Preface

It is now 15 years since the last review on hearing was published in the British Medical Bulletin. The previous review had been published over 30 years earlier. The shortening interval reflects the pace of scientific communication, but it also reflects the spectacular growth in what we know about hearing mechanisms and the prospects for treating deafness. That the British Medical Bulletin has chosen to devote this issue to hearing is a signal of the recognition that hearing - or rather the consequences of a lack of hearing - is one of the biomedical areas where UK research has made major contributions. In countries with ageing populations and lower mortality from disease, we should like to think that the fruits of current hearing research are already making a really significant contribution to improving the quality of life of their people.

In this issue we have tried to bring together a balance of chapters that reflect the startling progress in understanding hearing. As anticipated in the preface to the 1987 British Medical Bulletin issue on hearing, there has been further movement in the field away from the strict diagnosis of hearing loss towards the basic understanding of both peripheral and perceptual mechanisms. This is not to imply that diagnosis and management will be removed from the centre stage of audiology, for (as shown in several chapters) these remain the core skills in the clinic. There is, however, a growing appreciation that studying the basic mechanisms of hearing and hearing loss can form the only rational basis for treatment. Progress in the field has depended on both the application of new technologies and on new treatment methods. To carry this programme forward requires, as it has done over the past three decades in the UK, groupings of researchers, clinicians and healthcare workers interacting and exchanging their particular expertise.

The new element is molecular biology. No one could have failed to notice the explosive development of molecular biological technologies over the past decade. These have provided techniques that are particularly well matched to understanding hearing mechanisms where the amount of tissue is very small. The tools of molecular genetics have been particularly successful in finding the causes of hereditary hearing losses (see the chapter by Bitner-Glindzicz). One of the more surprising consequences is that the intricacies of the cochlea are now known to a much wider scientific community. The identification in 1994 of the gene mutation responsible for a hereditary hearing loss (Usher type 1B) and recognition of the gene product as an unexpected motor molecule (myosin 7a) introduced the inner ear as an important system to cell biologists. This work, the outcome of a collaborative project by UK hearing researchers, may have been instrumental in bringing a new generation of researchers...
into the studying hearing. It also means that the inner ear, as a topic for
study, has moved into the student textbooks from where it had been
banished for a very long time.

Although some of the methods of molecular biology were forecast in the
1987 review, it was hard to anticipate how all-pervasive the molecular
technologies would become. We have moved from what was then called a
biochemistry of hearing, where the techniques were poorly adapted to the
very small amounts of tissue available in the auditory system, to a
molecular biology and even a nanotechnology of hearing where single
molecules, the natural units of the inner ear, can be investigated. It is
difficult sometimes to appreciate the scale of this change in viewpoint. The
way in which mouse and animal models of hearing and balance loss have
informed human hearing loss has been a major theme of the past decade.
These topics are taken up in the chapters by Forge and Wright, Ashmore
and Richardson. With the detailed maps of human and mouse genomes
reaching completion we are now in a ‘post-genomic’ era where the
interactions between proteins, and not just the gene sequence, becomes
the goal. A major current that has run through the past 15 years has been
how to restore hearing using biological rather than surgical repair. Despite
a number of inflated claims and false starts, there are now cautious signs
of progress. These are described in the chapters of Raphael and of Holley.

As well as concentrating on the very small, hearing research has taken
advantage of the emerging whole brain imaging technologies. It has been
clear that new diagnostic techniques in neuro-otology would open up
major new avenues of investigation. The use of fMRI and PET are now
almost taken for granted in studies of brain function, but for obvious
reasons (MRI scanners produce sound levels in excess of 110 dB) the
study of auditory function has lagged behind the understanding of vision
and of other senses. Largely due to the efforts of workers in the UK at
Nottingham the situation has now been improved and, as described by
Palmer in this volume, we are now engaged in understanding the neural
basis of auditory cognitive tasks. Bronstein and a pioneer user of imaging
the UK, Griffiths, describe the clinical opportunities in the relatively
under-explored areas of neuro-otological symptoms and of central
pathologies. Development of the central auditory system is a recurrent
theme in hearing research. How experience affects the central connections
and how central auditory processing affects the development of language
are taken up in the chapters by Moore and by Bailey and Snowling. Long-
standing questions about auditory development have their roots in the
study of the plasticity and form of brain connections that are problems in
neuroscience. In contrast, tinnitus research, reviewed by Baguley, contains
so many novel and competing proposals about the basic mechanisms that
it is hard to avoid the conclusion that this is a field set for an explosive
growth over the next few years.
This volume of the British Medical Bulletin is necessarily selective of topics for reasons of space. We have tried to choose several areas where there have been significant changes and improvements in audiological technology. Ramsden surveys the recent developments in cochlear implants and the future possibilities of placing the implant stimulus more centrally. Despite these newer developments, there has been some radical rethinking of how traditional hearing aids work and how best to optimise their use. These topics are described by Moore and by Gatehouse. The discussion seems appropriate as we have now reached a time where digital hearing aids, in view of the size of the market, should be cheap enough to be classified as consumer electronics, on a par with many other ‘hi tech’ items we take for granted. The year 2003 is the 25th anniversary of the original description of oto-acoustic emissions by Kemp and his chapter develops the current thinking behind their use for early screening of deafness.

Standing back from research carried out in the UK, it seems clear that, by any international standards, the UK hearing research community has made a major contribution. This is no reason to be complacent. We must recognise that the resources devoted to hearing research in this country are very modest. For those of us who have sat on funding committees, the position of hearing research needs continuous defence against claims that it is a very small and specialist field and therefore cannot be sustained. The Medical Research Council has however maintained strong support for the Institute of Hearing Research at Nottingham. The MRC and the Wellcome Trust also retain a fellowship programme that supports clinically qualified individuals who wish to build bridges to the basic biomedical research communities. The major change over the past 15 years has been the growth of funding for hearing research projects from charities. These include the major player, the Wellcome Trust, as well as the critically important but more modest charities such as Defeating Deafness, the Royal National Institute for Deaf People and the British Tinnitus Association. The support for focused hearing research on a major scale has so far been indirect, with the Wellcome Trust, whose annual spend surpasses the MRC, funding a new Centre for Auditory Research at UCL as part of the joint infrastructure fund (JIF) designed to maintain UK university research.

As every science funding cycle reveals, communities of research workers are fragile. Movement of just a few key research teams nationally and internationally can make or break a research speciality. These are interesting times. After 25 years as Director, Mark Haggard has stepped down at the MRC’s Institute of Hearing Research at Nottingham and David Moore has become its new director. UK research may thus be at a watershed where new directions may soon be established. A further driver for mobility has been the recent three UK University Research Assessment
Exercises, where universities have recruited aggressively to build up research expertise. On the whole this has not redistributed hearing research significantly although there has been some movement to the south-east over the past 5 years. Whatever national movements are apparent, there are now extensive collaborations and exchanges of expertise and researchers between the UK and centres in Europe and in the US. If there is one lesson to be learnt from the past decade it is that hearing research depends on national and international free collaboration between its scientists.

This volume tries to give an overall picture of activity in what has been a dynamic period in the field. The aim has been to convey some of the scientific excitement in a way which provides pointers to the past literature and to future developments. We hope this issue of the British Medical Bulletin can be used as a resource that points not only to what is already known but as a signpost to the key hearing laboratories, developments and opportunities of the next decade.

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