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THE FOUNDATION FOR SCIENCE AND TECHNOLOGY

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More UK spending on research

By good fortune, the Foundation held a dinner-discussion on Priorities in UK research on 16 July, the day after the Government made public the outcome of its three-year spending review covering 2002-2006, which deals more generously with science than had been expected and than recent experience has shown. The result was to suffuse the evening's discussions (a report of which will appear in the next issue of *FST Journal*) with unaccustomed cheerfulness.

In round numbers, direct support for research through the research councils will increase by 10 per cent a year in real terms. In addition, it is planned that the stipends of graduate students supported by public funds will increase to £13,000 a year by the end of the period, taking the edge off the customary impoverishment of the most junior of research workers. But the motive for this welcome development is not so much compassion, but the objective of encouraging young people to follow careers in science. There is also to be new money for the refurbishment of laboratories and for new buildings.

Foot-and-mouth inquests complete

The three inquiries set up by the UK Government to deal with the consequences of last year's outbreak of foot-and-mouth disease (FMD) are now complete, with the publication of two reports in the past few weeks. This form of inquiry was offered, when announced on 9 August 2001, as a speedier way of gathering information than the public inquiry for which many of the Government's critics had asked.

The inquiry, carried out under the auspices of The Royal Society and chaired by Sir Brian Follett, reported on 16 July this year. Its remit was to advise on the scientific aspects of the control, prevention and transmission of infectious epidemics in livestock. Its chief conclusion is that Britain should not abandon the present goal of having unvaccinated cattle herds, but should prepare to use vaccination in the control of future epidemics. The Committee's report argues that vaccination could be more effective than the contentious policy of the "contiguous cull" in which cattle on farms neighbouring those with overt infection were killed, not least because vaccination could be more widely used. The Follett Committee also says that vaccinated animals need not be killed at the end of an epidemic, but that animals shown to be free from infection could safely enter the food chain. It asks that the Government should have suitable vaccines and tests in place by the end of 2003.

The other inquiry now reported, carried out by a committee chaired by Dr Iain Anderson, was designed to draw lessons from the 2001 outbreak. Its chief criticisms of the handling of the epidemic are that ministers said publicly that the epidemic was "under control" (in March 2001) when this plainly was not the case, that there appears to have been no documentation of the decision that contiguous culls should be completed within 48 hours and that the British Army should have been recruited earlier in the outbreak. ❐

Sustainable science

Sir – I thank the Foundation for a stimulating evening of discussion entitled *How should governments support science and innovation in a growing economy**. However, I felt a little frustrated by the rather limited scope of both the presentations and the ensuing discussion and wish to address a number of points which either did not arise or there was insufficient time to pursue.

Science funding is important from an economic perspective, but also from educational, cultural and social perspectives. Without adequate funding for science our society and economy would be impoverished, our democracy deprived of an informed electorate and our people divested of aspiration and vision. While I appreciate that economics were to the fore in this discussion, I do not think it acceptable to ignore the holistic benefits of science funding.

I do not recall the word "sustainable" in open discussion. Surely, given the huge media attention to global environmental change as well as UK issues related to land for housing, transport and so on, we should recognise that development and economic expansion is valid only where this is sustainable.

Funding of science was really only peripheral in the discussions that were too parochial for my liking. I appreciate that both universities are concerned about funding and agree that it is deplorable that Northern Ireland should invest so little compared to other parts of the UK. However, there are overarching issues. We urgently require a proper cost-benefit analysis where all benefits are accounted for, not just those in terms of spin-off companies and the like. Public support of science must not be restricted to London and surrounding areas. The continued centralisation of Government investment in science will inevitably undermine both the quality of life and the economies of regions and should be reversed. The regions require a quality science base and should be financed accordingly.

Science and the benefits that come from science require people of the highest ability, but science is losing good people to other professions at critical stages. University entrants with science backgrounds are opting for vocational subjects such as medicine and pharmacy, while many excellent science graduates pursue careers outside science. These issues raise doubts about the sustainability of the excellence of UK science and are due to poor career structure and rewards. Unless salaries, working conditions such as job security, and the image of scientists is addressed positively we will see continuation of the drift away from science.

Professor W I Montgomery
Head of School of Biology and Biochemistry
Queen's University, Belfast

*Discussion Meeting, Belfast, 19th March 2002, *FST Journal*, **17** (5), 9–13 (2002).

Dear Sir...
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Realistic and workable legislation

Dr Robert Coleman

Pathological specimens and data — What controls should be in place?

This was the topic of a Dinner/Discussion Meeting held in conjunction with the Academy of Medical Sciences on 23 April 2002. The meeting was conducted at the Royal Society.

Dr Robert Coleman is Chief Scientific Officer for Pharmagene Laboratories Ltd

I am speaking on behalf of the pharmaceutical and biotech industries, which are the chief commercial users of pathological specimens.

In the wake of the Alder Hey and Bristol incidents, various recommendations and guidelines have been produced. The Chief Medical Officer's guidelines make plain support for the use of retained tissues in research. The Royal College of Pathologists echoes that position, asking that consent should be obtained for the use of retained organs in research and that consent be generic.

Whether the guidelines drafted by the Royal College have been endorsed by the Department of Health (DoH) or by the various ethics committees is not clear. The DoH issued a consultation document in January that raises many of the same issues afresh.

My chief concern about the prospective DoH guidelines is that they, and attendant legislative changes, should be realistic and workable. As such, the proposal within the DoH draft guidelines that individual consent should be obtained for every specific use of tissue is not practicable. I fear that the guidelines will be unnecessarily restrictive.

Moreover, the draft guidelines do not address the issue of confidentiality. Instead, they create a problem that does not currently exist: they say there should be contact between the researcher and the donors of tissues, whereas we believe there should be none. Indeed, current guidelines stress the importance of donor anonymity.

The present climate has already had a serious effect on the key public sector workers who facilitate the use of human tissues in research. People in the National Health Service are now unclear what they can and cannot do with human tissue. That uncertainty has led to research ideas being abandoned because of the extra stress and unpleasantness involved in taking them to the ethical committees. Since Alder Hey, colleagues seek to avoid possible criticism even when they believe their projects will benefit patients.

Pharmagene is a drug-discovery company that works exclusively with human tissue. We have therapeutic programmes of our own, but we also work on those of clients, mostly pharmaceutical and biotech companies. We supply data related to efficacy, side effects, absorption, metabolism and toxicity of drug candidates in man.

background

For the past two years, British physicians (especially pathologists) and members of the public have been wrestling with the macabre problem of managing in a seemly fashion the large quantities of human tissue accumulated over the years at National Health Service hospitals. The issue caught the public eye in 2000, when it emerged from an inquiry into a series of unsuccessful paediatric cardiac operations at the Bristol Royal Infirmary that infant hearts had been removed post mortem for further examination, usually without parental consent. That revelation was followed by reports that even larger collections of stored (and largely unused) organs and tissues were kept at the Liverpool Childrens' Hospital, also known as the "Alder Hey Hospital".

The British Government's response to these developments was swift. In February 2001, the Chief Medical Officer, Dr Lliam Donaldson, produced a report on the scale of the problem, estimating that more than 100,000 organs were stored at NHS hospitals. The report recommended that there should be an independent "retained organs commission" to oversee the return of organs (when requested) to relatives and to solve problems arising from the large numbers of organs and tissues not attributable to known individuals. The Retained Organs Commission was constituted as a "special health authority" on 1st April 2001; its Chief Executive was the second speaker at a dinner-discussion meeting held jointly by the Foundation for Science and Technology and the Academy of Medical Sciences at the Royal Society on 23rd April 2002.

Among our own drug-discovery programmes is a novel treatment for cystic fibrosis we hope will start clinical trials in December this year.

The company's existence depends entirely on the voluntary donation of human tissue. We use no animal tissue or cell lines. Why so? Drug discovery and development is a long and expensive process that has an inexcusably high failure rate. Approximately 80 to 90 per cent of compounds reaching the end of the clinical phase fail — in perhaps 75 per cent of cases, because animal rather than human tissue has been used. That is why we are committed to using human tissues to develop drugs intended for human use. Human tissues are available and the public is willing to donate them.

What tissues do we look for? We use frozen and fixed tissues for looking at the cellular localisation of particular proteins and messenger RNAs. We can also do experiments on live tissue, on fresh tissue, even though it may have come from an individual who has died; such tissues may live for several days and retain responsiveness to drugs, so that we can ask very direct questions of them.

All donation is anonymous but we do seek as much medical history as the individuals and the suppliers are prepared to give us. To that end, we supply a questionnaire. At the very least, we need age, sex and significant drug therapy and the reason for the removal of the tissue and/or cause of death. We also do a pathological examination on every tissue.

In the search for new drugs, the value of human tissues has been and continues to be under-estimated. Because this material is so valuable, the disposal of tissue that might be used for *bona fide* ethically acceptable research might be regarded as being itself unethical. Tissue donation should be regarded, as blood donation is, as a public-spirited act. Commercial research can be and, indeed, is conducted on human tissue in ways that are responsible, culturally sensitive, ethically sound and legal. The public needs safe effective drugs, the pharmaceutical industry is there to provide them and the use of donated tissue is an increasingly important element in the discovery process.

Our potential treatment for cystic fibrosis arose from studies of lung samples from cystic fibrosis sufferers and people free from the disease. This novel approach would not have been possible without the use of human tissue. The same principles have led us to establish research programmes aimed at the development of drugs for the treatment of Irritable Bowel Syndrome and migraine as well as for the management of pre-term labour.

You will appreciate that we are in a curious position: we rely entirely on material we cannot buy. (The law prevents that.) We can acquire human tissues only by donation, and so are totally dependent on willing donations by people who have died or on the willingness of next of kin. There is also competition for tissues; NHS employees have insufficient time to organise access to tissues, while there is no established legal and ethical framework for doing so.

What we need is a single set of guidelines. Perhaps the promised DoH guidelines may fit the need. But I must emphasise that public opinion is not a constraint. At one of the hospitals we work with, 2,000 patients about to undergo surgery were asked whether they would be prepared to donate tissues removed for research by a commercial organisation: only 2 per cent refused.

We need a system that will allow tissues removed at operation to be used for research if the putative donors agree. There should be an opportunity to ask people at an appropriate point for their consent, and a system for distributing retained tissues to *bona fide* research organisations that have been ethically scrutinised and approved.

Since the foundation of Pharmagene, we have worked very hard to make the process a little easier. Up to a point we have succeeded, but the Bristol and Alder Hey incidents have made a lot of people and organisations nervous and very cautious. Evidence suggests that research is not the worry, but rather the attitudes of those who take the tissues, about paternalism and poor clinical and ethical practice. My belief is that the public actually supports the use of waste tissues for *bona fide* research. ❐

The Retained Organs Commission

Steve Catling

Steve Catling is Chief Executive of The Retained Organs Commission. He has been seconded to the Commission from the Department of Health.

I speak on behalf of The Retained Organs Commission. I hope to assure you that we are not antagonistic to research or indifferent to its importance. I will raise three questions about organ retention: (1) Why have recent events provoked such an intense reaction? (2) Why was the Commission established and what has been done so far? and, (3) What does it hope to achieve?

Organ retention has caused a great furore. More than 20,000 people contacted NHS trusts in the fortnight after the Redfern Report appeared to ask whether organs and/or tissues from deceased relatives had been retained. Although this number is only a few percent of those who had died and had post mortems during the preceding decades, the need to respond stretched many NHS Trusts.

We have commissioned public opinion research that, we hope, will give us a better understanding of public attitudes towards organ retention. Meanwhile, I believe that present attitudes have their roots in several different aspects of today's culture — historical, sociological and psychological.

The story of the grave-robbers Burke and Hare continues to be surprisingly fresh in people's minds. Another historical example is the famous gothic novel by Mary Shelley: while the plot of Frankenstein may be a complex metaphor for the impact of technological and scien-

tific change on the one hand and the social isolation of individuals on the other, it is the metaphor itself, the artificial monster assembled from stolen organs and tissue, that captures the imagination. The novel is at the extreme of a spectrum of an historical tradition which today often associates pathology and scientific research using human organs with images of violence, criminality and insanity.

Several psycho-sociological issues ensure that problems relating to organ retention receive maximum attention and arouse disproportionate distress and anger. For many, incomplete burial or cremation conflicts either with the dictates of religion or with cultural views about death and its aftermath. Initially, I was surprised at references to the Holocaust from a number of respondents with Jewish backgrounds, but then I realised that, for many, the offence committed by the Nazis was not only to kill 6 million of their fellow Jews but then to fail to respect the bodies of the dead once they had been killed.

Equally for Muslims and Hindus, there are real issues about the timing and manner of funerals and considerable concerns about bodily integrity. Beliefs relating to resurrection and reincarnation also lead to concern that if the bodies of the dead are not complete at the time of the funeral, the reincarnated or resurrected individual will be impaired.

Public concern about organ retention is therefore not simply a hysterical response by relatively few individuals, but a reflection of both fundamental cultural mores and more recent psycho-social trends. Those engaged in activities dependent on organ retention must seek an accommodation with these opinions. To those who consider that public opinion is irrelevant to the conduct of research, current difficulties give the lie.

The Retained Organs Commission was founded after the incidents at Bristol and the following Redfern Report, whose publication the Government delayed by more than three months to ensure an effective response to the inevitable public reaction to its grim findings. The Chief Medical Officer offered 17 recommendations, including proposals for legislative change, a comprehensive review of the coroner system and improvements in clinical education and training.

One recommendation was the immediate establishment of an independent commission to oversee the return of retained organs and tissues to families requesting that and to consider the question of historical and archive collections obtained from post mortem examinations. The Retained Organs Commission was set up the same day, in shadow form, and immediately issued guidance to NHS Trusts on handling enquiries from the public; it was formally established on 1st April 2001.

The Commission has four functions:

- To manage the process of organ return in the NHS;
- to provide advocacy for families;
- to consult on and propose a regulatory framework for museums and archives:
- and to advise ministers about the changes needed in the law.

The Commission, constitutionally a health authority (the smallest in the NHS), has an unusually large number of non-executive directors. These include four professors (of law, ethics, pathology and physics), one senior educationalist who heads a health study centre, two directors of relevant voluntary bodies and two who have direct experience of organ retention. The Commission is supported by 18 staff. We run a helpline and a website to provide information.

The Commission has sought to advise and manage the NHS response from the outset. The guidance issued on the day of the Redfern Report was designed to ensure that trusts responded effectively, appropriately and sympathetically to enquiries. The guidance was effective for those trusts – most of them — willing and able to accept it. Almost immediately, we also placed a moratorium on providing information for returning human organs or tissue for respectful disposal chiefly because we wished to avoid difficulties occasioned by multiple funerals.

It also became clear that cataloguing all the human material would take far too long and was not what people wanted. Most callers wanted simply to know whether their relatives had been complete or entire at the time of the funeral and, if not, what organs and tissues were still retained. Very early, we had determined that we would not cold-call individuals linked with retained organs. So we developed guidance, issued in early March 2001, which provided for information systems to be validated and searches carried out to ensure that no material had been inadvertently hidden.

Checking that 275 trusts could access the information took more than six months. In July, with most trust systems validated, we issued guidance on the return and respectful disposal of organs and tissue. This followed an extensive consultation process and also included a clear message that Chief Executives of trusts had personal responsibility for ensuring that families were treated properly and mistakes avoided. For a few trusts, this process will not be complete during 2002.

On our function in advocacy and support, our helpline has dealt with nearly 3,500 calls since April 2001, many requiring follow-up with trusts. We have also received and dealt with almost 3,000 separate e-mails from the public or from NHS trusts seeking advice, information or clarification of the guidance. We have published information booklets on blocks and slides, on making enquiries and on respectful disposal.

For most of our respondents, the primary motivation is to find out what happened. Many are content simply to leave organs and tissue in NHS laboratories once they have found out what happened at the post mortem and subsequently. At the same time, the Commission has been meeting in public, both to enable the public to contribute to our work and to make it plain that nothing is being hidden. The Commission is currently undertaking a major consultation on a wide range of policy issues relating to the use and disposal of human tissue and options for a regulatory framework.

There remains a great deal to be done over the next 12–18 months. To ensure a continuing foundation for medical research requiring access to human organs and tissue, the Commission needs to accomplish three things:

- If you will pardon the phrase, we need to bury the past.
- We need to engender confidence in effective managerial and regulatory frameworks based on revised legislation.
- We need to improve public knowledge and understanding about the benefits of organ retention and pathology.

There are four immediate issues we must decide, as follows:

Blocks and slides. As you know, these are not organs but small pieces of tissue taken from organs and then treated so that they can be examined histologically. Should they be dealt with differently from organs on account of their relatively smaller size and because they are no longer simply material removed from the body but have been materially changed?

Regulation of collections. Collections of organs and tissues require a regulatory framework. Should there be a regulatory body? What powers should it have? Should it license collections or merely require their registration? What sanctions are needed? Should the current functions of the Inspector of Anatomy be subsumed in the new regime?

Returning retained tissues. Should we stimulate by publicity another round of organ return — an issue raised with the Commission frequently since the proposal adopted by the Scottish Parliament that tissue should be retained for five years,

subject to an annual round of publicity to enable relatives to seek to have material returned to them.

Respectful disposal. The Commission will also have to grapple with questions relating to the respectful use and disposal of human material. Where there are clear indications that consent for retention had not been given, should these materials be disposed of? Where material has not been claimed, might it continue to be retained for respectful use? What should be done with unidentified material and so on?

There are several other important questions left unanswered. How should unidentifiable organs and other material from before March 2000 be dealt with? Is it acceptable to continue to use for beneficial purposes organs and tissue about which no enquiry has been made by relatives? Should the absence of enquiries from relatives even be equated with consent or lack of objection? Is incineration at hospitals or designated clinical waste disposal sites ever appropriate for human material? ❐

www.nhs.uk/retainedorgans//index.htm

Tissues in teaching and research

Professor Nick Wright FMedSci

Professor Nick Wright is Warden of the Barts Hospital and The London School of Medicine and Dentistry.

Academic pathologists are now facing a serious threat to research. If we do not solve the problems, the whole of biomedical research in the UK will be hurt.

Here is a recent experience of mine. I was interested in getting some blocks of liver cancer from a group of friends so as to look at a particular molecule. One colleague replied to my e-mail request, "We have a number of such blocks. However, post-Alder Hey, it is not possible to send you these without the consent of the patients. This would be a hopeless task. I am sorry to be unable to help." The use of the word "hopeless" by a senior academic pathologist smacks of despair. That is the situation we are in.

I want to distinguish between organs and tissues removed at autopsy or post mortem and tissues removed in diagnostic procedures such as biopsy, the surgical removal of an organ and material for cellular diagnosis. By confusing the second with the first, we may throw out the baby with the bathwater.

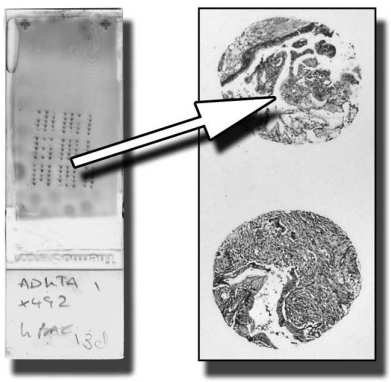
We retain tissues at autopsy for good reasons. In an autopsy on a post-operative baby, for example, if you want to examine the brain, you have to fix it for seven days in formalin. If you want to examine the heart, you have to stuff it with cotton wool, suspend it in formalin and dissect it several days later. By then, the body has gone, the funeral is over – but you are left with the tissue.

In good autopsy practice, tissue retention is necessary on several grounds. Tissues are needed for audit purposes – between 20 and 30 per cent of primary diagnoses are proved wrong by autopsy. Then we have to teach — undergraduate students, postgraduate surgeons and pathologists. There is also research: the natural history of AIDS or new-variant CJD would not have been worked out without autopsies. Pathologists interested in multiple sclerosis or Parkinson's disease or Alzheimer's rely on tissue banks and brain banks throughout the country.

Recent advances in perinatal and foetal medicine have required detailed perinatal autopsies. The profession has been slow to tell the public, which wills these developments, that the successful design of such operations rests on the dissection of many hundreds of organs. If we want to see further advances in cardiac surgery in children, we have to accept that.

We do not fully appreciate that we are in danger of losing the surgical pathology archive and the research depending on it. All over the country there are carefully catalogued archives of human tissue, mainly embedded in paraffin. Much research in what we call the "post-genomic era" depends on access to such tissues — to find where novel genes are expressed, for example.

We are just beginning to explore what can be done with accurately catalogued organ and tissue banks. The infamous blocks are small pieces of tissue preserved in paraffin, from which you can cut thin sections. More recently, we have been using what are called "multiblocks", where we take multiple specimens from multiple blocks and put them on the same slide. This has enabled us to move very quickly in looking for prognostic markers. Borrowing a term from molecular genetics, they are called "tissue microarrays". We can localise genes and their products by *in situ* hybridisation or by immunohistochemistry. They are a potentially very powerful resource. To access this



Tissue microarrays

range of material is, of course, becoming very difficult.

A more recent advance is the application of tissue microarrays to the molecular genetics of tumours. We can compare the expression of genes in different tumours of the same type and identify prognostic markers. Pathologists then need to look at the tissue to try to understand the genetic differences. An example of the benefits is the antibody against the gene product called NFB2, shown by these techniques to be over-expressed in breast cancer, which has now been sanctioned by the National Institute for Clinical Excellence for treating patients with advanced metastatic disease. Without access to large numbers of breast carcinomas, we could not have done this.

Tissue retention is extremely important for teaching. For example, pathologists traditionally hone their skills by what are called slide seminars: they circulate slides among each other before meeting to discuss them. I have recently been to meetings where pathologists have been too frightened by recent events even to circulate the slides, so that the meetings are fruitless. Our postgraduate courses use large numbers of slide collections, while pathologists send each other slides for specialist referral. That too has been caught in the tension. Should we be doing this without consulting the ethical committees or getting the patients' permission?

Just see what the Americans do about tissue retention. The American College of Pathologists has minimum retention periods. Wet tissues are kept for short periods, ordinary blocks for a minimum of 5 years, blocks from paediatric patients for 50 years and slides for 5 years. Those are minimum periods because these materials may form part of patients' records, just like electrocardiograms or X rays.

By contrast, in the UK we have a plethora of guidelines. Apart from the Royal College of Pathologists' guidelines, the Joint Committee on Medical Genetics has pronounced on what we should do with tissue and the Medical Research Council has guidelines for the use of tissues in research. And now we have the Retained Organs Commission.

We are now running into serious difficulties. In the past four years, adult post mortems at teaching hospitals have almost halved. Paediatric autopsies are also falling, partly because we are losing paediatric and perinatal pathologists. Coroners' autopsies are also falling, preventing their use in teaching. (One pathology department I know of has suspended autopsy teaching for lack of material.) This situation could have a serious detrimental effect on clinical governance: clinicians are often frustrated by coroners' refusal to investigate fully unexpected deaths following surgery, for example.

In the absence of agreed guidelines, the local ethical committee is the only avenue we have to get tissue. The committee reports to the health authority, so that there is a disturbing lack of uniformity across the country. I have a frustrating personal experience of ethical committees. Last year in May, I wrote to a colleague asking for blocks from male patients who had received transplants from female donors; I wanted to assess the rate at which cells from the donor move into the transplant. It took us 10 months to get the permissions required to get our hands on the tissue. Two days later a paper was published on this topic in the *New England Journal of Medicine*. It is debatable whether it is worthwhile doing such research.

What we most urgently need is an agreed nationally applicable method by which patients can give consent for their tissues to be used in teaching and research. Then we need a nationally applicable system for access to these tissues. We need an arrangement whereby currently archived tissue can be accessed, the close involvement of the local ethical committees and we need some interim guidelines. But we need to dispute the view I have heard voiced in the highest circles that tissues removed during surgical operations should be returned on request to the patient: the Americans are right to say that they are part of the patient record. And of course we need public consultation, education and debate on all these issues.

We have seen the terms of reference for the Retained Organs Commission but we do not yet know how its work will affect us. The return of organs from the research collections? One such collection is the Multiple Sclerosis Brain Bank at Charing Cross, the contents of which have been donated properly with informed consent by people who died. As yet, we have no definition of what "human tissue" means: organs and part-organs certainly, but does it include standard tissue blocks, slides which are at present on glass or even things like teeth, skin, hair and nail clippings?

I conclude with a statement of what I believe we should look for from the Commission:

- The exclusion of collections of blocks and tissues, especially those from surgical pathology archives, from the requirement of registration and/or licensing?
- Access to these tissues to be decided by the local ethical research committee under appropriate guidelines?
- Can we agree that material present in these archives is deemed to be *abandoned* and so does not have to be gifted (which entails tracing the person concerned or the relatives)?
- Appropriate mechanisms should be put in place for patients to gift their tissues for research, audit or teaching.

Unless we can secure these goals, we face a difficult future in teaching and research. ❐

discussion

Confidentiality and anonymity. There were different sensitivities in relation to different kinds of tissue. The main concerns, and the remit of the Commission, primarily concerned organs and tissue retained following *post mortem* examination. There was little pressure to return surplus tissue retained after surgery. Despite the example cited of the Mexican emperor who lost a leg, but gave it a royal funeral, it was thought that most patients would be relaxed about tissue surgically removed.

Pathological specimens constituted data, and it was for consideration how far consent should be needed for the use of patient data, including photographs, for research. One participant saw a fundamental difference between data about patients and bits of people. Another response was that the use of information about patients for research should be referred to local ethics committees.

A participant from the commercial sector saw anonymity as the key to using personal data. Such data caused no problems so long as researchers knew the clinical context and could go to an intermediary to get further information where necessary. Another speaker was not sure that anonymity would solve all the problems when studies needed linked data about patients.

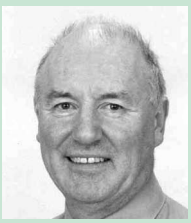
⇨ A detailed summary of the discussion is available on www.foundation.org.uk

The public understanding of science

Professor Malcolm Longair CBE

Science Communication

Informing and educating the public on issues of a scientific nature was discussed at a meeting held on 5 February. The first speaker was Professor Longair, who has communicated his excitement for science to audiences around the world for many years. Further speakers were BBC science correspondent Pallab Ghosh, Simon Pearson, Executive Editor of The Times, *and* FST Journal *editor Sir John Maddox. The general discussion is summarised by Sir Geoffrey Chipperfield.*



Professor Malcolm Longair is the Head of the Cavendish Laboratory, the physics department of Cambridge University and Jacksonian Professor of Natural Philosophy.

What are we trying to do in what I continue to call the "public understanding of science"? There are several goals: to encourage and support young people, to counteract the negative image of science, to provide advocacy for science and its benefits, including supporting the resources going into science, to improve the lot of scientists and, in particular, of science teachers and, finally, to embed science into general culture.

The last point is a difficult area. If the talk at a dinner-party is about science, you can be sure that it is not about Newton's laws, laws of thermodynamics, electromagnetic induction, relativity, the equivalence principle, $E = mc^2$ or Heisenberg's uncertainty principle. Yet, those of us in the field know that these are at the root of our scientific culture. The difficulty is that these concepts require a lot of careful thought and precise use of language. Without these it is difficult to gain a deep appreciation of science and the scientific process.

Nevertheless, there have been successes. For example, unlike 20 or 25 years ago, the public understanding of science is now firmly on the agenda of the science community. We now accept not only that we are responsible for producing excellent science but that we must explain what we are doing to those who fund us. Also, there are now many people trying to communicate the real essence of science, not just its "Gee Whiz!" features. Another encouraging sign is the success of Science, Engineering and Technology weeks. It amazes me that we can fill our largest theatres at Cambridge during Science Week — science has become part of the national agenda.

The vast improvement of the technology for communication should not be ignored. The Web, CD-ROMs and Powerpoint programs have made communication much more effective. For example, my laptop stores 36 public lectures. The one I like best is called "Great experiments in physics". In one hour, I do seven live experiments. The audience makes the measurements and between us we determine all the fundamental constants of physics. With the aid of Powerpoint, one experiment together with plotting the data takes only five to ten minutes. Perhaps I should add that it takes me two days to set up the equipment and that the presentation itself leaves me exhausted.

That is the good news. What are the worries? Are we really improving scientific literacy? We are, but we must concentrate on the essence of what it means to do science rather than on superficial aspects of scientific endeavour.

The students who come to Cambridge are fantastically able intellectually, but their preparation can vary very widely. I speak about physics, but what I say applies to other scientific disciplines. Students are leaving school with less experience of mathematics, of explanation, of practical science and a reduced course content. The teachers are heavily overloaded with little or no scope for enhancing the educational experience. The result is a reduced appreciation of what it means to do science.

Some of the same problems recur at the university level. I want my best scientists to talk to young people and others, but I can no longer ask them to give school and public lectures because they do not have spare time and effort. The best scientists are dangerously over-committed.

Furthermore, when you ask the students, they often wonder if it is worth the enormous effort to become a professional scientist. It is extremely hard work. Somehow, we must change these perceptions. I fear that at the root of all these problems is a very serious problem of underfunding at school and university level.

What about the press? It does a good job within the constraints of accessibility. The question most of us have when we look at scientific stories in the press is whether they have communicated the things that worry the professionals. Often they do, but sometimes they do not. Yet scientists live in a world of uncertainty and complexity. Communicating that and distinguishing between provisional and secure understanding is a real challenge.

Let me end by giving a very good example of public communication of science. Stephen Hawking's *A Brief History of Time* has had a mixed reception. The book has to be read carefully. For example, in just one sentence, Stephen encapsulates the whole of wave/particle duality in physics, one of the big stumbling blocks for lay people. He writes, "The theory of quantum mechanics is based on an entirely new type of mathematics that no longer describes the real world in terms of particles and waves: it is only observations of the world that may be described in these terms." That is a brilliant way of putting a very deep scientific truth. I wonder how many people noticed that sentence. It shows how tricky this public communication business is. ❐

The journalistic process

Pallab Ghosh

Pallab Ghosh is a Science Correspondent for BBC News. He has worked for the BBC for 12 years working for Radio 4's *Today Programme*, *Newsnight* and the *Ten O'Clock News*. He is also currently chairman of the Association of British Science Writers.

My job is making snap decisions about what constitutes a science and then reporting on it as accurately as I can. A recent example was when ACT claimed to have cloned the first human embryo. It was a Sunday and the pressure was on to get something out as quickly as possible. I am not an expert in the field, so what qualified me to make the decisions?

It is a serious question whether specialist areas should be covered by people who really know what they are talking about, by a series of scientists on BBC News, for example. Sky Sport does that in its coverage of football; it hires ex-footballers, people who really know what they are talking about. If we had that for science stories, no doubt a number of egregious mistakes and scare stories would not appear.

There is a view that the journalistic process, designed to sell papers rather than to promote science, will always choose to headline the sensational bad piece of research and ignore the mass of good research, to dwell on the striking sound-bite rather than on the caveats. So, if there is something wrong with the process, what shall we do to try to fix it?

I suppose the Guidelines on Health and Science Communication, produced by The Royal Society, the Royal Institution and the Social Issues Research Foundation, were meant to do that. I have to say that when they came out, a lot of people felt insulted. "We have been doing our jobs for a long time, we thought we knew what we were doing and then a bunch of outsiders tell us what to do." The guidelines are fairly obvious journalistic rules.

A group of us science journalists got together to consider how to return the compliment. In the light of the recent mix-up of sheep and cattle brains at a ministry laboratory we came up with: LABEL YOUR TEST TUBES.

Label your test tubes

I suspect that if The Royal Society were to distribute that to its members, it would go down just as well with them as their guidelines have done with us. There are mistakes in science as there are in journalism.

At the BBC I am taken as seriously as the economic correspondents and the political correspondents. My job is to ask questions – whether it is right to reduce the moral status of the embryo in order to find new cures for diseases or for biotechnology companies to make lots of money out of it, whether we need the so-called benefit of GM crops in return for the loss of control of our food supply.

My job is to reflect the debate that is going on in the scientific community and also, more importantly, in wider society. That is the difference between scientific journalism and propaganda – sorry, "the public communication of science".

People are fed up with having forced upon them a technology with lots of benefits for the producers but none for themselves. Most importantly, since BSE, the public has lost faith in the advice that was given by Government or scientists.

There are golden opportunities for the scientific community to listen to the anxieties of the public and engage in a dialogue with the growing mass of people who feel disconcerted and disenfranchised by the way in which science is being applied, driving the country in a direction with which they do not feel entirely comfortable.

The front page of the *Daily Mail* is very good at identifying what people are thinking; much more could be achieved by taking note of what it is saying and then engaging in the debate rather than simply dismissing it.

As I see it, the science communication industry, despite all the rhetoric, is still wedded to the deficit model, the filling of empty vessels. That is why I disagree with Professor Longair. The people who come along to lectures give us the feeling that we are doing a good job. But in my view, it is still an élite preaching to the middle-class converted, not talking to the people buying the *Daily Mail*.

People buy those front pages for a reason: the self-perception of infallibility, evangelical fervour in the justness of a cause. The research community should look at its own performance. How often have cancer charities sought to enhance their profiles to get extra coins into their collection tins? How often do companies hype their unpublished research simply to raise their share price? What can be done to ensure that there are fewer stories such as "GM foods stunt your growth"? There has to be greater openness. Researchers talk endlessly on this theme, but I know many who do not speak to the media because they have been burned before.

Researchers must also try to understand the media – not just us friendly science correspondents, but the snarling, biting 24 hour news networks springing up. I cannot stress this too strongly. If a

dodgy headline comes up, that is an opportunity to get out there and do the 24-hour radio networks, the TV networks. But you need to be clear about your message.

Here's a real example. At the height of the GM food debacle, I asked The Royal Society to put someone up for the One O'Clock News and was told that they were having a meeting to decide what statement to make and that they would issue a press release the next day. Thankfully, Bob Ward has changed all that – the society is now far more responsive. Organisations whose substance is science and technology need some person responsible for communicating science on the board. But they must be real professionals, not just propagandists.

Things aren't rosy in the journalistic world. We have our faults and, at the Association of British Science Writers (ABSW), we are trying a few remedies. We are trying to draw some of the brightest and best into our profession, in part by producing booklets to unveil the mysteries of entering this arcane area. We also manage a bursary scheme that targets people who would otherwise not be able to go on science communication courses. When science reporting is about reflecting the concerns of society, it is wrong that top science journalists should be largely from public schools and Oxbridge. (One has only to look around this room to realise that we are not the only ones with that problem.) We are trying to get a network going so that we can talk about stories and increase the quality of our information. We are working with the Royal Institution's science media centre to get quality briefings, to get the information we need to do our work better. ❐

discussion

Getting across the message. Much of the discussion revolved around the inability of scientists to understand the problems of the media, which were usually responding to what they felt to be public concern and interest. The result was that scientists were ineffective in making their case.

Some felt that scientists, as well as journalists, could legitimately complain that the Guidelines were condescending, and did no more than tell them to do what any good scientist already did. But others argued that, if the object of the exercise was to get a real dialogue going between scientists and the media, a surrogate for the public, they missed the point.

Scientists needed to start from an understanding of the issues the public cared about. Who had done the market research to show that? They then needed to think about how to deal with it — and not in terms of learned articles, but in language and style that the person in the street would want to read.

Once a science issue becomes a front-page story, it may cease to be a science story, so that the scientist is no longer dealing with a knowledgeable scientific correspondent, but a generalist. So a scientist needs to know about the status and problems of the journalist with whom he deals. Who is he (or she)? What is his deadline? Who has he been speaking to?

PR support and training is vital and scientists are woefully short of it. Look at the effort NASA put into PR over the Hubble telescope — and how it paid off.

How well are we doing?

Simon Pearson

Simon Pearson is Executive Editor of *The Times*. He joined his local paper, the *Mansfield Chronicle Advertiser*, after leaving college in 1976. He worked as a sub-editor in Hong Kong and Australia, returning to the UK to join the Home Desk of *The Times* in 1986.

How well is science communication doing? There is no doubt in my mind that scientists are getting the message across to the public in print and broadcasts far more frequently than in the past. But is it the message they want to get across?

At the bottom of page 10 in the 29 January edition of *The Times* was a story headlined "Our cloned cow kidney works, company says". The story said that the company, ACT, claimed to have produced the first cloned human embryo and to have created an organ from cloned stem cells that functioned when transplanted into an animal — "the first procedure of its kind". Was this more important than any of the dozens of other stem-cell stories in recent months? I still don't know.

But all was not well – ACT's findings were published without peer review and a senior scientist, John Gearhart, resigned in protest from the editorial board of the on-line journal that published the claims. Professor Gearhart told me, some days later, that the rigour of the paper was insufficient and that the company had a record of releasing material prematurely. He added that "some companies are learning that their material has more impact on politicians and with the public on the front of a newspaper than in peer-reviewed journals".

This instance illustrates some of the difficulties we are facing as both science and the media expand beyond the relatively simple structures that contained them both for much of the past century. There is a standard framework for communicating science which, in ideal conditions, works like this: scientist makes discovery, scientist waits patiently for peer review, work is published, sometimes a press conference is held, newspapers publish a full story with analysis and interviews, circulation soars on

news of breakthrough, delighted public praises politicians for excellent use of taxpayers' money, politicians give more money to happy scientist.

As we know, it doesn't always work like that because irksome journalists get it wrong, rogue scientists don't always play the game and commercial pressures distort the infrastructure for disseminating sound information.

My job at *The Times* is to coordinate the work of the news desks, the chief subeditors, the picture editors and graphic artists in creating the news. Our aim is to create the best package. We seek to be intelligent, creative and better than anyone else.

Scientists and journalists are not natural bedfellows. Virtually everything one does is antithetical to the nature of the other. While scientists spend weeks, months or even years researching and preparing scholarly papers and then wait months while their peers review their work, journalists believe that the world can be explained in bite-sized lumps. In its extreme form, journalism holds that there is nothing that cannot be explained in a single paragraph.

Each day, I see two or three hundred stories and select only 20 to 30 for use at a length of no more than 400 hundred words. Most stories have to grab my attention in the first few paragraphs; a tall order for complex scientific issues.

The news pages of *The Times* are designed and edited in the four hours between the end of the editors' afternoon conference at 4.40 pm and the first edition deadline at 8.30 pm. Commissions are changed, pages re-ordered, stories promoted and demoted. Journalists do not spend much of the day writing, but they do learn to put their words on screen very fast. Science is judged against what other correspondents are offering. We ask whether there is a new fact that will re-ignite our readers' interest – the suicide bomber was a woman, perhaps.

In science, the peer-review system is our security blanket. Most of what appears in our news pages meets the guidelines mentioned by Pallab Ghosh. We do, however, operate outside the guidelines when the evidence is compelling; that may happen more often in future, not in some misguided search for sensation to increase sales, but because scientists and their corporate partners will lead us there and it will be increasingly difficult to resist.

Radio and television are producing outstanding programmes fronted by impressive correspondents, a first generation of photogenic and audio-friendly personalities from the top drawer of science, who are destroying the caricature of the stereotypical boffin. They are inspiring ordinary people, not just the Lord Winstons, the Susan Greenfields or David Attenboroughs, but dozens of scientists from many universities who find there is a lot of fun and money to be made on the other side.

Front-line news reporting does less well. This is important because what appears on the news pages of *The Times*, *Telegraph*, *Guardian*, *Mail* and *Mirror* is what appears in MPs mailbags. These are the issues on which leading articles and comment pieces are based, with which much airtime on television and radio will eventually be filled. On news, we are short of scientists with a public face.

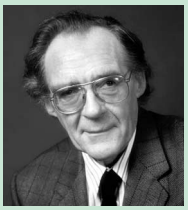
The Chief Medical Officer is no substitute for Lord Winston and the Chief Vet no substitute for David Attenborough. BSE may have no link with variant CJD and hardworking scientists may have got us out of a terrible mess, but the public has yet to be convinced. GM foods may pose no proven risk and indeed may hold huge potential benefits for mankind, but the public has yet to be convinced.

That is not solely due to the vagaries of an irresponsible press but also to the failure of the majority of scientists to stand and be counted in the eyes of the public and put their cases convincingly. The point is that men and women of science need not only to be armed with guidelines for journalists but with a mobile phone on which journalists can get hold of them ten minutes before deadline. We would also like photographs of you, details of your research in no more than a few hundred words, any useful graphics, all beautifully packaged of course and not just in the week of the British Association meeting.

Science is probably the last preserve of a recognisable élite that has not been fully assimilated into mainstream society, and yet science is probably the greatest force for change in modern society. That is why it is essential for scientists to engage vigorously with a public that is deemed often and, perhaps unfairly, to be anti-science. ❐

A balanced perspective

Sir John Maddox FRS



Sir John Maddox FRS is the former editor of *Nature* and now the editor of the Foundation's journal, *FST Journal*. Sir John started his career as a lecturer in theoretical physics at Manchester University before becoming the science correspondent of *The Guardian* in 1955.

All professional people hate guidelines, but there is a particular problem with the press. In the past three or four years there have been several spectacular examples of how stories have been exaggerated in a way that has fastened on the public fear of the unknown, creating substantial public problems.

The most spectacular case is that of genetically modified food – Frankenstein food as it was described on one of Ghosh's slides. A more recent case, also mentioned this evening, is that of the triple vaccine for measles, mumps and rubella, MMR. How should that story have been reported?

Nobody with a finger in the guidelines business wishes the press to censor itself or to hide stories and it is entirely proper that, if a scientist feels – and has evidence collected by reputable means - that this vaccine can cause autism, that should be reported. There is no point in hoping that the press will hide things that seem substantial.

On the other hand, if a report of vaccine causing autism is going to appear in a newspaper or a broadcast, it is essential that the same medium should also carry a story explaining what autism is and how difficult it is to diagnose and that it should ask the question, "Why is it that autism seems to be a disease of the past three decades, previously unknown?"

discussion

The importance of education. Another theme was concern about scientific education, and the lack of enthusiasm in students for science. Reasons ranged from fashionable theories about the illusion of objectivity, the realisation that scientific learning could be hard work to the inflexible nature of the science curriculum in schools and the poor quality of much science teaching.

No doubt something could be done about the latter, with due long-term commitment and money from the Government (not noticeably evident), but the former could be dealt with only by greater commitment from the scientific community.

All experience was that the most effective way of motivating students to take up science subjects — whether or not they intended to become professional scientists — was to expose them to young and enthusiastic scientists, doing research or development on exciting topics. But Professor Longair's point was valid: how could heavily pressed researchers and teachers find the time to go out to schools or give public lectures? Within the present situation, it was impossible.

Both themes raised the question more of the duty of scientists than of the media. There was strong support for the view that it was part of the duty of a scientist to communicate with the outside world. This was true both in the narrow sense of making sure his work is on the public record and in the wider sense of ensuring that his work is understood, where necessary, by the wider public.

"Where necessary" is not for the scientist to decide; rogue scientists, media interest, political pressure and public concern will decide that. It is his duty then to deal with the interest — aggressively in dealing with misconceptions, but also sympathetically when people are making choices about their lives.

Few scientists will be automatically good at this; their first duty is, therefore, to know their limitations and to get training to help overcome them. A particular element of this duty is towards students in schools — getting over the excitement of science and the need for all to understand the scientific process. Only if this duty is fully accepted will the necessary pressure be exerted to get the funds and time to do it.

⇨ A detailed summary of the discussion is available on www.foundation.org.uk

All these questions would help ordinary people put the matter in perspective. But it would also be entirely reasonable that a newspaper, recognising the public health problem caused if the public shied away from an indubitably effective vaccine such as MMR, should write openly about the dilemma underlying all vaccination campaigns: their benefit is to the community as a whole (although individuals are also protected against damaging diseases). Should not governments therefore accept responsibility, on behalf of the population at large, to compensate those who may be damaged by the administration of a vaccine? I have not seen this argument come up in the recent argument about the safety of MMR.

For what it is worth, the guidelines that Pallab Ghosh would consign to the wastepaper basket embody explicit warnings against the dangers of using a single unconfirmed scientific report to suggest that conventional wisdom is mistaken. If they had been followed, I doubt that the MMR fuss would have blown up as it did. The same is certainly true also of the earlier and more damaging fuss about genetically modified foods. What I regret is not simply that the affair has kept some foods off the supermarket shelves, but that it has created a sense of unease about the present world which, as Malcolm Longair has said, is not merely exciting but also explicable.

So how well are we doing? Much better than we were 30 years ago at explaining difficult concepts to the public. We are, nevertheless, still some way from the ideal state of affairs in which people can turn to their radios or their newspapers and find a guide to what the future is going to be like, and responsible and careful analysis of the dangers of doing certain things and, indeed, a vision of what science and all the other intellectual disciplines on which science depends have to offer.

I believe that, well though we are doing, we can do much better. I think it is one of the functions of guidelines in this field – I should confess, by the way, that I had a small hand, right at the end of the process, in putting together the guidelines Ghosh has mentioned; I found it an educative process. The guidelines are still a little too patronising.

I would also like to see them go further than they do in urging that it is a part of a scientist's responsibility to answer politely and carefully questions asked by journalists. I would even say that it should be an implicit duty on scientists to collaborate with enquiring journalists and to do so with good humour, not for the reason often quoted in America that it is the taxpayers who pay the research bill, but rather because I believe, as Malcolm Longair emphasised, that science is a part of our culture.

Newspapers and the media generally provide a critical underpinning of our culture; science is a central part of this. So scientists have a responsibility to deal kindly with the media to help them understand their problems.

I have another concern, about the movement for the public understanding of science. (I notice that the *Science Reporter*, the ASBW's newsletter, now uses the letters "PUS" for "public understanding of science" in such a fashion that I wonder why they haven't added an extra "S" to the word to make it seem even more distasteful.) But public understanding of science, although it may from time to time be described as the élite talking to the élite, is a necessary part of the process of turning hard concepts into understandable concepts.

When the research community feels beleaguered, perhaps from lack of public understanding, it should not forget that often, sitting in the same lunch rooms and common rooms, are other academics who are quite often as hostile to the scientific enterprise as anybody. When the research community puts all this emphasis on making a bridge with the public at large, it should also take on the arguments, cogent and penetrating though they may be, of their academic colleagues in other disciplines.

When you think of it, the NGOs recruit help in making trouble for science among academics who are often sceptical of, even hostile to, the agenda of science. The public is not hostile to science, as the ready acceptance of innovations that improve life shows. But not all innovations are beneficial. All of us must be engaged in trying to distinguish between the beneficial and harmful innovations. Anguish arises when dangers are misrepresented, usually by exaggeration. Science journalism may have come a long way in 30 years, but we have a long way to go before these problems can be handled confidently. Academic scientists could and should provide more help. ❐

The interface between Arts, Humanities and Science

Three speakers were invited to give their views on reducing the barriers between Arts, Humanities and Science at a Foundation for Science and Technology discussion held at the Royal Society on 26 March 2002

The relationships between the research communities

Dr John Taylor OBE, FRS, FREng
Director General of the Research Councils.

Science is crucial to our long-term economic and social well being. We are fortunate in the UK to have a strong science base. A stronger strategic framework, more of a shared vision and better cooperation among the key players offers the prospect of even better value from our major investments in science research. This could be further enhanced by more interaction between the science base and the arts and humanities.

I want to focus on research in science, arts and humanities; the history of discussions of the Arts and Humanities Research Council and the relationship between research in the sciences, the arts and the humanities.

In 1997, Sir Ronald Dearing recommended setting up an Arts and Humanities Research Council. The first aim was to bring together arts and humanities research, the second to allow better inputs to high-level decisions on research policy and funding. The Arts and Humanities Research Board (AHRB) was set up in 1998, meeting the first aim: it is funded by the British Academy and the Higher Education Funding Councils in the UK countries. Technically, the board operates as a company limited by guarantee.

In July 2001, the Council for Science and Technology produced a report, Imagination and Understanding, recommending, *inter alia*, a UK-wide Arts and Humanities Research Council; in September the Higher Education Minister announced a review of the AHRB to examine its future. In that November's Quinquennial Review of the Research Councils, my office also supported the idea of an AHRC as part of the Office of Science and Technology (OST) and of the community of research councils.

What do we actually mean by research in arts and humanities? It is important that the science research community understands what our A&H colleagues mean by research — and perhaps *vice versa* as well. There are important synergies and interfaces between science and technology, and arts, design and humanities, and, importantly, between research in these fields.

One contribution to the debate about research in the arts differentiates between research **into** the arts, **through** the arts and **for** the arts. Research **into** art and design, such as musical criticism, history of drama, and visual analysis, uses methods close to those of the humanities and could reasonably be assessed by the same processes and by the same criteria.

Research **through** art and design, by contrast, includes materials research, action research and industrial design and its use in other ways for the development of new products, some of which could be covered by an Industrial Partnership Development Fund.

Research **for** art and design is the most complex, and includes painting, drawing and composing.

If the science and arts research communities are to get closer together, the challenge will be to understand better how they differ in their values, ethos and methodologies in research.

One of the key perennial questions the Research Councils face is what is appropriate for public funding and what is not? When is it legitimate to share funding with industry, other government departments doing applied work, charities and so on? The same issues arise in A&H research. It is interesting that Dearing recommended an industrial partnership fund for the AHRB.

So, it seems that differences in the research methodology between the sciences and the arts are lessening. In particular, arts and humanities see the need for

- Research in teams needing some critical mass of people, and reasonable stability;
- Significant technology infrastructure particularly IT, libraries, languages;
- Peer review of grant applications and group work.

There is some collaboration within the broader research council network. For example, the Economic and Social Research Council (ESRC) in conjunction with the AHRB is inviting outline proposals under a new 5 year, £5-million research programme on "Cultures of Consumption". Then the Engineering and Physical Sciences Reseaerch Council (EPSRC) and AHRB are considering a £6-million, 5-year research programme called "Designing for the 21st Century" which is aimed at meeting the design challenges of an information society.

The Quinquennial Review of the Research Councils, which concluded that there is much innovation at the boundaries between traditional disciplines, included as a major recommendation the establishment of a high-level strategy group of the Research Councils' Chief Executives under my Chairmanship. This organisation, called Research Councils UK, or RCUK for short, was launched on 1st May this year.

The three main functions of RCUK are:

1. To provide a collective voice of the Research Councils on policy issues and be the main interface or portal to all their stakeholders.
2. To take forward the development of the strategic roadmap for science in the UK, and the processes for bidding for future funds and allocating them.
3. To drive and oversee the programme of activities needed to achieve much closer convergence and integration of Research Council processes.

The existing research councils welcome the notion of an AHRC if it is for the right reasons. How do we make it win – for both communities? ❐

discussion

The meaning of terms. A theme, related to the possible skewing of policies resulting from ambiguous definitions, was the risk that over-emphasis of inter-disciplinary approaches might be at the expense of traditional fields such as history and literature. Biology was quoted as another discipline suffering similarly. There might be a danger of producing a research culture in which Research Councils were run by academics for academics, creativity was stifled and disciplines such as translators and developers fell behind.

These anxieties were acknowledged but it was pointed out that 70 per cent of AHRB funding went to traditional humanities research. It was a mistake to think of such research as qualitatively different. A distinction needed to be made between the need to encourage research into fields of creativity and the need for greater inter-disciplinary effort. Efforts in this latter direction fell seriously short.

Stimulating inter- and multi-disciplinary research

Sir Brian Follett FRS
Department of Zoology, University of Oxford.

Perhaps I could raise two sets of issues. First, how is research in the humanities and creative arts supported within the universities and colleges? Second, how can Britain stimulate and encourage inter- and multi-disciplinary research across disciplinary lines?

In the case of humanities the capacity of an individual academic member of staff to undertake research is particularly dependent upon the availability of time and of certain infrastructural requirements such as libraries, IT and the ability to travel to other institutions. As a nation we have also added the Arts and Humanities Research Board (AHRB) which operates in a manner similar to that of the research councils in the natural and social sciences. It is important to appreciate that the balance between the two research funding sources provided by the taxpayer (the QR funding from the Higher Education Funding Council which supports academic pay and provides research infrastructure; and the project grant stream from the research board) lies more heavily in favour of the Funding Council in the case of the humanities (75:25) than the natural sciences (40:60).

The out-turn from the latest Research Assessment Exercise (December 2001) and its subsequent conversion into QR funding is important for the future in all academic disciplines but especially so in the case of humanities and the creative arts academic staff. An analysis of the results at a university level and a comparison with the results in the previous exercises of 1996, 1992, 1989 and 1985, offer a number of interesting conclusions:

- A majority – about 60 per cent – of universities have not changed their relative rankings significantly over 16 years and five assessments. There is much more stability in the system than commentators admit to.
- The financial consequences have become progressively important over time and can be enormous both in absolute terms and in the proportion of total funding council allocations for teaching students (T-funds) and for research (QR). In the top 10 institutions QR averages 50% of total grant and £36 million per institution, for the next 30 it averages 25% and £18 million, for the next 30 it falls to 6% (£5 million per institution) and for the remaining 40 to 2% (£0.7 million).

The conclusions are rather stark. About 10 institutions in England are capable of being very research intensive and their academic staff will have up to 50% of their time each year available for research. Another 30 universities can expect to provide academic staffing levels such that about 25% of an individual's time can be devoted to research. In the remaining universities teaching is dominant and creative solutions will be needed to ensure staff have time to undertake significant levels of research. Given the especial dependence of Arts and Humanities faculty upon time, then some creative thinking looks to be required so as to ensure the continuation of a robust research culture in many departments.

The AHRB has an income stream from Government (the four Funding Councils and the Department for Education and Skills (DfES)) which will soon reach £70 million p.a. About two-thirds of the income is allocated as grants either in support of specific research projects or as grants which buy out an individual's time. The grants require matching contributions in research time from the individual's own institution. We have also recently established a number of large research centres, which receive major funding over a five-year period and are focused on major projects that require cross working between universities. Our other major expenditure is in the support of nearly 2000 postgraduate students.

Most of AHRB funding goes towards the humanities in the pre-1992 universities, reflecting current and past research cultures. One of the most exciting opportunities lies, though, in being able to stimulate creative arts research in Britain. Our most significant ambition on this front is to undertake a design initiative with the EPSRC and this features in AHRB's bid to the 2002 Spending Review.

Ministers across the UK are at this time considering the recommendations from a DfES-led review into the future of the AHRB. We have cause for optimism for it to become a research council, and for it to be located alongside the other research councils within OST.

Let me now comment upon stimulating multi-disciplinary research. Discussions about "inter-disciplinarity" need to continue but I ask whether the difficulties are not more fundamental and "structural". I am also reminded of views expressed by Hunter Rawlings (President of Cornell University). He offered five reasons behind the development since 1945 of the university system in the USA, one that most of us accept as the benchmark against which we judge ourselves. The five are:

- Competition between universities;
- A partnership with government, in practice meaning state aid for major infrastructure projects and a research council structure for providing project funding in open competition;
- An openness to the world for faculty and students;
- Research which is curiosity driven;
- An ability to create new interdisciplinary endeavours.

I believe that Britain now passes all but one of these tests well.

But we have not been good at the last test of "creating interdisciplinary endeavours". Thinking of Warwick, a modern university, I realised that the university had not created a really new academic department for 20 years (apart from the recently formed Medical School). Interestingly, the two it established at that time (the Warwick Business School and the Warwick Manufacturing Group) both have features of multi-disciplinarity. Looking at the last Research Assessment Exercise I was struck by how "conservative" Britain generally is in terms of academic disciplines, and suspect that this applies across the world. Ninety per cent of the 60 units of assessment (= a department in university parlance) fall clearly into single subject domains with only a handful having features of multi-disciplinarity.

That "conservatism" is aided and abetted by the Research Assessment Exercise, which unwittingly inhibits the establishment of truly new Departments.

The best way to stimulate new interactions is to build them within a department rather than across departments. I would argue that Britain is losing a trick by not establishing more entities which will drive a major wave of multi- and inter-disciplinary research. ❐

discussion

Other sources of funding. Attention was drawn to the fact that there were other sources of funding for cross-boundary research than research councils. The "SciArt" programme of The Wellcome Trust had been funding some ten projects a year in interdisciplinary fields for the last three or four years. The programme in its existing form would come to an end shortly, but the matter was under review to establish how it might be replaced. The Wellcome Trust was instanced as an example of interdisciplinary activity founded as it was on a historical medical collection.

⇨ A detailed summary of the discussion is available on www.foundation.org.uk

A multi-disciplinary culture

Sir Christopher Frayling
Rector of the Royal College of Art.

discussion

The unpopularity of science. One theme of the discussion echoed the two cultures debate. It was contended that the problem of an arts dominated culture needed to be addressed at a much earlier level than the research councils; as far back as primary education. The 1851 exhibition and what immediately followed it had been a notable interdisciplinary exercise but the impetus had been lost and replaced by rigid compartmentalism, not least in the universities. A side effect had been the growing unpopularity of science, fostered by the media. Universities were guilty of erecting disciplinary boundaries. In fostering research it was important to ignore boundaries.

In an excellent report called *Imagination and Understanding* published last July by the Council for Science and Technology[1], under the heading "Research and economic change" is this:
Arts and humanities research is of continuing importance to the creative industries in a wider sense, including entertainment, design, software, advertising and publishing, which the DCMS's Creative Industries Task Force estimates to employ more than 1.3 million people, with revenues of some £112 billion per year. Art-science-technology activities… are of growing economic importance. If the new economy is a disruptive and radical change associated with information and communication, then the relationship between the arts and humanities and the sciences is at the very heart of future economic growth… The MIT Media Lab [for example] which began in 1985 as a cooperation among university researchers in cognition, electronic music, graphic design, video, architecture and holography, is now a major centre of innovation.

The report concluded that the 'institutional separation' of research funding in the arts and humanities from everyone else was likely to discourage imaginative connections of this kind, and to limit the access of arts and humanities research to capital and infrastructure funding. One of the implications was that, just as engineering and the physical sciences have a close research relationship with the manufacturing economy, so the studio disciplines within Higher Education (HE) of art, design, communications, music, dance and the performing arts, could have a close research relationship with the creative sector of the economy, plus — and this is key — all the exciting possibilities of crossover.

Putting the AHRB next to the other research councils could be a terrific way of encouraging interdisciplinary activity of this kind, mitigating the divisive effects of the RAE. Examples of possible outcomes include the Industrial Design (Engineering) postgraduate work of the joint Royal College of Art/ICSTM programme; the new Creative Design course at Imperial; or Design Against Crime, an initiative launched by the Design Council involving social policy, criminology and design. Already, the AHRB has announced a joint series of projects with EPSRC 'Designing for the 21st Century'.

What are the creative industries? The 1999 Department of Culture, Media and Sport Mapping Document (following an earlier one of 1997) defined these industries as those which depend on the creation of original intellectual property by individuals and teams for their added value, which have creativity at their heart and which have the potential for wealth and job creation. The component parts of the creative sector as officially defined are: visual art, design, fashion, advertising and graphics, film and broadcasting, the music business across the spectrum, digital software, theatre, dance and live performance; museums and galleries, heritage and publishing.

One of the key arguments underpinning the Mapping Document is that, in a country like Britain where labour is not cheap, where raw materials are not plentiful and where the manufacturing sector as traditionally defined is reducing, the work of creative individuals and multidisciplinary teams is one of the big engines of wealth creation.

The Mapping Documents of 1997 and 1999 linked up with a survey of 13-16 year olds in schools in the UK which had already shown: a) that Design and Technology had become the fourth most popular subject at GCSE (after English, Maths and General Science); b) that Design and Technology has the lowest truancy rate of any subject in the curriculum; and c) that 93% of the boys and 24% or the girls surveyed said they wanted to be designers of websites and computer games. In these contexts, it is clear the creative industries can create opportunities for higher education that other industries have sometimes found it difficult to reach.

A recent book by Peter Hall called *Cities in Civilization*[2] examines, through history, the elements that have made cities really swing. Hall concludes that the consistent features are a concentration of young creative types in close proximity to local industries, and that the successful cities of the next decade will be the ones that fuse information technology with the creative industries, in clusters of small businesses, many of which will link up with other creative centres such as galleries, colleges and universities.

So my second point is that, by placing an AHRC next to the other research councils within the OST, all sorts of relationships can potentially be unlocked between universities, the studio disciplines, the sciences and this growing sector.

Which brings me to the definitions of research and business that have traditionally been applied to universities. A recent document called *Higher Education — business interaction surveys*[3] examines various different models and definitions, and concludes: *For government, the implication of the survey findings is that there is a very varied approach to business interaction, with some traditional forms of business essentially limited to very few institutions.*

My third point is that by placing an AHRC next to the other research councils, shared expertise in the whole area of universities, research and business can spread across HE.

There is still confusion surrounding the role of research, both within the arts and humanities and outside them. Between 'research into' and 'research through' (or 'research for'), which is actually a distinction originally invented by me (customised from Herbert Read's *Education Through Art*, 1942).

But I believe with the *Imagination and Understanding* document that "art-design-science-technology activities… are of growing economic importance" and that "the relationship between the arts and humanities and the sciences is at the very heart of future economic growth". ❐

1. Council for Science and Technology: *Imagination and Understanding — a report on the Arts and Humanities in relation to Science & Technology* (July 2001).
2. Hall, P. *Cities in Civilization* Weidenfeld & Nicolson (1998).
3. Charles, D. & Conway, C. *Higher Education — business interaction survey: a report to the UK Higher Education funding bodies and the Office of Science & Technology* (Centre for Urban and Regional Development Studies, University of Newcastle-upon-Tyne, NE1 7RU; 2001).

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Mr Tony Meggs, Group Vice President Technology, BP
Mr Rob Wright, Director Energy Policy, DTI
Professor David Fisk FREng, Imperial College
Office of the Deputy Prime Minister, Department of Transport, NERC, Science Systems Limited

July 16, 2002

Priorities for Research and Innovation in the UK

Dr John Taylor OBE FRS FREng, Director General of the Research Councils, Office of Science and Technology
Dr Alastair Keddie, Acting Director General Innovation, DTI
Professor Ian Halliday, Chief Executive, PPARC
Office of Science and Technology, DTI

July 9, 2002

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Professor John Enderby CBE FRS, Physical Secretary and Vice-President, The Royal Society
Sir Alec Broers FRS FREng, Vice-Chancellor, University of Cambridge
Professor John Kay FBA, Economist and Writer
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June 25, 2002

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Sir Peter Williams CBE FRS FREng, Chairman, The Engineering Technology Board
Sir Alec Broers FRS FREng, President, The Royal Academy of Engineering
The Royal Commission for the Great Exhibition of 1851

May 22, 2002

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EMTA, Department for Environment, Food and Rural Affairs, Department for Transport, Local Government and the Regions

May 1, 2002

Asymmetric Warfare

Sir Keith O'Nions FRS, Chief Scientific Adviser, Ministry of Defence
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Mr Mike Granatt CB, Head of Civil Contingencies Secretariat, Cabinet Office
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April 23, 2002

Pathological Specimens and Data - What controls should be in place?

Professor Nick Wright FMedSci, Warden, Barts Hospital and The London School of Medicine and Dentistry
Mr Steve Catling, Chief Executive, The Retained Organs Commission
Dr Robert Coleman, Chief Scientific Officer, Pharmagene Laboratories Ltd
Cancer Research UK, Department of Health, Medical Research Council, The Wellcome Trust

March 26, 2002

Crossing the discipline boundaries – integration of the UK science, arts and humanities base

Dr John Taylor OBE FRS FREng, Director General of the Research Councils, Office of Science and Technology, Department of Trade and Industry
Sir Brian Follett FRS, Department of Zoology, University of Oxford
Sir Christopher Frayling, Rector, Royal College of Art
Arts and Humanities Research Board, The Wellcome Trust

March 19, 2002

How should governments support innovation and science in a growing economy?

Mr Leslie Morrison, Chief Executive, Invest Northern Ireland
Professor Gerry McKenna, Vice-Chancellor, University of Ulster
Mr Noel Treacy TD, Minister for Science, Technology & Commerce, Dublin
Department for Employment and Learning, Engineering Employees Federation, Engineering Training Council in Northern Ireland

March 12, 2002

How should radioactive waste be managed?

Lord Howie of Troon, House of Lords
Dr Robin Jeffrey FREng, Executive Chairman, British Energy
Professor Ekhard Salje FRS, Programme Director for Research, Cambridge-MIT Institute
The Rt Hon Michael Meacher MP, Minister for the Environment, Department for Environment, Food and Rural Affairs
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February 27, 2002

Encouraging Innovation and Economic Growth – Does the Patent System Deliver?

Sir Hugh Laddie, High Court Judge
Ms Alison Brimelow, Chief Executive, The Patent Office
Mr Ian Harvey, Chief Executive Officer, BTG
Microsoft Research, Qinetiq

February 5, 2002

Science Communication – How well are we doing?

Professor Malcolm Longair CBE, Jacksonian Professor of Natural Philosophy, Head of the Cavendish Laboratory, University of Cambridge
Mr Pallab Ghosh, Science Correspondent, The BBC
Mr Simon Pearson, Executive Editor, The Times
Sir John Maddox FRS, Editor, FST Journal
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November 13, 2001

The Decline in Global Fish Stocks

The Earl of Selborne KBE DL FRS, House of Lords
The Rt Hon John Gummer MP, Chairman, Marine Stewardship Council
Mr Elliot Morley MP, Parliamentary Under-Secretary, DEFRA
Mr John Williams FNI, General Manager, Boyd Line Management Services Ltd
DEFRA, Fishmongers' Company, Southampton Oceanography Centre

October 3, 2001

The Lord Lloyd of Kilgerran Prize Lecture

Nick Millard, Project Director, Autosub Project: Southampton Oceanograpy Centre
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