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Consultation Response

Subject: Science Higher Education in 2015 and beyond

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SCIENCE HIGHER EDUCATION IN 2015 AND BEYOND – CALL FOR EVIDENCE

Introduction

Pharmaceutical companies invest nearly £10 million every day in the UK, amounting to 25% of all private sector R&D investment. This figure is substantially greater than pharmaceutical company investments in any other European country. The pharmaceutical sector is also a significant supporter of academic research, hosting nearly 670 PhD students in laboratories and funding over 325 separate collaborative research projects in 2005[1]. As well as providing substantial funding, over £70 million on collaborative research (excluding contract and clinical research) in 2003, this provides access to new compounds, technologies and resources students and universities would not otherwise have.

The chemical and biological sciences are core disciplines in drug discovery and development. A number of research based pharmaceutical companies have major facilities in the UK in order to interact with the excellent academic research base and to recruit well trained graduates, postgraduates and post docs from its Higher Education Institutions.

Over the last fifteen years there has been a fundamental shift in the sector – mergers and organic growth have led to truly multi-national companies that invest in R&D and manufacturing on a global basis. Today there are no global R&D headquarters for any of the major companies in the UK.

A major factor which is critical to the success of the UK in retaining R&D investment is access to skills and knowledge, primarily the supply of skilled graduates and postgraduates. The continuing supply of highly skilled scientists form UK Higher Education Institutions is vital if the Government vision of a science and innovation-led economy is to be realised.

The ABPI wishes to provide evidence on several of the issues that have been identified by the Royal Society as needing further investigation.

[1] ABPI 2006 survey of member company support for collaborative research (unpublished data)

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

Evidence form our report *Sustaining the Skills Pipeline*[2] reveals a number of issues around current and future supply and demand of high quality graduates. A general decline in the number of students studying chemistry and *in vivo* related disciplines, such as pharmacology, physiology, toxicology and pathology, is seriously affecting a range of core and emerging disciplines.

Industry is taking action to address these concerns in the short to medium term; for example through creation of a partnership between industry, Research and Higher Education Funding Councils and the British Pharmacological Society to establish an £11 million dedicated fund to springboard capacity building in integrative mammalian physiology; and an AstraZeneca, GSK and EPSRC partnership in a managed programme to support synthetic chemistry. However Government must find ways of incentivising students to take science degree courses, especially in these areas of biology, chemistry, physics and mathematics. It is essential that a pool of quality science talent should be created, not just to enter industry, but to sustain academe and provide the science teachers who can encourage pupils to pursue science in Higher Education.

The low proportion of science teachers with chemistry and physics qualifications was highlighted by DfES in their report on deployment of teachers of mathematics and science in secondary schools[3]. This revealed that only 19% of teachers of science were physics specialists and that 16% of schools (26% of 11-16 schools) had no physics specialist at all. The situation for chemistry specialists is also a concern, with 7% of schools (12% of 11–16 schools) having no chemistry specialist. Teachers holding a physics or chemistry degree are also older, on average, that those with a biology qualification, and hence are closer to retirement. The lack of well qualified physics, chemistry and maths teachers will inevitably lead to a further decline in the number of pupils progressing from 16-19 education into university.

Clinical pharmacologists are essential members of the team which investigates safety in man in early stage trials. In recent years teaching in clinical pharmacology as part of a medical degree has reduced as this speciality has become less important to the NHS, hence the supply of clinical pharmacologists for the pharmaceutical industry and contract research organisations is not being met. Furthermore, the aspirations for Health Service research will be limited by the available talent pool of suitable qualified and experienced UK scientists.

A variety of reports have shown that there are similar training issues, skills shortages, technical specialisms, education, partnerships, hierarchical structures and technical issues across pharmaceutical, bioscience and biotechnology; however whilst the R&D skills are similar, mainstream pharmaceuticals also need additional skills in the conduct of large scale clinical trials, technology transfer from development to manufacture, primary and secondary manufacture, and commercialization[4].

A number of responses focused on emerging disciplines which are numerous, and the speed at which they develop is increasing. It was noted that many of these rely on the same core graduate skills as are required for more traditional areas, particularly mathematical skills which are essential

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[2] Sustaining the Skills Pipeline in the pharmaceutical and biopharmaceutical industries, ABPI November 2006

[3] Mathematics and science in Secondary Schools – The Deployment of Teachers and Support Staff to Deliver the Curriculum, NFER for DfES January 2006. Research Report 708.

[4] Scoping the Pharmaceutical Sector, SEMTA 2005

for computational science, computational chemistry and modeling of pharmacokinetics and pharmacodynamics as well as for many of the increasing number of 'omics' disciplines. Detailed information on the specific requirements for these areas can be found in our report.

Overall, skills shortages in the UK do not appear to be significantly worse than in Europe and elsewhere; but if companies, particularly the larger pharmaceutical companies, experience difficulties in recruiting then they are very likely to recruit from outside of UK.

- **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**

The ABPI research covered both quantity and quality of graduates and postgraduates. We found that both opportunities, and problems associated with skills are, directly or indirectly, related to either quality or number of candidates with a close relationship between the two. However in some instances quality, but not number, was considered a high priority.

Opportunities for practical science training within first degree courses have decreased substantially in recent years. Funding is desperately needed to support significantly increased opportunities for practically based skills training. We understand, from sources within universities, that to provide substantial practical experience for undergraduates, they have to fund it from income intended to support research. Research carried out by ABPI has revealed that the majority of pharmaceutical companies predominantly recruit graduates who have had the opportunity to work for up to a year in industry as part of their degree course, because their practical skills are so much better than those of graduates from courses based solely in universities[5]. Hence we believe that teaching of science subjects needs more than just maintenance of the status quo. The future productivity of the UK depends on an increase in practical science and technical skills and increased numeracy, however one finding of the ABPI skills report was that of particular concern is a decline in the ability to apply mathematics skills. This negatively affects a broad range of disciplines and skills, both core graduate skills and specialisations.

In 2005 only 7.4% of A level entries were for maths, down from 9.5% in 1996[6]. Poor numeracy skills of young people is a major concern of Government, however we believe that higher level mathematical skills are also important, and share the concerns of the Institute of Physics that changes in the nature of mathematics courses at school level have led to students being less proficient and less confident in the mathematical skills required by physical science degree courses.[7] One finding of the SEMTA scoping study of the pharmaceutical sector is that not only do many of the lower grade vocational staff lack basic numeric and literacy skills, but this is also becoming apparent in graduate staff.

There are some fine examples of university courses that have been developed between the Higher Education Institutions and industry. Graduates from these courses are highly employable. For example, the Kings College London Drug Discovery Skills MSc course is an excellent example of how an enlightened academic department has worked with a group of pharmaceutical companies to develop an MSc course that meets their needs. The companies provide financial support and work placements and the young scientists taking the course have a high success rate in future employment in the industry.

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[5] Sustaining the Skills Pipeline in the pharmaceutical and biopharmaceutical industries, ABPI, November 2005
[6] DfES Statistical First Release www.dfes.gov.uk/rsgateway/DB/SFR/s000630/additionaltables_16.xls
[7] Undergraduate Physics Inquiry, October 2000. Institute of Physics
http://policy.iop.org/upinew/exsummary.html

An aspect of employer training schemes that is highly beneficial is the provision of work experience placements and university courses that include an industrial placement. Students who have this type of industrial exposure have the best chance of future employment. Tax incentives should be provided to industries that provide these training opportunities.

- **The current discipline boundaries, and whether a general science first degree option could be appropriate**

The proliferation of new universities with easy access (i.e. reduced entry qualifications) and degrees in subjects that are of little value to employers devalues the system. The introduction of hybrid degrees and modular courses may be a way of attracting students but these courses often bear little relationship to the needs of employers or the building of a students' knowledge in a discipline. The need for graduates with a high quality degree focused in a single discipline is also identified in SEMTA's 2005 report[8].

The popularity of modular degrees, with high levels of flexibility, has negative consequences for employers such as the pharmaceutical sector. For example, students studying for biochemistry degrees in many universities are able to opt out of mathematically challenging courses such as enzyme kinetics. However in industry many biochemistry roles require the ability to use such knowledge and skills. This illustration is just one example of the benefit that would arise from better engagement and communication between industry, expert organisations and DfES. Many of the degree courses and research areas, which are of fundamental importance to the pharmaceutical industry, have declined in popularity in favour of more fashionable subjects (such as forensic science). These issues need to be tackled by properly coordinated strategies, shaped by all stakeholders to deliver the workforce of the future and to ensure the continued success of the UK in these economically important areas.

- **The impact on the UK, of international flows of students and STM professionals**

While difficult to quantify, the consistent and regular anecdotal evidence is that quality of graduates is deteriorating from all but the leading universities. This decline is highlighted by UK research and development facilities recruiting, and taking an increasing number of students on industrial placements, from universities across the rest of Europe. This recruitment trend is not necessarily negative, improving inflow of new ideas and people, yet it reduces the recruitment from UK courses.

- **The developments in HE and economic policy inside and outside of the UK and how the HE system can accommodate these changes**

We strongly believe that the Government should provide both appropriate funding frameworks and strategic direction to maintain the science capability critically required for biomedical research in the UK. We would like to see an infrastructure that encourages Vice-Chancellors to lead their university in pursuit of a comprehensive science and education strategy, with appropriate levels of funding. Student participation in higher education should be based on national needs linked to a clear strategy and not on market forces driven by students as 'customers'.

The Higher Education Funding Council's proposed introduction of TRAC for teaching is a welcome step towards providing appropriate funding for laboratory based courses, however there is a danger that the costs used for scientific, laboratory based courses, will reflect the current

[8] Scoping the Pharmaceutical Sector SEMTA 2005

situation, where practical work has been reduced to a minimum, rather than the preferred situation where sufficient funding is provided to enable students to enhance their theoretical knowledge through development of the practical skills which are lacking in many current graduates. A relatively cheap cost base for a course which doesn't involve much practical science is not good value, and will not supply the graduates which the UK economy requires. It is vital that universities are also funded to invest in high quality facilities and provide incentives, such as tuition fee waivers and bursaries, to attract students onto these courses. These weightings should, therefore, be reviewed as a priority.

Table 1: Change in funding of university courses[9]

	OLD FUNDING		NEW FUNDING		RISE IN FUNDING
Price group	Weighting	Funding unit (£)	Weighting	Funding unit (£)	
Clinical	4.5	12638	4	13936	10.3%
Lab-based courses	2	5616	1.7	5923	5.5%
Intermediate cost subjects	1.5	4212	1.3	4529	7.5%
Lecture-based courses	1	2808	1	3484	24.1%

Subject weighting must represent the cost of the teaching each subject to a high standard. Laboratory based subjects will be substantially more expensive to teach than library based subjects, and this must be reflected in the funding allocated to these areas. In addition, funding should recognise the strategic importance of a subject to the economy – in particular chemistry, maths and biomedical research.

We recommend that government encourages Vice-Chancellors to continue to run science courses by making it financially viable for them to do so by improving the weighting of science subjects. It is now relatively more expensive to teach science subjects in universities than it was in the past. Nearly all Chemistry Departments conduct undergraduate teaching at a loss, and recoup the shortfall through HEFCE research funding. In chemistry, more stringent requirements for chemical handling, exposure and disposal have been particularly significant. The poor state of undergraduate science teaching facilities in universities was highlighted by Sir Gareth Roberts' Review into the supply of people with science, technology, engineering and mathematics skills[10], new chemical handling requirements have also meant that the standard of many university teaching laboratories is totally inadequate. The expense of refurbishment of labs is considerable. Whilst the funding multiplier for teaching of laboratory based subjects remains low, this situation is unlikely to improve substantially.

If changes to the funding of Higher Education are to be recommended, we would not wish to see Further Education Colleges, or Higher Education Institutions which provide a high proportion of

[9] Funding method for teaching from 2004-05. HEFCE June 2004/24
[10] SET for Success, the supply of people with science, technology, engineering and mathematics skills. April 2002.

part time courses of relevance to industry, disadvantaged. The pharmaceutical industry would welcome an expansion in the range and availability of good quality, relevant, Foundation Degrees and would welcome opportunities to work in partnership with universities and other organisations to encourage their development.

We support action to encourage young people from under represented groups to consider higher education, and agree with the aim of appropriately funding institutions to support these students. However we also believe that higher education is not appropriate for many young people hence this extra funding should be used to encourage the best to apply and to provide relevant support, we would not encourage selection based on anything other than ability.

We recommend that the Government takes a holistic approach to science education from primary level, through secondary and higher education and develops a cohesive strategy that delivers the quality outputs required by companies operating in the UK, namely excellent scientists and engineers. Focus on one part of the education system may lead to imbalance in other parts and not produce the solution initially expected. It is critically important that teaching and research are not disconnected as it is only through research-informed teaching that the UK can continue to develop gifted scientists for the future. There is a clear interdependence between teaching and research. Research-informed teaching is instrumental in driving forward the boundaries of science and developing motivated scientists who will in turn enthuse the next generation of scientists and teachers. Learning from research projects is also an important part of the undergraduate curriculum. Lecturers who continue their professional development through involvement in research, keep up to date and provide enthusiasm and relevance in their teaching and will continue to inspire young people.

Departments that provide good teaching in addition to some research should be encouraged. These departments should be judged on the overall value of their provision, not just on research quality or the level of research income. Such departments can provide a valuable stepping-stone for talented researchers who later move on to be successful in bigger research departments. Chemistry departments such as Bath, Exeter, Salford, have typically provided this function. Sadly, of these departments, only Bath still survives. Departments that can attract a significant number of students and show that they produce high quality science graduates, who are well regarded by employers and by research universities should be rewarded.

Many of the comments made above indicate just how vital it is that a high quality HE sector is maintained. We hope that HEFCE will, in future, intervene more rapidly to promote the public interest – particularly when strategic science subjects are under threat. A national strategy for key subjects must replace the current situation where local university finance determines the future of education.