society for general Microbiology

ROYAL SOCIETY CONSULTATION ON SCIENCE HIGHER EDUCATION IN 2015 AND BEYOND

EVIDENCE SUBMITTED BY THE SOCIETY FOR GENERAL MICROBIOLOGY (SGM)

Introduction

The Society for General Microbiology, founded in 1945, is an independent professional scientific body dedicated to promoting the 'art and science' of microbiology. It has now established itself as one of the two major societies in the world in its field, with some 5,500 members in the UK and abroad.

General Comments

Microbiology is a subject that is generally encompassed within Biological Sciences/Biomedical Sciences, although several Universities offer the subject as a named degree. Probably typical of many other subjects within Biological Sciences, we have found it difficult to obtain the following information – without which generalised statements are ill-founded:

i) it is often stated that there are fewer microbiology graduates than previously. This may be true, but the time scale over which these changes are supposed to have taken is rarely defined, and there have been increases in the numbers of Universities offering named routes through degrees due to modularisation. Several Universities (particularly post 1992) offer Microbiology as a degree in this way, but usually fewer than 10 students graduate. This implies that the subject is less interesting than previously – but previously these Universities did not offer the degree at all. Thus there is little information about numbers of microbiology graduates (2005 sample survey by J. Verran, MMU) and changes over time. This would be easy to obtain, with appropriate resources.

ii) Microbiology modules are very popular in most biological science degrees. Thus, even if a student does not graduate with a microbiology degree, they may well have been trained in the subject, and become microbiologists on graduation. This information is not known. In the past, when microbiology degrees were fewer in number, this was always the case. It is likely, for example, that many members of SGM are not microbiology graduates. Again, this information would be easy to obtain. Both this point and the previous one would provide relevant information as to the continuing importance of microbiology.

iii) The Bologna process is relatively well established in mainland Europe, but not in the UK. Two recent SGM meetings explored this topic. It was suggested that more international collaboration through FEMS (Federation of European Microbiology Societies) would be beneficial. Some European countries focus more on microbiology as a Masters subject. The anticipated cost of developing MScs in science subjects

such as microbiology, and the requirement for appropriate student numbers, for economic reasons, may be off-putting for some Universities.

iv) Postgraduate studies (research PhD) in microbiology appear to be thriving. There is considerable support for these students through professional societies and conferences.

v) Following from the EHE (Enterprise in Higher Education) scheme in the 1990s, much emphasis was placed on development of transferable skills for undergraduates (also the case currently for postgraduates). However, recent discussions have indicated that employers notice a lack of subject based practical skills – including some more basic lab skills (such as dealing with concentrations, etc). Universities have reduced the practical content of many courses due to cost.

vi) The number of undergraduates has increased. However, the opportunities available for those who wish – or are able – to take them, in terms of active learning, project work, industrial experience, mentoring, have also increased. Good students remain excellent. Conscientious students benefit from increased accessibility of information via WebCT or similar provision. Mature students, and part time students are usually sufficiently motivated to seize the opportunities made available to them. Some Universities work successfully via widening participation schemes. Some of the students entering via this route require additional support, and may not be sufficiently experienced or confident to actively seek such support. More 'teaching' orientated Universities should consider additional personal support for all students; the personal tutor system has never been more important (but is costly in terms of staff time).

vii) Interdisciplinary research is gaining increasing importance (e.g., biology and materials science), but provision is rarely made for this within the undergraduate curriculum. Department- or School-based programmes tend not to extend across physics, chemistry, engineering, maths, except as remedial activities within the first year of study. The opportunity is there for inspirational lectures from key researchers within an institution in later years of the undergraduate programme. Many Professors however tend to teach less due to research commitments.

viii) Some degrees (e.g. Biomedical Sciences) are accredited. Many of these students take microbiology, and become microbiologists. The changes in NHS training schedules will impact on their professional development, and Universities will have a significant role to play in these changes. Medical and dental students often engage in problem-based learning, and there is a perception that there is a fundamental lack of scientific information, training and experience accompanying this approach. Bacteriology, and particularly virology, requires some lab experience or at least observation.

ix) Students from EU countries (undergraduate and postgraduate) who come to UK Universities appear to be more adventurous (at least bi-lingual), motivated and open to opportunities than some home-grown

students. Language options are rarely taken by science undergraduates.

It is clear that some students embrace their studies, whilst others do not, for whatever reasons. However, they are all working towards a degree which they feel benefits them. It is important to recognise the importance of effective and inspirational teaching and learning in Universities, despite the current focus on research. More general degrees may lack this inspirational approach, which more often provides the drive for students to take up a particular subject within STM. There are too few links between Universities and schools in terms of changes within A and AS curricula, appropriate teaching, learning and assessment methods, and the significance of a given A level grade in terms of what the student is able to achieve within a University setting. Again in schools, it is the inspiration and excitement of science which will attract students towards the subjects. Thus, public understanding is also an important aspect. Forensic science, and previously environmental science, have become popular mainly due to television exposure. Microbiology provides another excellent topic for coverage: bad news (as well as good) is always newsworthy, yet we do not appear to have harnessed sufficiently the public fascination with disease.

Specific Comments

1. The nature of the benefits to a student that accrue from studying an STM subject at HE level, whatever their future occupation.

This is becoming increasingly variable: much more so than say, even ten years ago. Which science (sports science, forensic science rather than the 'harder' sciences, physics, chemistry and even microbiology itself) and from which institution it is received counts for more than the 'graduateness' of the graduate. This is rather unfortunate as a first class degree from an institution near the bottom of the 'league tables' very often reflects a persistence and growth by its holder comparable with degrees from other more prestigious institutions. The blurring of the 2/1: 2/2 boundary and the increased visibility of student progression/attrition being determined less by their achievement of learning outcomes and more by financial pressures from higher management *e.g*. *THES* March 18th 2005p*; THES* April 21st 2006 p7*; THES* June 2006, p7) all contribute to this situation.

Many Leeds Metropolitan University students enter unrelated occupations, but by making employability and transferable skills evident to the student they can highlight these to the employer. Past students visiting the university to talk to current students rated the employability tutorials and evidencing of their transferable skills as extremely useful.

2. The demand for STM graduates from the economy and wider society, and how this demand is changing.

Many Leeds Metropolitan University students no longer gain employment in STM subjects, however this trend seems to be changing slightly. Compared to ten years ago a much larger proportion go on to master's courses, the

majority in STM areas. Other areas include media studies, business and management related courses.

3. The quantity of those graduating at all levels of the higher education system, and the quality, depth and breadth of their educational and training experiences.

Although the biosciences have not experienced the same course closures as the physical sciences, this masks undesirable variations in the strength of interest and engagement across different areas of the discipline. Subjects such as sports science, psychology and forensic science are increasingly popular in universities whilst core subjects such as biochemistry, pharmacology and microbiology are finding it harder to recruit students.

The SGM is concerned about the current and future state of microbiology within the HE system. Recent years have seen the absorption of several microbiology departments into large schools of biosciences. Whilst our data suggest that the number of students who study microbiology at some point during their degree has remained fairly constant, they are increasingly doing so within general biology programmes rather than within named microbiology degrees. It is a cause of great concern that the number of specialist microbiology graduates is falling at the same time that demand for microbiology expertise has never been higher. Recent health and food safety issues (e.g. *E. coli* food poisoning; avian 'flu) have placed microbiology high on the public agenda, yet there is a real danger that there will be a gap between supply and demand with respect to graduate microbiologists over the next decade.

Although undergraduate bioscience degrees offer quality, depth and breadth to their students, an issue of increasing concern is a decrease in the amount of practical work undertaken. The cost of practical provision is a major problem and is accepted to be one of the reasons for the recent closures of physical sciences departments. For a subject like microbiology, which relies on a core set of practical skills, the reduction in practical teaching threatens the ability of the HE sector to produce graduates equipped to enter the profession. It is now not uncommon for employers to report that graduates lack practical skills that would formerly have been taken for granted.

4. The length of time HE studies should take, and how that time should be broken down (with reference to the Bologna proposals to standardise the structure of HE across Europe).

Since the introduction of the AS/A2 structure, there is little doubt among academics that this alteration has resulted in new problems:

4.1 The total 'knowledge' base of the students has declined.

4.2 An increase in passivity in student has been evident shown by increased expectations to be 'spoon-fed' and that study should be facile.

4.3 An increase in 'surface' learning strategies rather than deep.

4.4 Most importantly the practical abilities and confidence of students, especially from the public sector of secondary education has declined

even more precipitately. Safety training, conveyance of expectations about conduct and attitude in practical classes now require more time and repeated reinforcement throughout the first year in HE.

Alternative systems are possible, e.g., the Scottish system: a three year degree leading to an Ordinary degree with a fourth 'Honours' year for the selected students who have developed the ability and motivation of a suitable standard for truly independent study will allow more time for students to develop the latter capacities. Also, the use of the 'course certificate' *i.e.* a recognition of attendance and application separate from the terminal assessment of attainment of learning outcomes, but linked as a prerequisite for entry to it. The course certificate system could with advantage also be linked to award and maintenance of student bursaries as recognition of real effort and application.

5. The current discipline boundaries, and whether a general science first degree option could be appropriate.
With the broad range of abilities and background of current students the initial focus of some degrees has been adapted to concentrate more on general skills, particularly lab based skills. This means it is more difficult to attain the desired level of expertise in the students. An overhaul of the system and types of qualification, particularly looking at making more of the sequence of content to avoid repetition, aid reinforcement and skill development, would be welcome.

There is nothing to stop universities from offering general science first degrees and indeed this may be a more appropriate route for students who do not later pursue STM careers. However, there would need to be sufficient flexibility in the course structure for a student to still pursue a specialist interest developed part-way through his/her undergraduate studies. Because students have limited exposure to some topics (such as microbiology) in the school curriculum, we need to ensure that they do not become 'locked-in' to a generalist route if they become enthused by a subject when they encounter it as undergraduates. This should not be a problem, since most universities already offer a common first year, which allows students to swap between degrees prior to following a more specialized route in Years 2 and 3.

6. The changes to the skills, knowledge and experience of those entering the HE system and how the HE system can accommodate such changes.
There are essentially two types of student entering the HE system — those who want to become practising scientists and those who enjoy science but do not necessarily want to use the knowledge directly in their future employment. This creates a dilemma for the average academic who has to balance subject-specific knowledge with generic transferable skills in their course material to meet everyone's needs. In addition, many students now enter HE with insufficient knowledge of mathematics and chemistry, low level literacy skills and an assessment-driven motivation borne of an A level culture dominated by 'teaching to the test'. They have their heads stuffed full of information but with little understanding or the ability to express their own ideas either verbally

or in writing. Increasingly it is falling to Universities to address these remedial issues. It is not up to the HE system to 'accommodate such changes' but to work with schools to ensure that students are appropriately prepared when they enter HE. A long-term and concerted effort is needed to overcome these problems, including reducing the amount of assessment and testing in schools, fostering critical thinking and promoting better communication between schools and universities. Recent changes to GCSE are a step in the right direction, but must be reinforced in the current revision of the A level criteria and syllabi.

7. The need to allow students to be flexible in their choices of occupation as they gain their qualification and afterwards.
Transferable skills should be highlighted in each area of study, including employability skills, as a boost to student confidence and aid to employer.

9. The financial impact upon students who undertake HE study.
Students have to fit study around their employment now, rather than fit some work in when not studying. This has greatly affected not only the structure of courses, but the nature of study, engagement with projects, and has been particularly detrimental to lab-based projects which require on-site learning often at irregular hours.

10. The impact, on the UK, of international flows of students and STM professionals.
Recently a couple of employers have commented that they are having to train students on first employment and that some degrees are not providing adequately prepared graduates (examples both relate to pharmaceutical companies). There may be a need for more applied courses either at foundation degree or HND/HNC equivalent levels.

Other considerations
Graduate entry programmes have particular relevance to the structure and content of science higher education. Fourteen UK medical schools currently offer graduate entry medicine and four UK dental schools will offer a dental programme by 2007. These are four-year courses and entry is restricted to candidates with a first degree. Most of these programmes rely on the fact that all of the biology and other sciences underpinning the curricula will be represented in the subject knowledge of the graduate group. As the number of universities offering graduate entry programmes increases and with a possibility that medicine and dentistry will exclusively become postgraduate courses (as in the United States), it is clear that within this sector there will be an ever-increasing demand for science graduates.

It is also worth noting that graduate entry programmes encourage applicants from disadvantaged areas and lower socio-economic groups. The maturity of graduates is also acknowledged as a positive factor in terms of the responsibilities expected from a doctor or dentist.

Sources
These comments are mainly personal observations prepared on behalf of SGM by Dr Rob Allaker (Barts and the London Queen Mary's School of Medicine & Dentistry), Dr Susan Assinder (University of Wales Bangor), Dr Trudy Hartford (Leeds Metropolitan University), Dr Michael Tully (Leicester School of Pharmacy) and Professor Joanna Verran (Manchester Metropolitan University & Convener of the SGM Education Group).

About the SGM
Society membership is largely from universities, research institutions, health and veterinary services, government bodies and industry. The Society has a strong international following, with 25% of membership coming from outside the UK from some 60 countries.

The Society is a 'broad church'; its members are active in a wide range of aspects of microbiology, including medical and veterinary fields, environmental, agricultural and plant microbiology, food, water and industrial microbiology. Many members have specialized expertise in fields allied to microbiology, including biochemistry, molecular biology and genetics. The Society's membership includes distinguished, internationally-recognised experts in almost all fields of microbiology.

Among its activities the Society publishes four high quality, widely-read research journals (*Microbiology*, *Journal of Medical Microbiology*, *Journal of General Virology* and *International Journal of Systematic and Evolutionary Microbiology*). It also publishes a highly respected quarterly magazine, *Microbiology Today*, of considerable general educational value. Each year the Society holds two major scientific meetings attended by up to 1500 microbiologists and covering a wide range of aspects of microbiology and virology research.

The governing Council of the SGM has a strong commitment to improving awareness of the critically important role of microbiology in many aspects of human health, wealth and welfare. It has in this connection recently initiated a 'Microbiology Awareness Campaign' aimed at providing information to the government, decision makers, education authorities, media and the public of the major contribution of microbiology to society.

An issue of major concern to the Society is the national shortage of experienced microbiologists, particularly in the field of clinical microbiology and in industry. To attempt to improve this situation long-term, the Society runs an active educational programme focused on encouraging the teaching of microbiology in university and college courses and in the school curriculum, including primary schools. Some 400 schools are corporate members of SGM.

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