are mainly the result of an increased capacity to sustain high speeds rather than improvements in absolute speed. Particularly important in many sports is the ability to reproduce sprints, without loss of speed, even with only brief recoveries between sprints. One of the contributors to the onset of fatigue during sprinting is the increasing presence of hydrogen ions, a product of high rates of glycogenolysis. Sprint training increases the buffering capacity of skeletal muscles and may also increase the transport of hydrogen ions into the systemic circulation. Skeletal muscles also increase their capacity for anaerobic glycogenolysis as is reflected by an increased activity of phosphofructokinase, a key enzyme in the control of glycogenolysis. A further adapataion to sprint training is an improved synchrony in muscle recruitment. This is probably the reason why the increase in power output is greater than can be explained by changes in cell biochemistry.

Strength Training - co-ordination and recruitment

As in sprinting the early improvements in strength and power cannot be explained in terms of changes in the size, shape or biochemistry of muscle cells. There appears to

be at least two phases to the adaptation to strength training. The first is a clear gain in strength and power without any measurable changes in size of muscle or strength of muscle *per se*. Thus a combination of improved co-ordination and recruitment of muscle mass may be the main reasons for the early improvements in strength. The task specificity of the gains in strength support this explanation. Only after many weeks of training are there significant increases in muscle cross-sectional area. Although studies on animals have shown that strength training increases the number and size of muscle fibres, hyperplasia is probably not the explanation for hypertrophy of human skeletal muscle after strength training.

In summary, the physiological adaptations to all types of training share the common characteristic of acting in concert to delay the onset of fatigue and improve functional capacity.

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Photographs courtesy of Ron Maughan

Nutritional Support for Training

Ron Maughan gives us the sporting guide to good eating

The aim of training for any sport is to improve performance in competition, and thetraining is therefore aimed at developing those characteristics that contribute to successful performance. The primary need for the diet of the athlete in training is to meet the additional nutrient requirement imposed by the training load, and this will vary greatly between sports and between individuals. Any training programme will increase the level of energy expenditure and that, in anything other than the very short term, this must be matched by an increased energy intake to maintain energy balance. Metabolic rate during running or cycling, for example, may be 15-20 times the resting rate. Such levels of activity may be sustained for several hours each day by trained athletes, and the metabolic rate may remain elevated for several hours afterwards. Even the sprinter, whose event lasts only a few seconds, may spend several hours per day in training. Soccer players preparing for competition at elite level may expend about 6 MJ (1500 kcal) per day in training. Sometimes it is necessary to reduce the body fat content, and then an energy deficit must be incurred, but any large mismatch between intake and expenditure will seriously curtail the ability to sustain the training load.

Pushing proteins - a myth?

Athletes engaged in strength and power events have traditionally been concerned with achieving a high dietary protein intake in the belief that this is necessary for muscle hypertrophy. In a survey of American college athletes, 98% believed that a high protein diet would improve performance. A diet deficient in protein will lead to loss of muscle tissue, but there is no evidence to support the idea that excess dietary protein will drive the system in favour of protein synthesis. Excess protein will simply be used as a substrate for oxidative metabolism.

The contribution of protein oxidation to energy production during exercise may decrease to about 5% of the total energy requirement, compared with about 10-15% (ie the normal fraction of protein in the diet) at rest, but the absolute rate of protein degradation is increased during exercise. This leads to an increase in the minimum daily protein requirement, but this will be met if a normal mixed diet adequate to meet the increased energy expenditure is consumed. In spite of this, however, many athletes ingest large quantities of protein-containing foods and expensive protein supplements; daily protein intakes of up to 400 grams are not unknown in some sports. The recommended diet for athletes, however, may even contain a lower than normal proportion of protein on account of the increased total energy intake.

Fat versus carbohydrates

The energy requirements of training are largely met by oxidation of fat and carbohydrate. The higher the intensity of exercise, the greater the reliance on carbohydrate as a fuel: at an exercise intensity corresponding to about 50% of an individual's maximum oxygen uptake (VO_2 max), approximately two thirds of the total energy requirement is met by fat oxidation, with carbohydrate oxidation supplying about one third. if the exercise intensity is increased to about 75% of VO_2 max, the total energy expenditure is increased, and carbohydrate is now the major fuel. If carbohydrate is not available, or is available in only a limited amount, the intensity of the exercise must be reduced to a level where the energy requirement can be met by fat oxidation. The primary need, therefore, is for the carbohydrate intake to be sufficient to enable the training load to be sustained at the high level necessary to produce a response.

During each strenuous training session, substantial depletion of the glycogen stores in the exercising muscles and in the liver takes place. If this carbohydrate reserve is not replenished before the next training session, training intensity must be reduced, leading to corresponding decrements in the training response. Any athlete training hard on a daily basis can readily observe this; if a low carbohydrate diet, consisting mostly of fat and protein, is consumed after a day's training, it will be difficult to repeat the same training load on the following day.

Stuffing carbohydrates, snacking sugars

Feeding a high-fat, low-carbohydrate diet for prolonged periods has been shown to increase the capacity of muscle to oxidise fat and hence improve endurance capacity in the rat; this may not be effective in man. Similarly short term fasting increases endurance capacity in the rat, but decreases exercise

tolerance in man. Thus the training diet should be high in carbohydrate, preferably with a large proportion in the form of complex carbohydrates rather than simple sugars. This suggestion conforms with the recommendations of various Government expert committees that, in a healthy diet, carbohydrates provide 50% of dietary energy intake.

A dietary carbohydrate intake of 500-600g may be necessary to ensure adequate glycogen resynthesis between training sessions, but this will again depend on the training load and body size. These high levels of intake are difficult to achieve without consuming large amounts of simple sugars: most athletes find that they can only satisfy the requirement for carbohydrate by eating confectionery and sweet snacks between, or even instead of, meals.

Supplementary advice

With regular strenuous training, there must be an increased total intake to balance the increased energy expenditure. Provided that a reasonably normal diet is consumed, this will supply more than adequate amounts of protein, minerals, vitamins and other dietary requirements. There is no good evidence to suggest that specific supplementation with any of these dietary components is necessary or that it will improve performance. A diet which may be considered inadequate for a sedentary individual consuming 4MJ per day, may meet the requirements of an athlete taking 12-15 MJ/day.

Indeed without resorting to sweets, snacks and convenience foods, such a high intake may be difficult to achieve. There is, however, no evidence that this pattern of eating is harmful; for the individual who has to fit an exercise programme into a busy day, it is inevitable that changes to eating patterns must be made, but these need not compromise the quality of the diet.When the energy expenditure is very high, carbohydrate-rich drinks and snacks become an essential part of the diet.

Blood and bone

Two exceptions to the generalisation about dietary supplements may be iron and, in the case of very active women, calcium. Highly trained endurance athletes commonly have low circulating haemoglobin levels, although total red cell mass may be elevated due to an increased blood volume. This may be considered to be an adaptation to the trained state, but hard training may result in an increased iron requirement and exercise tolerance is impaired in the presence of anaemia. Moderate exercise has been reported

to increase bone mineral density in women, and this may be a significant benefit of exercise for most women: hard training, however, may reduce circulating oestrogen levels and hence accelerate bone loss. For these athletes, an adequate calcium intake should be ensured, although calcium supplements themselves will not reverse bone loss while oestrogen levels remain low.

No drugs, just creatine

One further exception may be in the case of creatine. Recent evidence suggests that ingestion of high doses (about 20 grams per day) of creatine for a period of 4-5 days will substantially elevate the muscle creatine content: some of this increase is in the form of creatine phosphate. This has been shown to improve performance in high intensity sprints, where there is a large reliance on creatine phosphate as an energy store. The greatest improvements are seen where repeated sprints are performed with relatively short recoveries, suggesting not only an increased total muscle content, but perhaps also a faster resynthesis rate after exercise. Although competitive performance may be improved in this way, the greatest benefit may be on the training load that can be sustained: more intensive training can be carried out, leading to greater physiological adaptation. The normal dietary source of creatine is meat, giving typically about 1 gram per day. Vegetarians may experience the greatest increases in muscle creatine content as their dietary intake is otherwise negligible. There are no reported side effects, and creatine supplementation does not contravene the doping regulations.

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Photographs courtesy of Ron Maughan

Drugs in Sport

Is a drug being used legitimately as a therapuetic agent or illegitilmately as a performance enhancing agent? David Mottram outlines what is banned, what is allowed and the problems of doping control.

Throughout the twentieth century there have been instances of drugs being used as performance enhancing agents, culminating in the events of the Seoul Olympics of 1988. Since that date the media's attention at any major sporting event has focused on the latest 'drug story'.

Drugs may be used by athletes in a variety of ways

- for legitimate therapeutic purposes
- in a recreational context
- to overcome the effects of an injury
- as performance enhancing agents.

In each circumstance there are examples of drugs which are considered as doping agents by the International Olympic Committee (IOC) and other governing bodies in sport (Table 1).

I	**Prohibited Classes of Substances**	
	A	Stimulants
	B	Narcotics
	C	Anabolic Agents
	D	Diuretics
	E	Peptide and glycoprotein hormones & analogues
II	**Prohibited Methods**	
	A	Blood doping
	B	Pharmacological, chemical & physical manipulation
III	**Classes of Drugs Subject to Certain Restrictions**	
	A	Alcohol
	B	Marijuana
	C	Local anaesthetics
	D	Corticosteroids
	E	Beta-blockers

Table 1. IOC Medical Commission - Prohibited Classes of Substances and Methods, January 1997

What's not allowed

I Prohibited classes of substances

Stimulants encompass a large group of drugs with disparate pharmacological action, including amphetamines, xanthines such as caffeine, cocaine and sympathomimetics such as ephedrine and salbutamol. Their pharmacological effects may be manifested peripherally and/or centrally. In dope testing, the number of positive results for stimulants is high.

Narcotics, including morphine, methadone and pethidine, are potent analgesics. Positive test results are uncommon. Similarly, there are few positive test results for diuretics. This class of substance was wont to be used in an attempt to mask the use of other prohibited drugs, however, the sensitivity of current analytical instruments has undermined this ruse. Diuretics are occasionally used, illegally, to void fluid prior to a weigh-in in sports where weight categories apply.

Anabolic agents comprise two sub-classes - the anabolic androgenic steroids and β2 sympathomimetics. The anabolic steroids include synthetic drugs such as nandrolone and stanozolol and the endogenous steroid, testosterone. β2 sympathomimetics, which are also classified as stimulants, may have powerful anabolic effects when administered systemically. This is particularly true for clenbuterol. Anabolic agents provide the highest incidence of positive test results.

Peptide hormones, including human growth hormone and erythropoietin, are rarely detected through the current doping control procedures as effective tests from urine samples are not sufficiently well developed. The expense of procuring these substances provides a significant limitation on their use.

II Prohibited methods

Blood doping, whereby blood, red blood cells or related blood products are administered, is used to increase the oxygen carrying capacity of the blood. This procedure is relatively safe, provided it is carried out under medical supervision and using the competitor's own blood. Erythropoietin may be used to produce a biochemically equivalent effect. Pharmacological, chemical and physical manipulation, used to alter the integrity and validity of urine samples, is banned.

III Classes of drugs subject to certain restrictions

Drugs such as alcohol, marijuana and beta blockers may be subject to restriction by certain sport federations where it is considered that their use may affect sport performance or other competitors. The use of corticosteroids and local anaesthetics, used principally for treating sports injuries, is restricted by the route of administration and the need for written notification of their use prior to competition.

Testing for drug misuse

The testing procedures for drug misuse in sport involve testing both in competition and out-of-competition testing (OOCT). The latter was introduced to combat the fact that anabolic steroids are used more effectively during training, thereby allowing a 'wash-out' period prior to competition. Procedures for testing are laid down by the IOC and analysis is carried out in IOC accredited laboratories, of which there are currently 25, worldwide. Where a competitor tests positive, it is their sport's governing body which determines what action should be taken. If sanctions are deemed necessary, most governing bodies apply a 3 month ban for a first offence involving over-the-counter (OTC) drugs and a 2 year ban for other drugs.

It is difficult to determine the extent of the problem of drug misuse in sport. From a statistical perspective, the IOC figures from their testing laboratories indicate that only around 2% of samples are positive. This figure contrasts markedly with anecdotal reports on the extent of drug misuse in sport which appear in the media. Research on the prevalence of drug misuse in sport provides conflicting evidence (Mottram *et al*, 1997).

The problems of doping control

Certain drugs or classes of drugs have produced problems with respect to doping control. The stimulant, caffeine, is a constituent of many common beverages including tea, coffee and many soft drinks. The IOC places a limit of 12 micrograms per millilitre of urine, for testing purposes. To achieve such levels an individual would need to consume around 6-8 cups of coffee at one sitting and be tested within two hours.

A number of sympathomimetics, such as ephedrine and phenylpropanolamine are available for purchase from pharmacies in OTC cough and cold remedies. This is a particular cause for concern by competitors who worry about taking a banned substance inadvertently. This concern is justified since many of the results of positive dope testing in the stimulant category involve these OTC drugs. Where it is considered that the presence of the drug was inadvertent, the governing body will administer a warning but not impose a sanction on the competitor.

Certain classes of drugs used in the treatment of asthma, such as the β2 bronchodilators and corticosteroids, are banned in sport. However, it would be unacceptable to prevent asthmatics from competing in top level sport because of their legitimate drug therapy. The IOC has therefore permitted the use of three selective β2 bronchodilators (salbutamol, terbutaline and salmeterol) but only in aerosol form, as these drugs are banned by the systemic route due to their anabolic effect. Similarly, for asthma, corticosteroids are only permitted by aerosol. In both cases written notification of administration is a pre-requisite.

Substances which are endogenous, such as testosterone and peptide hormones, create difficulties in determining whether a positive test result is due to doping or the fact that the competitor is a biological outlier.

Finally, there have been a number of high profile cases of competitors testing positive for recreational drugs such as cocaine and ecstasy. Whilst these drugs may not have been taken for performance enhancement, they fall within the IOC list of banned substances. It is likely, with the more widespread use of recreational drugs in society, that this problem will increase.

Why are drugs misused in sport?

The factors which may influence a competitor to use drugs in an attempt to enhance performance are significant. The trend towards professionalism in sport and the concomitant commercialism and sponsorship places heavy emphasis on winning at any cost. Most athletes have a relatively short professional life span in top competitive sport and need to capitalise on their talents during that narrow window of opportunity. Peer pressure comes into play on competitors either directly through offers of drugs or indirectly through uncertainty as to whether fellow competitors are using performance enhancing drugs. Drugs are readily available and there are many individuals who are making a living out of peddling drugs in gymnasia and changing rooms. Finally, there is significant pressure engendered by media sensationalism, again fostering uncertainty as to how extensive the misuse of drugs really is.

The future

There will always be competitors who will use performance enhancing drugs in sport. To minimise the occurrence, we need to adopt two approaches. On the one hand, we must continue with research into more sensitive and discriminatory methods for drug testing. On the other hand, more research is needed into the motivating factors for drug misuse and into the development of more effective, better targeted education and information programmes for emerging as well as established competitors.

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Physiology of Football

From dribbling to sprinting, from aerobic to anaerobic power - it's a question of intermittent exercise. Thomas Reilly outlines the physiological requirements and stresses of the elite footballer.

The last two decades have witnessed a remarkable expansion of sports science. The subject is now a well respected field among its parent disciplines, including human physiology. In recent years the development has extended to specific sports, but most particularly to football. The 1st World Congress of Science and Football was held at Liverpool in 1987: this event is held every 4 years and is next scheduled for Sydney, Australia in February 1999 (Fig 1). The Diploma in Science and Football was instigated at Liverpool John Moores University in 1991 and is now a full-blown BSc (Hons) degree programme. Besides, post-graduate research projects directed to the physiology of football have led to doctoral awards including, for example, the DSc programme of Jens Bangsbo at the August Krogh Institute (The physiology of soccer with specific reference to intense intermittent exercise: 1993) and PhD of Barry Drust at Liverpool (Metabolic responses to soccer-specific intermittent exercise, 1997).

Fig 1. The cover of the 4th World Congress

The awareness of how physiological knowledge can be applied to football is now evident within the professional game. Many of the top European club teams employ physiologists who play a major role in the preparation of players for competition, implementing nutritional strategies for recovery between games and assisting medical staff in designing training programmes for rehabilitation from injury. They also take the lead in physiological assessments of players in both field and laboratory contexts.

The scheduling of matches for the 1994 World Cup in USA in hot humid conditions led to outcries among European teams about the possibilities of heat injury. These issues were addressed in a consensus statement from a group of leading physiologists who convened under the patronage of FIFA (the world's governing body for soccer) at Zurich in 1994. The Proceedings were published in a supplementary issue of the *Journal of Sports Sciences* (Summer 1994) and the rules for the World Cup matches were modified to allow players to drink fluids during the game.

Complex challenges

It is fair to concede that the study of soccer does pose complex challenges for the physiologist. Nevertheless there has been a good deal of information gleaned about the physiological demands of competition at various levels of play, including for example the energetic consequences of specific games skills such as dribbling the ball (Fig 2). Paradoxically, whilst the major metabolic demands of top-class soccer play over 90 minutes are largely aerobic, the crucial events which determine the outcome (e.g. goal-scoring) may be anaerobic. Besides, players may cover 10-13 km during the course of the game, but less than 2% of this distance is covered in possession of the ball (Fig 3).

The conventional physiologist's model of intermittent exercise falls well short of simulating the exact stresses of competitive soccer. Despite this, there has been good progress (eg by Bangsbo, Drust and others) in improving the intermittent exercise protocols studied in laboratory conditions. Issues still remain as to the physiological causes of fatigue as it is manifest towards the end of games and the strategies for offsetting fatigue are more complex than is the case with running or cycling, for example.

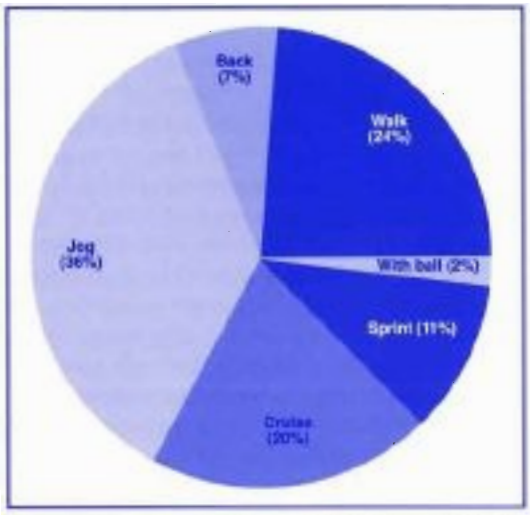

Fig 3. Relative distance covered in different categories of activity for soccer players during a game. Cruising refers to an intermediate intensity, between jogging and sprinting, each at a range of speeds.

Enduring the stress

Soccer play calls for an array of capabilities including aerobic and anaerobic power, muscle strength and flexibility, agility and complex motor co-ordination. Muscles are employed isometrically and dynamically (both in concentric and eccentric modes), energy systems may be nearly depleted and important games may be encountered with a frequency making complete recovery in-between difficult. Travel schedules, unforeseen replays, seasonal overloading of fixtures, injury avoidance all illustrate the irregular cycles which soccer players must take into consideration. The pace of the game at international level has speeded up in the 1990's, as illustrated by the current work-rates of Premier League players and the emphasis on fitness among the successful Brazil national side in 1994. So as you watch the world's best players ply their trade skills in France during the forthcoming summer, spare a thought for the physiological capabilities they have attained and the physiological stresses they endure.

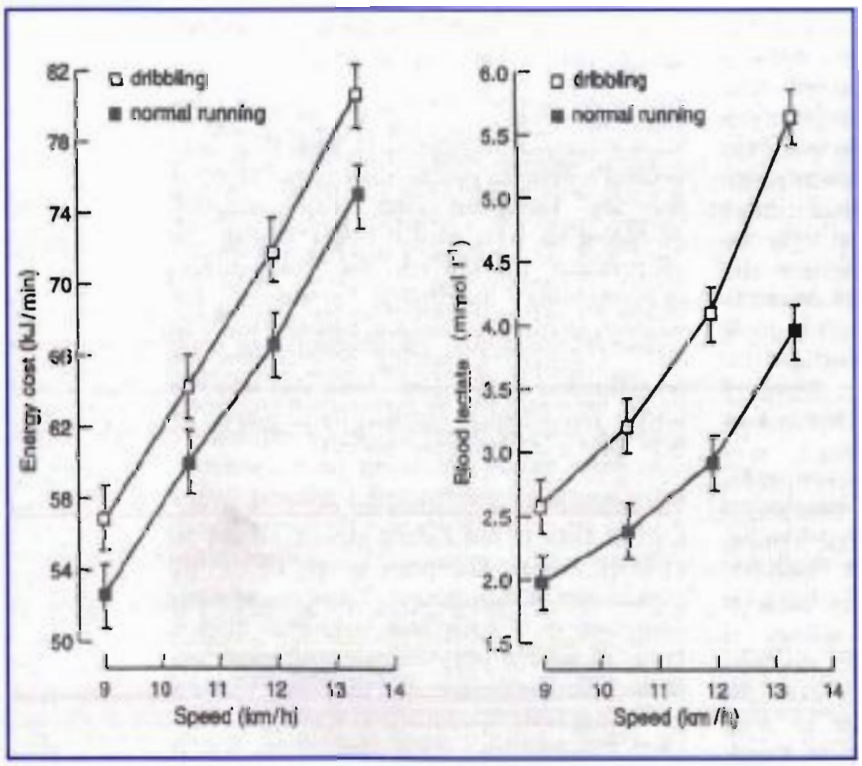

Fig 2. The elevation in physiological demands of soccer is illustrated by the energy cost and blood lactate responses to running and to dribbling a football, each at a range of speeds.

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Stepping into Sports Science and Medicine

Sue Ward, who is the convenor for the Teaching Special Interest Group, writes about the various career opportunities open to graduates of Sports Science and other related disciplines.

The multidisciplinary nature of Sports Science, covering areas such as physiology, anatomy, biomechanics, biochemistry, nutrition and psychology is reflected in a comprehensive and evolving range of diverse career opportunities. However, these opportunities are not the sole preserve of the Sports Science graduate. Graduates with training in particular areas of human science and a strong interest in sport could equally well consider a career in Sports Science and Sports Medicine.

Stepping up the ladder - which way to go?

Many graduates elect to pursue post-graduate training at the Masters and PhD levels, not only in the United Kingdom but also abroad. For example, graduates who wish to travel can now pursue a "European" Masters degree in areas such as Biology of Physical Activity, Adapted Physical Activity, Fitness Training and Swimming Coaching, with periods of study in typically a minimum of two universities in different countries. Post-doctoral training opportunities also abound. The step into a career in higher education is easier than in some disciplines, because of the popularity that Sport-related subjects continue to enjoy at the undergraduate level. There are currently many academic employment opportunities for appropriately-qualified Sports Scientists, both in Universities and Colleges.

A degree in Sports Science can be a stepping stone also to further academic training in areas relevant to sport, both at the first degree level (eg. physiotherapy) and at the Masters level (eg. business administration, media studies). A popular career option for many Sports Science graduates is in primary or secondary education. While it is common to specialize in physical education, this can readily extend to the teaching of sports science (a relatively recent A-Level offering by some Examination Boards). Graduates are required to complete an appropriate post-graduate teaching qualification, most usually the Postgraduate Certificate of Education.

Coaching careers have been bolstered

Coaching is another popular career choice, be it at the club level or with international performers. Regardless of level, however, it is necessary to gain professional qualifications in Sports Coaching (these range from introductory to advanced). Indeed, it is now common practice for many Sports Science undergraduate programmes to incorporate into their curriculum entry-level, awards of the National Coaching Foundation and of National Sports Governing Bodies. Coaching and athletic performance are not confined to the human athlete: horse racing, for example, is a sport that relies heavily on sports science and veterinary medicine.

The long-term career prospects in Sports Coaching have been bolstered substantially by recent developments designed to improve elite sporting performance in the United Kingdom. For example, a partnership between the Sports Council, the British Association of Sport and Exercise Sciences, the National Coaching Foundation and the British Olympic Association has established a national Sports Science Support Programme, which operates through accredited laboratories in Universities and Colleges to offer service provision to athletes in physiological and biomechanical performance assessment. There are also opportunities arising out of the recent National Sports Medicine Institute initiative to establish regional groups that incorporate an integrated service provision to athletes in both Sports Medicine and Sports Science. And it will, of course, be of considerable interest to see what impact the new long-awaited British Academy of Sport in Sheffield will have on the demand for qualified Sports Scientists and Physicians.

A "leisurely" career?

A further area in which employment opportunities are expanding rapidly is the recreation and leisure industry. Sports Science graduates are eagerly sought after by health clubs and sports centres to serve as advisers on fitness, health promotion and lifestyle management both to the general public and the corporate sector. An alternative (and often lucrative) route is that of the personal trainer. It is not unusual for employers to expect a Masters qualification as a minimum. Also, further professional development is increasingly being required; for example, the American College of Sports Training and the Association of Personal Trainers both offer certification programmes.

From health to management

A growing awareness in the medical community regarding the benefits of long-term participation in physical activity is bolstering health promotion initiatives with the creation of GP referral schemes. In addition, clinical evaluation and rehabilitation are becoming more common in patient management. These areas represent good employment opportunities for graduates in Sports Science and related disciplines.

Another developing area for employment is that of sports administration. This can range from the sports club or Local Authority level through to professional sports clubs and bodies such as the UK and regional Sports Councils, the National Coaching Foundation and National Sports Governing Bodies.

Finally, Sport Science graduates are also keenly sought after by employers for a variety of posts that are not in themselves related to sport but which utilize the self-motivation and team-working skills that sport science develops. These include the armed forces, the police force, and the commercial management sector.

These are therefore buoyant times for the new graduate in Sports Science

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BASES

Neil Spurway describes the origins and objectives of The British Association of Sport and Exercise Sciences

The study of human exercise can be pursued as a straightforward physiological challenge. Participating subjects usually then contribute to generalised, statistical conclusions. Once the particular person becomes the focus, however, the emphasis shifts. Psychology is now at least as important as physiology, and family, societal and economic factors are always close at hand. Even within pure biology the individual's spinal biomechanics or nutritional basis can matter as much as cardiac output or motor control. So sport and exercise scientists of diverse backgrounds need to band together, sharing concerns and insights, as well as being critical about their specific sciences from standpoints not always the same as those of the home disciplines.

The British Association of Sport and Exercise Sciences (BASES) provides a forum in the UK for that interaction. It started in 1977 as the Society of Sports Sciences (SSS), just two years after the first Sports Science degree courses had begun at Loughborough University and Liverpool Polytechnic. Membership was mainly physiological till 1983, when SSS joined with the Sports Biomechanics Study Group and the British Society of Sports Psychology to form the British Association of Sports Sciences (BASS). However, recreational and health-related exercise always figured prominently in its programmes and, in 1993 the current name was adopted to clarify this fact.

Physiology, Biomechanics and Psychology have separate specialist Sections, reflecting history, but in addition there is an Interdisciplinary Section - to which most members of the founding disciplines also belong. Concerns here are branches of Exercise Science which do not fit under the three named banners, but also multi- and inter-disciplinary activities. In an important sense, therefore, this is the core of the Association.

BASES' publication vehicle, in association with the International Society for Kinanthropometry, is the *Journal of Sports Sciences* (founded 1983). The Association also accredits members for expertise within individual sections. Accreditation typically requires an appropriate higher degree or at least three years' supervised experience. Physiological Accreditation also covers laboratories, with site vists in which the accreditor becomes a subject of the laboratory's procedures. Being accredited is necessary for the provision of scientific support under Sports Council or Lottery auspices. Chartered status, an aspiration for the future, would cement that position. Training and education (professional and public), plus lobbying for greater fundamental research funding, are also high on the agenda. SSS/BASS/BASES has come quite a way in 20 years.

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EUROPEAN COLLEGE OF SPORT SCIENCE

Who needs another society? Anthony Sargeant explains.

In 1995 a group of academics from a number of European research groups came together in Nice, under the chairmanship of Professor Bengt Saltin to found the European College of Sport Science. There was much discussion before, and at that founding meeting, on the lines of: who needs another scientific society? and, would such a society receive the active support of the academic community? In the event, the level of interest and support that has been forthcoming in the few years since the inception of the College has been overwhelming and more than justified the decision of the founders to proceed.

One of the factors that played a decisive role was the fact that although the scientific study of human performance had a long and creditable European heritage - in British physiology the name of AV Hill comes immediately to mind - there was no obvious scientific forum in Europe for bringing together scientists engaged in research across the many integrating disciplines that had a contribution to make to the study of human performance. The high level of interest in the College is also clearly a reflection of the very dynamic phase of development that exercise and sports science is entering in universities across Europe, combined with the acknowledgement by national and pan-national organisations and governmental agencies of the vital (in all senses of the word!) contribution that sport has to make to the health, and well-being of our society.

The mission

From the beginning the College has been determined to take a broad view of the subject area which it was addressing. Thus, The European College of Sport Sciences is *".....a scientific society dedicated to the generation and dissemination of scientific knowledge concerning the motivation, attitudes, values, responses, adaptation, performance and health aspects of persons engaged in sport and physical activity and the social structures and consequences related to that engagement".* Furthermore, *"sport"* has been used to include *".....all forms of human movement which aim to express or improve physical performance, whether pursued in the context of competition, recreation, therapy, or in the prevention and amelioration of disease".* In part, this broad inclusive approach was a recognition of the fact that fundamental scientific understanding of the phenomenon of human movement was as likely to develop from research nominally conducted, for example, in the areas of rehabilitation, ergonomics, preventative medicine, or indeed the basic sciences, as in the study of sports performance itself. In addition, many research groups were themselves working across a number of fields in a way that facilitated cross-fertilisation, of ideas and knowledge gained, from one to another.

Activities

The College publishes a regular newsletter and other publications are planned for the near future. The principle activity to date has been the organisation of annual congresses of which there have been two; Nice 1996, and Copenhagen 1997. The success of these congresses has been quite remarkable, each attracting close to a thousand participants from around the world. In July 1998 the third annual congress will be held in Manchester hosted by the Health Care Development Unit of the NHS. The congress will provide a continuous programme of symposia and workshops for each contributing discipline as well as multi-disciplinary sessions, and provide a forum for the presentation of current research in free communication sessions. The aims of the congress are:

- to provide a state-of-the-art review of the basic, applied and clinical sciences as they relate to sport, exercise, health and the impact of sport on society.
- to provide a forum for integrating knowledge from the contributing sciences in multi-disciplinary symposia.
- to identify those areas where our knowledge is incomplete, and to discuss current controversies and the challenges that face exercise and sports scientists and health professionals.

Eminent invited speakers from around the world will present state-of-the-art thinking on a wide range of topics including: the molecular basis of muscle properties; growth, development and ageing; nutrition; drugs and sport; osteoporosis; epidemiological aspects of exercise, diet and health; neuromuscular control; spinal mechanics; physiological aspects of training and rehabilitation; etc.. There are two special symposia of interest to physiologists. One is in honour of the unique contribution to our understanding and awareness of the relationship between exercise, diet and health made by Professor Jerry Morris, who will be guest of honour and chair the symposium. The other is the 'AV Hill Memorial Symposium' in which Roger Woledge, Brian Whipp, and Bengt Saltin will speak, continuing the tradition of interest in the physiological basis of human performance as exemplified in the work of A V Hill.

The activities of the European College of Sport Science are made possible by the continuing support of a number of Directorate Generals of the European Commission but especially DGX with whom the College is working closely to develop new initiatives in the field of sports science across Europe.

Photographs courtesy of Raymond Besant and Ron Maughan

Membership

The society is based on individual membership. It is not an association of national organisations, although it seeks to support and collaborate with such organisations wherever appropriate. Full membership is open to scientists who are qualified in any of the cognate disciplines relevant to the College's mission. Student membership is also available. All members receive a regular newsletter and plans are well advanced for other publications (subscription details can be obtained from ecss@pallo.jyu.fi). A particular concern of the College has been the education and encouragement of young researchers and this is manifested in a number of European Union funded postgraduate courses. In addition, *'Young Investigator Awards'* are a key element of the annual congresses. These awards have been generously sponsored by Mars Incorporated since the inception of the College. In the 1998 congress US$ 34,000 will be awarded to PhD students and postdoctoral fellows on the basis of research presentations made at the meeting.

The future

Despite its success it is clear that the College has only just begun to meet the needs of the scientific community it was set up to serve. The direction of its further development is dependent upon input from those scientists with an interest and commitment to the field. At the Manchester Congress in July 1998 there will be the opportunity to join together in this important initiative, affecting as it does the health and well-being of our European communities. It is hoped that members of the Physiological Society will participate in large numbers, and encourage their young co-workers to compete for the *'Young Investigators Awards'*.

Anthony J Sargeant
Neuromuscular Biology Research Group
Manchester Metropolitan University
and Vrije University Amsterdam
The Netherlands

Anthony Sargeant is currently acting as adviser to the NHS on the development of the Institute for Research in Exercise, Sport and Health Science to be based in Manchester.

Makingsenseofscience

The *Making***senseofscience** Children's Books are 32-page highly illustrated books for 8-12 year olds published by Portland Press. Fran Balkwill is series editor, and series design and illustration is by Mic Rolph. There are six books in the series:

- Brainbox by Steven Rose and Alexander Lichtenfels
- Poo, You and the Potoroo's Loo by David Bellamy
- Planet Ocean by Brian Bett
- Satellite Fever by Mike Painter
- Light Up Your Life by David Phillips
- The Space Place by Helen Sharman

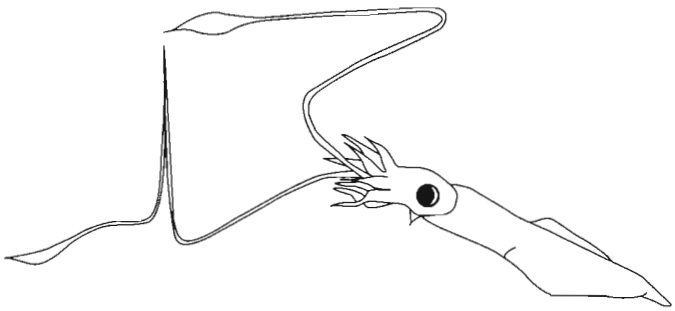
David Bellamy (left) at the launch of his book Poo, You and the Potoroo's Loo at Dillons in the Science Museum. With him are Mic Rolph (illustrator) and Fran Balkwill (series editor).

MICROELECTRODE TECHNIQUES FOR CELL PHYSIOLOGY

15th Workshop 9-23 September 1998

Laboratory of the Marine Biological Association of the UK,
Citadel Hill, Plymouth, PL1 2PB.

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 measurements of secretion.

- 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 £1100** includes accommodation, meals and tuition. Participants are responsible for their own travel arrangements.

THE CLOSING DATE FOR APPLICATIONS IS 30 APRIL 1998

- 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 dogden@nimr.mrc.ac.uk

Information on internet
http://www.nimr.mrc.ac.uk/Events/microelectrode.htm

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 1998 edition (to be distributed on 15 May 1998) should reach the ***Administration Office by 1 April..***

FOURTH SYMPOSIUM ON NEUROLOGY FOR NEUROSCIENTISTS

6-7 April 1998
Magdalen College, Oxford

A two-day conference for neuroscientists on the basic science questions that clinical neurologists face and how neurological diseases can illuminate neural function. Themes include transcranial magnetic stimulation, prion diseases, neurogenetics and neurological rehabilitation. The conference is sponsored and subsidised by the Guarantors of Brain. Registration fee of £25 will cover all expenses including travel.

Further information from Professor J B Clark, Dept of Neurochemistry, National Hospital, Queen Square, London WC1N 3BG. Tel: 0171 829 8722, e-mail: jclark@ion.bpmf.ac.uk ***

New Journal Launch

NATURE NEUROSCIENCE – DISCOUNTS FOR PHYSIOLOGICAL SOCIETY MEMBERS

Order before 17 April 1998

New from the publishers of Nature: Nature Neuroscience will provide a definitive source for the very best original research, editorial and comment covering all aspects of this rapidly developing field. Published monthly, it will provide you with a single, high-profile journal bringing together the cream of research from across the neuroscience discipline.

The journal will place high priority on clarity of presentation and accessibility to a broad multidisciplinary readership. Thus, Nature Neuroscience subscribers will be able to remain abreast of the major developments across all aspects of neuroscience, as well as being the first to read the most significant advances in their own respective disciplines.

Members of The Physiological Society can take advantage of pre-publication discounts for an extended period. Order before 17 April 1998 and you can save £50 on the cost of a subscription. Further information from Joanna Cooper, Macmillan Magazines, Porters South, Crinan Street, London N1 9XW. Tel: 0171 843 4957, fax: 0171 843 4998, e-mail: j.cooper@nature.com, WWW address: http://neuro.natureny.com ***

THE 1998 PATON LECTURE

27 April 1998
University of Liverpool

The 1998 Paton Lecture will be given by Professor Dan Todes of Johns Hopkins University, Baltimore, at the Society Meeting at Liverpool. The subject of his lecture will be "Pavlov's Gastric Physiology". ***

NEW HORIZONS IN CGRP AND RELATED PEPTIDES RESEARCH

11-12 May 1998
Shaftesbury, Dorset

Further information from Sue Brain.
Fax: 0171 332 4739, e-mail: sue.brain@kcl.ac.uk ***

THIRD ANNUAL CONGRESS OF EUROPEAN COLLEGE OF SPORT SCIENCE

15-18 July 1998
Manchester

This will be the largest meeting in the field of exercise and sport science ever held in Europe. The programme will include invited lectures, multi- and mono-disciplinary symposia, tutorial lectures and socratic debates. There will be strong representation of the physiological and exercise sciences, including nutrition and biochemistry, with this element of the programme organised by David Jones, Ron Maughan, Susan Ward and Clyde Williams. Sports medicine, biomechanics and motor control will also feature strongly. Free oral and poster communications are invited.

Further information from Professor Tony Sargeant, fax: 0151 236 4829, e-mail: ecss@hit1.demon.co.uk*

BRISBANE '98

A joint meeting of

THE FEDERATION OF ASIAN-OCEANIAN NEUROSCIENCE SOCIETIES

27 September-1 October 1998
Brisbane, Australia

The Federation of the Asian and Oceanian Physiological Sciences
The Physiological Society of New Zealand
The Australian Physiological and Pharmacological Society

The meeting will consist of a rich scientific programme of plenary lectures, "new perspectives" lectures, thematic symposia, oral communications and poster presentations reflecting the diverse scientific interests of the various societies.
The venue is the Hilton Hotel, Brisbane, Queensland, Australia.

Further information from Brisbane'98 Conference Secretariat, GPO Box 2609, Sydney 2001, Australia. Tel: +61 2 9421 1478, fax: +61 2 9251 3552, email: FAOPS/FAONS@icmsaust.com.au**

VISITING SCIENTISTS

Foreign visitors of the status of at least post-graduate student, working in laboratories of Members of the Society, may be made "Visiting Scientists" by the Society. The names of such persons, with the dates of their visits and a letter of support, should be sent to the Foreign Secretary, Professor O H Petersen, The Physiological Laboratory, University of Liverpool, PO Box 147, Crown Street, Liverpool L69 3BX.

ISOTT '98

23-28 August 1998
Budapest, Hungary

The 26th Annual Meeting of the International Society on Oxygen Transport to Tissue will take place at the Budapest Hilton, Castle Hill, Budapest, Hungary.

Further information from Andras Eke, President, ISOTT
fax: +36 1334 3162
e-mail: mailto:eke@elet2.sote.hu
eke@elet2.sote.hu
WWW address:
http://www.e.et2.sote.hu/eke/ISOtt/start.html

The Physiological Society

VACATION STUDENTSHIP SCHEME

The Physiological Society has agreed to allocate £25,000 to provide vacation studentships in 1998.

Eligibility

Students who have completed at least two years' full time study in a higher education institute or equivalent. This includes second year students and third year students wishing to do research projects in the vacation following completion of their course and intercalating medical, dental and veterinary students, provided that the research project is physiological in nature. The research project must be of good quality, of a physiological nature and undertaken in the laboratory of a Member of The Physiological Society, in any institute of higher education or equivalent (regardless of whether or not it is the one in which the student is normally registered).

Awards

The maximum award allowable will be £800 at a rate of no more than £100 per week. An award is intended to cover maintenance only: no funds can be provided by the Society for consumables and other research expenses.

Applications

Application must be made via the Administration Office on behalf of the student by a Member of The Physiological Society, who will be required to provide:

- information on the research project
- the reasons for the selection of the student
- justification of the support requested
- details of support received or sought from other sources
- details of three recent publications from the laboratory
- confirmation that appropriate facilities, consumable support and space are available.

No Member may make more than one application per year.

Successful students will be required to submit a report after conclusion of the studentship. (No subsequent application from the Member will be considered until the student's report has been received.)

Evaluation

Applications will be considered at the end of April. Completed applications will be circulated to all members of the Grants Sub-Committee for scoring. If more than three applications are received from any one department, that department will be asked to rank them, such ranking being for information only and not binding on the Sub-Committee.

Application forms are available from The Administrator (Vacation Studentships), The Physiological Society, PO Box 11319, London WC1E 7JF. Tel (0171) 631 1458.

The Physiological Society

VACATION STUDENTSHIP SCHEME
APPLICATION FORM

Details of Host Applicant

Name

Membership Number

Address

Tel

Fax

Three recent publications:

Details of Student

Full Name

Date of Birth

Degree or other course currently being studied:

Course Title

Department

Institution

Duration of Course

Years of course completed by this summer

Previous Studies and Relevant Work Experience

Year of Degree (1st, 2nd etc)	Subjects studied	Marks (or equivalent degree grades)

Details of any special projects/achievements or other previous relevant work or study

Details of Proposed Research Project

(Please give a succinct summary of the proposed scientific work to be undertaken.)

Summary of Costs

NB Living expenses are expected to cover the cost of accommodation in university halls of residence, or comparable student accommodation, if the student is not living at home for the period of the project, plus a subsistence allowance; the Society cannot contribute towards laboratory expenses

Living expenses per week: £

Number of weeks for which support will be required

Other expenses (*please give details*) £

Funding sought or received from other sources for this project

TOTAL AMOUNT REQUESTED FROM THE PHYSIOLOGICAL SOCIETY £

If an award is made we would like to transfer the funds directly into the correct account. Please complete. (All information is confidential)

Bank / Building Society: Account Number:
Name of Account Holder: Sort Code:

I confirm that appropriate facilities, consumable support and space are available to enable the student to undertake the above research project.

Signed ..... Dated

On completion, please return **SIX COPIES** of this form and of any supporting documentation (including a covering letter explaining your reasons for selecting this particular student) to the Administrator (Vacation Studentships), The Physiological Society, PO Box 11319, LONDON WC1E 7JF. The closing date for applications is **30 APRIL.**

For Office use:		

Confidential

The Physiological Society
APPLICATION FOR AFFILIATION

Surname (IN CAPITALS) .....

Forenames (IN CAPITALS) .....

Field of Interest IUPS classes ...../ ...../ .....
(see overleaf for codes)

Work Address .....

.....

.....

Postcode .....

E-mail .....

Title* Dr/Mr/Mrs/Miss/Ms *Circle as appropriate

Date of Birth ...../ ...../ .....

Special Interest Groups .....
(see overleaf for guides)

Tel .....

Fax .....

Photograph of Candidate

Research Area (eg, give thesis or project title).....

.....

Present Course / Postdoctoral Position .....

Qualifications:

Degree	Date	Subject	Awarding Institution

I enclose a cheque for £..... payable to The Physiological Society (see overleaf for fees).

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 in accordance with the purposes registered under the Data Protection Act 1984.

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

The Member of The Physiological Society proposing the Candidate should read the guidelines overleaf and sign the following statement.

I hereby confirm that the Candidate is *a postdoctoral worker or *registered for a higher degree in Physiology or related subject, and that he/she is a suitable person for admission to Society Meetings.
*(*Delete as appropriate)*

Membership Number
.....

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

Tel ..... Date ...../ ...../ .....

Address .....

.....

Please return this form to: The Physiological Society (Affiliation), PO Box 11319, London WC1E 7JF 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, Ireland **or abroad**. It is open to postgraduate students registered for a higher degree in Physiology or a related 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 within the first five years of attaining a first professional qualification (PhD or medical degree) or awaiting the outcome of their proposal for nomination for election to Membership of the Society.**

The Committee has authorised the Committee Secretary to accept or reject proposals as they are received throughout the year.

Affiliation must be renewed by payment of the appropriate fee at the start of each year (ie October). 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:

	UK & Ireland	Rest of Europe	Rest of World
With Meetings Abstracts	£10	£30	£35
Without Meetings Abstracts	N/A	£15	£20

Affiliation is for a term of five years in the first instance. An Affiliate may be permitted to remain as an Affiliate beyond five years on payment of the subscription rate applicable to an Ordinary Member.

All Affiliates receive copies of Meetings 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
IUPS CLASSES

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
33	Molecular Physiology
24	Muscle & Exercise
25	Neuroscience
26	Nutrition & Food
27	Pathology
28	Pharmacology
29	Radiation
30	Renal
31	Reproduction
32	Respiration

You may specify up to three Classes.

The Society's Special Interest Groups

AF	Autonomic Function
BB	Blood-Brain Barrier
CC	Cardiovascular/Respitatory Control
CI	Comparative & Invertebrate Neuroscience
CN	Cellular Neurophysiology
DP	Developmental and Plasticity
EC	Endocrinology
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
TE	Teaching

You may specify as many Groups as you wish.