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Engineering Physics Group

NEWSLETTER April 2009

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Our education and that of our successors in engineering physics

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A note from your chair

John Battye

The theme of this edition of the Newsletter might be said to be the education of scientists (physicists in particular) engineers and indeed the British populace as a whole. The latter not just relating to science and engineering, but of some of the consequences of no longer having a broad base of strong engineering companies within the UK.

The first comments come from me, and in a way brackets the whole of the discussion raised in this Newsletter. I first raise concerns about school education, progress to university education and then finish with comments on the consequences to industry of a poorly educated workforce. There follows an article by Vicky Weise, who writes at greater length on school and university aspects of 'the problem'. Then there is an article by Paul Bartlett who addresses the recent, 'Wakeham Report on University Education', and finally Samantha Davidson reports and comments on the survey we conducted of you, our EPG membership.

I structure my comments around two fairly recent events that came to my attention. The first concerns my chance discovery of a young lady doing an A-level science subject with what struck me as an amazing lack of prior grounding and understanding in her chosen subject. The second the situation concerning the 'importation' of Italian labour at the beginning of the year for an oil refinery upgrade at Total's plant in north Lincolnshire.

The first event: A couple of days ago I popped into a local shop to discover the young lady attending the counter was doing here homework. It was organic chemistry so, remembering that in 'my day' one did not formally start organic chemistry until A-level, but realising that things might be different these days, I asked whether she was doing her GCSE or A-level. (I might point out I am older, by a few decades, than the "Old-Timer" who wrote the next article.) "A-level," the young lady in the shop replied. I asked if she had done organic chemistry at GCSE. "I didn't do GCSE chemistry," she said. I asked what she thought of the ionic bond. "I never really understood that," she answered. " …. and now she is getting heavily into the covalent bond I thought." Shocked, I left the shop.

Now, I have to say that my recollection of A-level chemistry was that on some parts of the syllabus, notably organic chemistry, one did indeed find one was starting something pretty new, but even that was building on a reasonably constructed 'base'. One already, after doing O-level chemistry, had a pretty fair knowledge of what ionic bonds were; in fact one probably had a pretty reasonable

understanding of the essential aspect of these by about 13 years old. Certainly by 'O-level' one was also pretty well aware that there other types of bond, e.g. covalent ones. One was also well aware of the spatial 'reality' of molecules that might be formed by the coming together of various components, and the influence on whether that formation might be in relatively large or small quantities. One was also, of course, acquainted with the historical background to the 'discovery' of molecules and the measurements that went with that, and much more besides.

As a result of these recollections I thought I could perhaps imagine someone dropping an average novice to the subject of chemistry, or indeed science, in at A-level chemistry but thought that unless the current A-level syllabus omitted an awful lot, and did an awful lot of 'skating over the surface', it was hard to believe those issuing from the course would have anything but a thin venire of knowledge of the subject. One based on merely memorising stacks of reactions as a result of a 'skimpy' syllabus having failed to get across the underlying influences. Yet surely underlying influences and resulting patterns is largely what science ---- and in this I'll include maths ---- is largely about. The understanding of a science subject requires the progressive building in a very basic, fundamental, elementally logical way a great 'wall' of knowledge. One cannot arbitrarily miss out a few courses of 'bricks' near the base. To do that destroys the very thing that it is essential to foster in the scientist, elementally logical thinking and reasoning, ref. the preface of the book, 'A Burst of Verse for Science Year.'

What, you might think, am I doing writing about chemistry? The reason is it struck me that my immediate experience was likely to be indicative of the nature of things in other scientific fields, e.g. physics. After all, there are fair areas of overlap between chemistry and physics degree courses, especially if one considers particular options in both courses. For years I have heard rumblings, from those academia based colleagues I meet in IOP meetings, that many students now arriving at university to do physics have to be given 'remedial maths lessons', in order to overcome scholastic weakness. Another is the need to start imbuing practical skills and understanding, e.g. passing an h.f. signal down a metre or two of simple light flex will render a digital signal of a few MHz so impaired it will likely be useless to the receiving electronics.

The point of A-levels, 'in the old days' was that they were set by the universities ---- originally the universities local to the schools taking them ---- in order to ensure that those applying for a course had satisfactory grades. Grades which, incidentally, for many of those now in, say, the Russell Group included minimum grades of somewhere in the B to C range. With such grades the university at least knew the background knowledge and ability of the individual concerned was sufficient to comprehend and cope with the first year. I say ability because; in those days applicants arrived almost exclusively directly via a two year school A-level course in which the rate of learning was a relevant factor. There were very

few that had done the course in more than two years or sat multiple resists. Not that I want to decry the now multiple routs by which students typically arrive at university. It is excellent to have more flexibility, but to my mind, at least for the purposes of this article, that it is a different aspect of what has now seemingly become an unnecessary problem which I don't want to deviate into here.

How does all this relate to industry? Those of you in industry know that when you left academia and moved into this new environment you entered a somewhat different world. No longer were you 'top of the pile' either in discipline (if you thought of physicist in that way) or as both physicists and perhaps MSc and or PhD graduates. In fact you were in a mere corner of an organisation with very different overall interests and aspirations to those of academia. To start with you may have upheld your ego with the laurels of past glories and consequent successful movement into an organisation that actually made money and was prepared to remunerate at a level previously only imagined. You had to learn to take a different approach to your work. Presuming you moved into a research like role, depending of the sort of company you moved into, you either focussed on some small corner of what you had proved to be so knowledgeable and good at in the academic world, tempered by having to learn to adhere to hard engineering and ergonomic realities, or focussed on an altogether more pragmatic overall approach to wider scientific/technical aspects of your employer's activities. An approach requiring a good understanding of all the applicable theories pertaining to the subject, but aimed at achieving a practical result at minimum cost without dotting all the academic 'i's' and crossing all the academic 't's'. They could be subcontracted to universities or more specialist companies, e.g. Cambridge Consultants', if thought necessary. Whatever you introduction into this new world, as time passed you learned that what you had learned at university faded into the past. You settled into the ways of the new organisation you worked in. Of course that past training was always there to draw on, as needed, to temper decisions.

I also recall that when, in earlier years I, and my fellow pupils, were half way through our A-level courses, we were perhaps beginning to get a little 'cocky' thinking, "Ah! Now we know a lot of chemistry and physics etc." I remember that we were told, by our chemistry teacher (as it happened) "No you don't." Those of you that go on to university will, if you continue with the subject, consequently spend three years learning just how little you know. In retrospect, years later, I realised he was right. Indeed after, in my case eventually leaving the system with a PhD, I realise he was still right when looked across the whole vista of science, never mind physics and engineering. In short one learns 'a hell of a lot' and then finally perhaps learns caution in the scientific and engineering fields, and humility. A caution which is invaluable, a humility which, if you like, is merely an 'inner thing', or something one can perhaps begin to share with those of similar academic attainment, but which one is certainly unlikely have little synergy with in the wider industrial life. That is the 'barrier' one has to overcome in

communicating with others and 'surviving' in the wider field of industry and indeed society as a whole. As regards the latter few are very successful. How many pure scientists do you hear of who are MP's? Yet lawyers are in great abundance in politics and medical doctors also put up a pretty good showing in that field.

When a company recruits someone for a scientific based role with say a physics background they do it with the belief that the new employee has a good knowledge of the subject they hold a piece of paper in, and are generally fairly scientifically intelligent. At such at an interview, they believe, they can themselves do much to sort out if that individual is what one might describe as socially intelligent, appropriately worldly aware and broad minded enough to interact appropriately with the rest of their organisation. An organisation that has an established niche carved out in the market place, an established way of doing things to be successful in it, and a need to operate as a coherent team to compete in that competitively fought for niche.

In general science based companies cannot 'bull-shit'. Well not too much, or at least they have large fronts on which they cannot do much of it. Their technologists have to be good. As an organisation they have to have both depth and breadth, within the scope of their niche. Their new recruits, because of their academic background, have to first go into organisational slots that provide the depth. If the academic world has, in the interests of fulfilling government dictated targets produced graduates with a mere veneer, the companies that recruit them suffer. Other companies elsewhere, say in China, who perhaps recruited from a better educated pool, or because they have more choice to pick the crème de la crème of their pool, will win. The British government is wrong to think it is doing a good job improving the UK's statistics by pushing for 50% of the populace to go to university, if by so doing it promotes dumbing down to the extent that marginally scientifically educated pupils can suddenly 'pick up' science A-levels, which they pass because they have been over 'tutored' (I use a nice word!). At the end of the day the 'chickens come home to roost'. Rather as, in a different field, finance, artificial 'chickens' have recently 'come home to roost'!

Of course as Britain's industry dies, there is progressively less "to keep things honest" as Martin Blundel (ex. Formula 1 driver, now race commentator) would say. If academia don't keep things honest, albeit under the pressure of government initiatives driven by none scientists and engineers, Britain has a bleak future on the engineering front. Governments may imagine, from within their 'Westminster Village', that they can make a significant impact suddenly turning around policy to promote science and engineering in this country, but I believe they delude themselves. They are 'steering' a super tanker, not a coracle.

In my view even the short term, 'bang, bang', on-off control produced by five year election terms is ludicrously archaic for a modern economy like that of the UK's.

Much better that we should have the smoothing influence of a bit of 'integral action' ---- to use a control engineering term ---- produced by proportional representation and multiple party coalitions, as do the Dutch. In the UK's case the question would be ---- given how far along the road those in public life seem to have slid down the slippery slope of; hype, falsehood, and short termism --- whether the UK would degenerate into the quagmire of multiple party politics suffered by the Italians or rise to the smoother, more stable, long term vision and implementation the Dutch benefit from. It is largely a question of national culture, and particularly culture in political life. As indeed is the matter of how long it will take to re imbued Britain with a culture appreciative of scientists and engineering.

I was brought up in the north of England in it seems a different era, one where science and engineering had a status not so much less than they have in modern Germany. The days of my youth have long gone and I now live in the south. I can't see a culture akin to what I knew easily returning in the UK. Where are the school teachers to teach good science, where are the role models, in terms of people and companies to provide the vision for the youngsters of what can be achieved as an individual and a good position in an engineering company. In my view, 'dream on' government !

That is not to say that you, as individuals, in you own limited ways cannot push for public awareness of the above outlined problem. At the very least you need to 'hold your corner'. The effort doesn't have to be too painful. When holding a pint --- sorry ladies, or a Pimms ---- in one's hand might be one of those appropriate moments to 'chip in' when all about you are decrying the woes of the world and announcing how they would put the world to rights.

The second event: This concerns the French company 'Total's' refinery in north Lincolnshire. I first remind you of some of the points reported by the media earlier in the year. Back in late 2008 the PM, Gordon Brown, said stridently, as I think we began slipping into recession, "British jobs for British workers." The row blew up when in January workers in North Lincolnshire discovered that a refinery upgrade at the Total plant had been awarded to an Italian company who had subsequently brought in an accommodation barge load of Italian workers. When asked why, they said that the local British workers didn't have the right skill set. The British workers demonstrated and appealed to the British Government to honour their pledge. Workers on similar plants around the country promptly, avowed support, and demonstrated in sympathy. Somebody pointed out that the UK was now in the EU so the government was wrong to declare UK work for UK workers. According to EU rules agreed to long ago by the UK Government, it had to be EU work for EU workers, and the Italians were EU workers. The government quickly readjusted its position saying the demonstrations were unjustified. The commentators and pundits on TV all spouted an appropriately crowd sympathetic, jingoistic, or jeering (at Gordon Brown) line. I here present my perception, having

worked in this type of industry most of my life as precursor to a point I will make which concern's you, fellow engineers.

First of all let me make it clear that I don't know the truth between the points put forward by the contending sides. I don't know whether the local labour force does have the appropriate skill set, as they claim or, as Total claim, they do not. One of the objections of the local labour force was that they are not even allowed to apply for the jobs. To my mind it was hardly relevant. The fact is Total decided they wanted a job doing. They will have put out for tenders and of the several companies that no doubt replied they will have done an evaluation and ended up awarding the job to the Italian company. As far as I am concerned that is it, period. I might mention that I have been involved in numerous evaluations of a similar sort, in the same industry. None of these have been for Total or a company financially related to it!

When a company puts forward a bid like that, and the principle evaluates such a contract, 'everything' is considered. The bidder has to show its organisational structure and manning levels, how many of its personnel are already dedicated for the possible future job, how many are going to be hired in especially for it. How certain they are, and why, they believe they can get those extra people. The bidder of course wants to use as much of their regular, familiar work force as possible because they know how their company 'works' both structurally and in terms of procedures. That members of that regular work force know the contacts within the company, they have a 'slot' into which they know they can function satisfactorily and in which the company knows they can function satisfactorily. The bidder's tongue will, almost of necessity (to be realistic), 'spend quite a bit of time in their cheek'. The principle should understand this and try and pick the details relating to this point to make appropriate judgements and decisions. In the case of the Italian company involved in Lincolnshire, they probably use a largely Italian work force from top to bottom in the organisation. A good number will speak English, and probably many will speak fairly good French but they cannot easily suddenly integrate large numbers of English (only) speakers into their organisation. To just put them in threatens everything, not least discipline, perhaps manifest at some levels by endless 'cups of tea' while a misunderstanding or lack of clarity is, with enormous disruption and resultant cost, clarified. The biggest cost of the whole upgrade might well be the cost of lost throughput while the refinery is shut down, or partially shut down. The expeditious execution of the contract is very important. Companies in such as Total's position have enough difficulties trying to evaluate what might seem to be a good bid, in terms of price and perhaps a multitude of detailed and interacting technical aspects, without having to have the waters further muddied by a sea of additional manning problems.

Their will always be a sea of manning problems in even the best of bids. Nobody can afford to keep and pay for a large workforce of trained personnel sitting around for long doing nothing, awaiting a possible successful bid at some future date. Nobody, except perhaps the public sector! Well they can't afford it but they do it since it is not their money, and they can always put up taxes. They thus don't easily understand these issues which are so relevant in the private sector. A private sector which ultimately pays for everything, including the public sector by way of taxes.

Although, as described earlier, the UK government soon changed its stance after it was reminded that its commitment was to the EU, not the UK, I think it should have kept completely out of the situation concerning Total. However, what if a none EU based company had won the contract? The Japanese and Koreans, for example, are not short of companies that could do jobs of the sort necessary for Total. On the one hand the government would not have wanted to interfere since they advocate the need for free trade in Britain's 'free economy'. This would be especially so in view of their present stance of being seen to avoid protectionism in this current economic crisis. However, somehow, I think the PM would not have so easily stepped down from his 'high horse' as he did for the case of the Italians.

At the end of the day, there may have been appropriate skills amongst the multitude demonstrating in Lincolnshire and elsewhere in the country, but that was hardly the issue as things were. The UK government could, years ago, have a impressed a requirement --- as many third world companies learnt to do decades ago to help protect themselves from earlier British and other overseas company exploitation ---- that required any company operating in the UK to employ as much local manpower as possible. Unfortunately this requires a government department to overview and police the situation and so greatly complicates and slows down procedures. When dealing with a 'simple', highly lucrative product like oil, for example, this can still prove very cost effective for both the country, and the 'visiting' company. But what has Britain got? Not much room for a 'visitor' to make a 'decent' profit margin in this field, especially if there are additionally swinging government taxes to be paid. Besides, it could expect that it would not be long before stronger reciprocal pressures would be brought against UK nationals abroad, of which there are great numbers who have already found the grass greener --- especially scientists and engineers. No, the UK is treading a delicate line and the better that is understood by the comfortable many in their comfortable dells and dales, the better. Unless, of course, they are content to drift into third world oblivion. In a way they show by their actions that they probably do wish to do that. It is perhaps just that they don't want to accept the extrapolated consequences of their choice. Remember, there was a time when, say, those now dirty and dusty cities of Baghdad and Basra were the richest, most cosmopolitan and 'educated' cities in the world. Times move on, empires come and go.

The world does not owe the UK a living. In fact much of the world believes we have made enough out of them, often by very devious means, for too long. Our overseas policy in the last eight years, hanging onto the US coat tails, has done nothing to improve the situation. In fact I'm sure it will have made it worse, it being seen as us subconsciously hanging onto our imperialistic self image as we ever more vainly try to, "Punch above out weight." Foreign Secretary, Douglass Herd's words about twenty years ago, originally, I think.

Fellow scientists and engineers you are in a global market. Think in those terms. Your 'boundary conditions' are the world, not merely the UK. Consider if, these days, I said to those of you who, say, graduated from Sheffield University in some of the more traditional forms of science or engineering; e.g. physics or mechanical, chemical or civil engineering, that you focus your search for employment opportunities on south Yorkshire, you would laugh. (For some of you who have no idea of the area you may recall seeing the film, 'The Full Monty' which was made there. Things have moved on, but still !) Yet, when I was young, that might not have been unreasonable advice. The industrial world has moved on further than industrial West Yorkshire (Sheffield was part of West Yorkshire when I was young), further than the shores of Britain. Britain now has very limited capability in the heavy engineering field. What few companies there are still operating here are mainly satellites of foreign ones.

Just wait until the French move in to build new nuclear power stations in the UK! In many cases they will even be working for French owned electricity providers. How's your French? I'm not just thinking of your ability to reach the higher echelons. This is economic imperialism you are up against. The British should know all about it, after all we, well a very few of us, have been at the forefront of this rear guard action since the late 40's early 50's when the UK government 'withdrew' east of Sues. The fact is the voting majority don't realise this and British governments shuffle, miraculously with panache, myopically forward, ever fighting insignificant brush fires at levels that they should not interfere with or get involved with; e.g. whether to rename O-levels, GCSE, or whether the hospital cleaners have ticked the box saying they have cleaned behind the radiators with disinfectant. Perhaps I'm being excessively sarcastic. I suppose all governments, everywhere, have their difficulties and address them with limited success.

Integrated Science Pre-16 – an 'Old-Timer's' Perspective

Vicky Weise

The first students to undertake the new G.C.S.E. started their courses in 1986 and sat the first examinations in 1988. I started my G.C.S.E. courses in 1987. It

was an interesting time to be in the education system in England as no-one was really sure what to expect of the new system and how the papers were going to be assessed. The advanced students from the year above us were pushed to gain an old style O-Level in the core English, Maths and Science subjects but we were not given the option. The year above me were also given the option of studying Physics, Chemistry and Biology as separate subjects. However, by the time I started my course in 1987 my school had decided to be a 'pilot' school for the new Integrated Science G.C.S.E. This is now common practice in most state schools in England. So, from a student's perspective, what impact did this have?

The first obvious impact is the amount of time spent studying science. As a student who planned to take A-levels in at least Physics and Chemistry, I wanted to take the three separate sciences to provide me with a good grounding. This would have meant three separate courses. However, the new whizz-bang Integrated Science only offered me the option of taking two courses worth of science – Science A and B. Even at the tender age of 14 I could see that this would not provide me with the level of grounding I felt was required for the next stage in my education. Indeed at the time I was taking my options in early 1987 none of the local Sixth Form Colleges or independent schools would accept the Integrated Science qualification for entry onto their A-level courses. They felt that the individual subjects would not be studied in sufficient depth to provide the grounding for A-Level courses, with the jump between G.C.S.E. and A-Level being too large. Fortunately I have a very proactive father who took this up with the local Sixth Form and they changed their policy. However, the A-Level courses were not changed to accommodate those of us who had not studied the three sciences separately. The only way to describe the first term of my A-Level course was busy. Every night was spent supplementing the knowledge I had gained through my integrated course with the additional knowledge required to complete A-Level assignments. All the students from my school suffered in the same way.

A-Level science courses have changed significantly since 1991 when I sat my papers. Has this been the result of the introduction of Integrated Science at G.C.S.E. level? As someone who is still involved with schools and universities through various mentoring schemes, I have to say 'yes'. The jump I experienced between G.C.S.E. and A-Level was too large and the additional time I spent getting to the same knowledge level as students who had studied separate sciences was significant. I can understand why the A-Level course has been changed to reflect the change in the way science is studied pre-16 but have to ask, has this benefited those of us who want to pursue science as a career? Universities have now changed their courses to reflect changes in the A-Level course and as an employer of graduates it has changed my expectations of the level of knowledge B.Sc. and B.Eng. graduates are expected to have. Personally I think we are doing those students who want to pursue a career in science a

disservice with the trend towards Integrated Science. Many employers expect graduates to have the same level of knowledge that they had 20+ years ago, resulting in a mismatch in expectations. This can undermine the graduates' confidence in themselves with certain individuals not giving them sufficient time to 'bridge the gap', which they are generally more than capable of doing.

The second impact has a bearing on all students, not just those who want to pursue science as a career. I will use my sister and me as classic examples. My sister, Claire started her G.C.S.E. courses the year after me and has never had any interest in pursuing science as a career, she was interested in languages. I must add at this point that this is not through lack of ability, purely lack of interest. At our school you had to study Science A as a minimum, with Science B generally only studied by those with an aptitude or wanting to study science at A-Level. Claire studied for Science A only. To this day she has little true understanding of the separation between Chemistry, Biology and Physics. The courses were taught in a truly integrated fashion. For example, the water cycle would cover all of the three main sciences plus environmental science but no explanation of where the different science domains are brought to bear on the topic. Claire thinks that I must be warped in some way to love Physics, but with little understanding about Physics actually is. Generally the public see Physics as 'too difficult' and this will become an urban myth if people don't understand what it actually is.

I knew that I loved experimenting and owned a chemistry set, microscope and other scientific instruments from an early age. I was forever exploring my environment and working out what made things tick – admittedly my parents did sometimes despair at the number of things I would take apart and 'experiment' with. My natural curiosity meant that I understood some of the split between the three sciences but this was not sufficient when it came to studying A-Levels. Physics was an easy choice but if I am honest, Chemistry was a mistake. I have little patience for learning things 'by numbers', by which I mean having to rely on my memory rather than working it by first principles. For me, Chemistry meant too many memory tasks. I just wanted to experiment and blow things up as and when necessary. Actually the part of Chemistry that interested me on my G.C.S.E. course was environmental science but I was not even aware such a discipline existed until making my A-Level choices and even then it didn't sound 'hands-on' enough for me.

If the sciences were enjoying an upsurge in interest and university departments were not closing down, I could understand the push for Integrated Science. Could it be simply a matter of students not understanding the separation between the sciences and not pursing the correct course for them? I doubt it but the link should be explored further as if someone with a Ph.D. in Engineering Physics and

still involved in research can admit to being confused, surely this is not an isolated incident. How many potential Physicists, Chemists, Biologists, etc have we 'lost' on the way?

The third and final impact is the experience and domain knowledge of teachers. How many Integrated Science teachers are trying to teach Physics elements of their courses, having not studied the topic themselves since they were 16? How can they expected to impact enthusiasm of the subject and allow students to explore in-depth subject areas if they have no more understanding than an A-Level student? Personally I would be very uncomfortable teaching a group of 16 years old any form of biology with my G.C.S.E. Integrated Science qualification and indeed Chemistry with my A-Level qualification. As well, as doing a disservice to the students we are also putting teachers under significant levels of stress dealing with subject areas that they have minimal knowledge of. Again, I point to the number of universities struggling to fill their degree courses. I was enthused by Physics by a brilliant female teacher who had a passion for her subject and passed that onto her students. However, she was uncomfortable teaching biology and as a result skimmed over those elements of the course quickly. Out of her class there were few of us that took an A-Level course in Biology, with most studying Chemistry and Physics.

In summary, the personal impact that Integrated Science has had on me was that I had to work exceptionally hard to overcome the huge gap between G.C.S.E. and A-Level; I had little understand of the differentiation between the different aspects of science; and the level of teaching in science was not at a consistently high level. What do I consider the way forward? Integrated Science has it place in providing a broad science education to all, but there needs to be a clear differentiation between the sciences as part of that teaching to ensure that we all appreciate the different areas. However, if we want to enthuse more students to pursue science as a career we need to return to more traditional subject differentiation and ensure that teachers at pre-16 level are only teaching the subjects they are qualified in. Cross-discipline initiatives are common in the business world but we need to have a firm basis in order to do this effectively.

Wakeham: Whatever next?

A personal view by P.A. Bartlett

There has been quite a lot of discussion of late regarding the state of physics in the UK particularly in the 'Review of UK Physics' (RUKP) under the chairmanship of Professor Bill Wakeham of Southampton University. It seems that in these days of credit crunches that there has been a return, in some quarters, to a viewpoint that states that we should 'Engineer' our way out of recession. I think that there is

some merit in this stance. In my view we have spent many years holding back our science and engineering base through underinvestment and an over reliance on short term returns.

Sadly, it seems that we are destined to make the same mistakes if John Denham, secretary of state for Innovation, Universities and Skills has his way. On 19th February he stated that the government would steer the science research budget towards applications and areas seen as urgent priorities (such as medicine and climate change). Without fundamental research where is the seed corn for tomorrow?

What we need is a balanced approach were short, medium and long-term research (both 'pure' and 'applied') are encouraged in an environment that recognises that our future as a developed country demands enhanced activities in these areas. It is not a 'nice to have' capability but is absolutely essential to our growth within a balanced economy. However, there are a number of issues that society has to address to ensure that we have a future as a leading scientific country. The RUKP has made some good points about the state of physics in the UK. I will discuss the stages that a person goes through to become an Engineering Physicist (in the UKRP context) with some suggestions and criticisms scattered throughout. It is not intended to be comprehensive but it is hoped that the following sections will highlight a number of points that will stimulate debate within the Group.

School Physics: Physics is often stated to be vital discipline that underpins industry and academia. Indeed, the Wakeham Review of UK Physics made this very point in 2008. Despite this, the report states that the number of students taking A Level physics is in decline. It is commonly said that this is partially due to a lack of qualified physics teachers in schools but I think this is only a symptom of a wider problem. Physics is not seen by some students to be a 'sexy' subject that will lead to a financially rewarding career. I am sure that many active, junior physicists could agree with the latter part of that statement.

Many of those who have studied physics at a higher level are often attracted by the pay and conditions of the other career pathways that their degree opens for them. This also impacts the supply of physics teachers in a country that is churning out graduates who will have to service large student debts. The perception of teaching as a hard and relatively low-paid job, that also requires extra training on low wages, cannot help this situation. Consequently we have non-physicists teaching children. Not an ideal situation. In addition, children undertaking the 'car park test' (where the quality of the cars in a car park indicates the level of remuneration of the workers) can see that their teachers, despite their advanced academic qualifications, have not achieved as much, in financial terms, as these children may aspire to.

If there is a low take-up of physics in post-compulsory schooling, then as it says in the RUKP, there must be a study of the factors that contribute to this. However, it must not pull any punches. I fully expect that the perception of physics as a relatively low-paid and hard career path, that is only for 'geeks', is also steering children away from physics and subsequently, physics teaching.

Undergraduate Physics: The RUKP mentions that, "Whilst it has been shown above that the number of A-level students in physics has declined; this decline is curiously not reflected in the numbers of applications made to study physics and astronomy at undergraduate level". To me that is not as much of a surprise as it seems to be to the review panel.

My discussions with new undergraduates suggests, clearly in a anecdotal way, that many of these students have no intension of following a career in physics but see a degree in this subject as a way to gain higher-paid jobs (such as banking or in 'The City'). It seems that the quality of our physics graduates is valued by such employers. As a result, students wish to take on a degree, like physics, that will offer them the best chance of highly-paid careers when they graduate. The IoP seem to recognise this in the way that they advertise physics as a means to gain jobs in all manner of career pathways. It seems a shame that we may be encouraging students to think that the best job for a physicist is not in physics! If we are to develop our science and engineering base, I suspect that we need to encourage more of the brightest to stay in the source discipline.

More important for Engineering Physicists might be the following statement in the RUKP: "Several employers (both in evidence sessions and through the survey) commented on the progressive decline of the practical skills of graduates in physics. There is a feeling that undergraduate syllabuses contain too much 'theory', while the word 'practical' often means only the application of computer modelling or the conduct of a simulation project".

This is something that I have noted over the years. It may be that students are coming to university without the practical skills that older graduates obtained during previous A-level courses (with more of a 'hands on' component) or as a result of 'tinkering' with electronics and engineering at home. It is interesting to note that few of the students I meet (probably none) have ever soldered anything before coming to my laboratory. It seems that the 'tinkering' aspect, that fired many of our imaginations in the past, may have been lost. We must adapt to take this into account.

Regarding fixing the lack of practical skills, I think we need to ensure that university students get maximum exposure to practicals that simulate real-life 'research' activities as soon as possible. They must be encouraged to think for

themselves and explore practical physics through guided experience gathering rather than purely following scripted work. The emphasis should be on gaining practical competencies within a framework that supports/complements their theoretical studies. As Engineering Physicists we must address this issue via discussions with those with experience both in the industrial and university contexts. In addition, we in universities must emphasise that practical skills are vital to the career prospects of our students. I often tell my practical students that 'the degree certificate will get you the interview but it is what you can *do* that will get you the job'.

It must be said that industry should take some of the responsibility here. Expecting the education system to create the perfect workers for their area of activity is somewhat optimistic. It is often said that training is the first budget casualty. This should not be the case, as it is the skills of the workers that generate the products and services for these companies. Some organisations utilise training schemes to develop and consolidate 'whole person' competencies for the new graduate. This should be encouraged. The IoP can help here, even if the company concerned is a Small or Medium Enterprise (SME) via guidance for CEng and CPhys based Initial Professional Development (IPD) schemes. Indeed, the RUKP supports this view.

Postgraduate Physics: The RUKP addresses the research activities in universities in general terms but I do not feel it looks enough at the position of researchers at postgraduate level. There is much competition for good graduates in physics and (as has already been sated) it is clear that many would prefer to launch themselves into paying positions rather than extend their debts for a further three years. Perhaps the advantage of holding a higher degree should be better advertised by employers in all sectors.

It is clear that we still produce good science and engineering research in the UK but we must find ways to maintain our 'blue skies' capability so that we can push forward ideas into applied research. This must be a balance of low, medium and high risk strategies that can offer a range of outcomes from ground-breaking work to incremental change. It is also noted that there has been a historical disconnect between innovation and implementation in the UK that has resulted in our research sitting on the shelf for others to turn into products. As Engineering Physicists, we are uniquely placed to help to bridge the gap between ideas and products. Ours is a unique perspective and we should be active in pushing from the university 'side' and pulling from the 'industrial' side.

It may be that the Engineering Doctorate (amongst other schemes) is an ideal vehicle to help in this quest for technology transfer. However, I suspect that there needs to be a change in collective attitude about what we want from our

postgraduate qualified people within a multi-layered R&D environment that wants to retain international competitiveness.

Post Doctoral Physics: Here is a worrying trend from the UKRP: "The Panel's conversation with postdoctoral researchers suggests that many are not fully informed of the likely outcome of their career track, and often get inappropriate careers advice. This is perhaps of more significance to physics than to some other disciplines because of the large number of postdoctoral researchers, the duration of research projects, and the duration of the cycle of fixed term employment. First, their career advice is usually derived from their supervisors who have, very often, a potentially conflicting position. This observation has been made in other reviews. Secondly, most begin on the postdoctoral route with an aspiration to be an academic – but a rather small fraction of them can expect to make it."

Having completed a PhD, a student has to choose whether to continue along an academic path or go elsewhere for a career. Having a group of post doctoral workers in insecure and relatively low-paid jobs within a university department does not help to establish in the PhD student's mind that this path is an attractive option for them. It seems curious to me that some of the most research-active workers in universities are operating under such conditions. I am sure that the universities have good reasons for needing a flexible workforce but it can create discontinuities in knowledge and capability within a department. It seems that only the hardiest and dedicated will remain until they obtain a lectureship (a somewhat random process) or are forced to seek another path.

From a 'UK PLC' point of view, I see this as a potential waste of talent if the PhD student/postdoctoral worker leaves physics altogether as a result of their experience or career path perceptions. In addition, it must be noted that many post doctoral workers are not 'early stage researchers' but are older workers with years of experience. It is but an accident of funding policy that puts them in their particular position. It is often said that this is not an issue because we should have postgraduate physicists seeding industry with new ideas. However, does industry advertise for such people in a systematic way? Perhaps industry should play more of a part in shaping postgraduate and postdoctoral career aspirations and objectives so that they can see viable alternative career pathways early on. This is done for undergraduates via such things as 'Milk Rounds' at universities but it seems less overt for those with higher degrees.

What next? In this short piece I have tried to raise a few points that I have regarding what has said in the UKRP. I really do encourage you to read it as it is quite fascinating. I suspect that we have responsibilities as individuals in this. How should we demonstrate to a school child that Engineering Physics has a rewarding career pathway regardless of when they 'jump' out of academia? How do we address the public perception of physics as a discipline?

What can the Engineering Physics Group do to present our views to interested parties? Do you have views you want to put forward? I can only encourage you to contact us if you have your own thoughts on this subject. Engineering Physics is a broad church and as a result our group is large. We really should be using it our collective voice!

Engineering Physics Group Careers Development Survey Results 2008. The Way Ahead

Samantha Davidson

Our aim with the Careers Development survey was to find out whether there were specific career issues that were affecting EPG members which the EPG could help address. Thanks to the 45 respondents we have gained a broad view of opinions from new graduates right through to retired members giving a broad perspective of the current situation and how things have changed.

We began by finding out more about our members: are we primarily engineers or physicists and where do we work? The majority has a physics degree but work in the engineering industry. A small majority think of themselves as engineers rather than physicists (44% Engineers, 32% Physicists, 10% both, 15% other).

With regard to career structure issues that affect people in their place of employment, the majority of respondents (61%) had no career structure published by their company. The lack of formal career progression is a factor which can make it harder for anyone to justify promotions and pay rises. It is an issue which could put any minority (e.g. physicists) at a disadvantage as their role and therefore their benefit to the company may well be less well understood. The IoP is trying to address the advantages of employing physicists in their current 'Physicists Think' campaign, but there may be more work to do in regard of career progression. With regard to the position of physicists with respect to other employees, 21% said that physicists and engineers did not have the same opportunities as other employees. A worrying 13% said that engineers had better training opportunities than physicists in their company.

With regard to training opportunities we hoped to learn about examples of best practice that could be widely applied: company supported MSc's, flexibility of thinking and management training were identified as positive examples. However a startling 79% of you could not think of anything that had helped their career and 35% stated that there are practices in their place of employment that actually hinder their career progression. These included the separation of the technical and management career routes, working in a small company and lack of vocational training and project management training which would be more common in engineering degrees. Clearly there are some aspects of broad issues

which need to be addressed, company within the company culture perhaps with IOP influence, but there are some that could be addressed by an individual using training either within or outside the workplace.

When asked what the IoP or EPG could do to help your career 50% of those who expressed an opinion thought that support for gaining chartered status would be useful. 63% of our members who responded were not aware that one of the aims of this group is to assist physicists isolated in engineering industries to gain chartered status. We can help with finding local members to support you - please contact us if you are having any difficulties. The online IoP mentoring scheme can be used to gain advice from more experienced physicists. It would be very beneficial if more senior EPG members could sign up to assist those starting off in their careers. It could only take an hour of your time every few months, or could even be as little as a one-off conversation. On a personal note I have been both a mentor and a mentee and found both to be useful experiences. Being a mentor is also something that can support your chartered status application! Women can also try MentorSet (http://www.mentorset.org.uk/) which is supported by the IoP.

A clear need to support younger members with chartered status, be that CPhys or CEng, has been identified. We have discussed the requirements of our members with the IoP. Although the IoP currently have no courses directed specifically towards engineers in industry, the dates for the next chartered status workshops (CPhys, CEng, CSci) are included below. One common problem was the complexity of the forms required. A training session can offer a clear explanation of the expectations for each section and make these forms much easier to approach. I will also be e-mailing out guidance notes on the application process to all EPG members as this is the easiest route to make sure everyone who needs them has access. If you do not have access to e-mail and you wish to receive these notes please write to me care of the EPG at the IoP.

With regard to continuing professional development (CPD), 63% of people are not part of a scheme. Is CPD being undertaken? In order to gain Chartered Physicist status CPD is a necessity. Hopefully, as part of an employee's annual appraisal process these issues can be addressed. However, it is recognized that many factors can affect this; limited budgets either due to the current economic climate or working in a small company can be a problem. Simply not being considered an "engineer" can be an impediment to accessing training. Outside of your place of employment there are a variety of opportunities. The new online training courses available through 'MyIoP' are practical additions to the range of courses available and highly applicable to those in industry. Some of these courses are available free, including the useful 'Coaching' course for those members starting to move into leadership and management roles. There are many free training opportunities for women in; science engineering and technology relating to management and

people skills which could benefit career progression. One good way to find out about these is to sign up to the 'Daphnet' mailing list (www.daphnet.org.uk.). Funding for technical training is also available for women via the new UK Resource Centre in Bradford (www.ukrc4setwomen.org). There is also funding available for students to attend conferences via the EPG with the sole proviso that a short report is written.

It is apparent that members may feel isolated within the engineering industry and even from the IoP which to some members can appear to be an 'academic club'. I hope that we will be able to address these issues over the coming years and provide members with practical help such as those detailed above.

To conclude on a positive note, this survey has revealed that the majority felt that they had the same opportunities in their company as engineers or other employees. To improve on this, there are broader policy areas where we can inform the IOP of the needs of physicists in engineering. We have already provided the results of this survey to the Council via the GCC. These could help influence the IOP to support; the promotion of published and fair career structures in engineering companies, the recognition of physicists in a broad cross-section of industry and in the provision of relevant CPD for all members.

Survey responses are given in terms of percentages below. I plan to make use of your detailed comments in a future article.

Responses

1) Do you have a physics or engineering degree?
Physics 87% (34) *Engineering 8% (3)* *Other 5% (2)*

2) Do you think of yourself as a physicist or engineer?
Physicist 32% (13) *Engineer 44% (18)* *Both 10% (4)* *Other 15% (6)*
Other: Management Project management

3) How long have you been in employment? *Average 20 years*
How long have you been at your current place of employment?
Average 11 years

4) How many employees are there at your office or site? *Average 1200*

5) a. What percentage are on the pay roll as physicists? *Average 5%*
b. What percentage are on the pay roll as engineer? *Average 27%*

6) Is your company engineering or physics based?
Physics 5% (2) *Engineering 57% (21)* *Both 14% (5)* *Other 24% (9)*

7) Does your company have a published career structure?
Yes 31% (11) No 61% (22) Don't know 6% (2) Some 3% (1)

8) If there are both physicists and engineers in your company do they have the same career structure?
Yes 54% (20) No 16% (6) Don't know 11% (4) Not applicable 19% (7)

9) If there are both physicists and engineers in your company do they have the same training opportunities?
Yes 59% (20) No 13% (6) Don't know 8% (3) Not applicable 21% (8)

10) Is there an accredited training scheme e.g. (via : ACTS, IET, IOP)?
Yes 30% (11) No 54% (20) Don't know 6% (16)

11) Do you believe that physicists and engineers have the same opportunities in your place of employment as other employees?
Yes 77% (30) No 21% (6) Don't know 3% (1)

12) Are there any examples of best practice that have been of benefit to you in your career? *Yes 21% (6) No 79% (23)*

13) Do you believe that there are any practices within this or a previous place of employment that have hindered your career progression?
Yes 35% (13) No 65% (24)

14) Is there any one thing that the IoP or EPG could do to assist you in your career e.g. training, information, gaining chartered status?
Yes 50% (16) No 50% (16)

15) One aim of the EPG is to assist physicists isolated in engineering industries in gaining chartered status. Were you aware of this?
Yes 37% (13) No 63% (22)

16) Do you participate in a 'Continuing Professional Development' scheme (e.g. IoP's) ?
Yes 24% (9) No 63% (24) Not applicable 13% (5)

'*Getting Chartered' Workshops:* Have you ever thought about applying for chartered status but are not sure how to go about it? Are you unsure about the requirements or put off by the forms? Or are you a mentor to others working towards chartered status who would like to update your knowledge of the requirements?

If any of these statements apply to you then attending a 'Get Chartered' workshop can help.

The workshops will cover:

- The benefits of getting chartered
- The three designations (CPhys, CEng and CSci) offered by the Institute and the differences between them
- The requirements and application processes
- Making an effective application

Workshops will last a maximum of two hours and are free of charge.

To sign up for the courses please go to the following link:

http://www.iop.org/activity/cpd/Training/Professional_Development_Workshops/

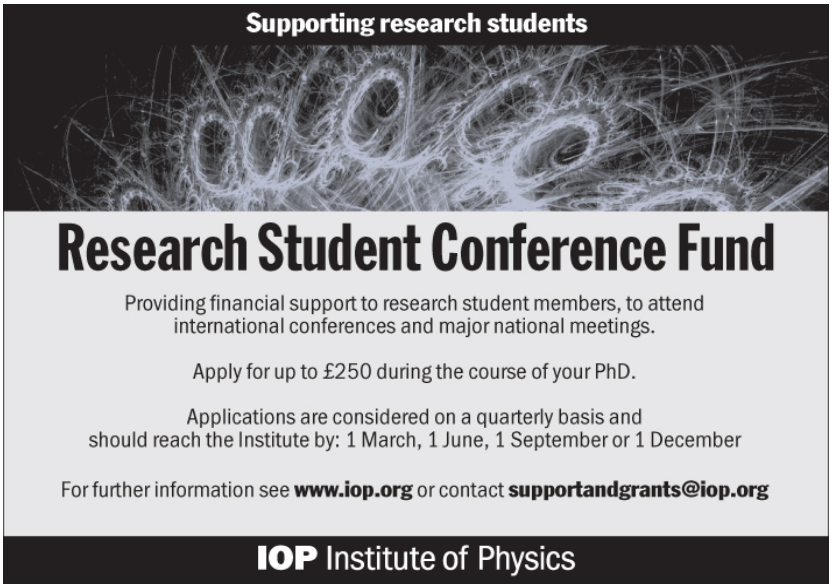
Free Chartered Status Training Event Dates:

Date	City	Venue
30 April	London	76 Portland Place, London W1B 1NT
28 May	Dublin	Buswells Hotel, 23-25 Molesworth Street, Dublin 2, Ireland
17 June	Birmingham	Copthorne Hotel Birmingham, Paradise Circus, Birmingham B3 3HJ
22 July	Edinburgh	Edinburgh Marriott, 111 Glasgow Road, Edinburgh EH12 8NF
20 Aug	Cardiff	Cardiff Marriott Hotel, Mill Lane, Cardiff, Wales CF10 1EZ
24 Sept	Manchester	Victoria and Albert Manchester Marriott Hotel, Water Street, Manchester M3 4JQ
29 Oct	London	76 Portland Place, London W1B 1NT

Grants

For those of limited financial means we offer a few travel grants for those wishing to attend visits to places of scientific and engineering interest that we organise. Please e-mail our secretary, Samantha Davidson (s.davidson@physics.org) both if you wish to apply for a place on a visit and, making your case, if you wish to request assistance with travel costs.

Bursaries



Thoughts, comments and ideas please

We, your committee, are very keen to hear of any thoughts, comments or ideas you may have. Perhaps some have been stimulated by the reading of this Newsletter. Please e-mail them to our secretary, Samantha Davidson.

As I trust you know by now we are always looking for articles. I know that for many in industry the necessary commitment to the fortunes of their employer --- few of which see their interests as having any direct synergy with those of the IOP --- makes it difficult, to participate in the activities of the Institute. However, I hope with the diverse examples of the articles in this and previous Newsletters some of you are stimulated to make submissions for EPG Newsletters of the future. I understand at least one of those published in this edition was stimulated by some comments I made in an article I wrote last year. The Newsletters, and to a sizable extent the group, really do depend largely on the efforts you put in yourselves.

Those who wish to stay here surely have the duty to keep lobbying for a better all round appreciation of professional engineers and physicists in terms of both status and remuneration? In fact, of course, the two go together.

If any of you have any comments on what has been published in the last couple of years, or wish to submit an article for a future publication, please send them to me John Battye *(john.battye@physics.org).*

Events of interest

- *Friday **29th May** 2009: 1pm.* Visit to the BMW's (Mini) manufacturing plant in Oxford. The EPG will pay the £12 / head charge. Please notify our secretary Samantha Davidson by Friday 8th May if you plan to visit.

- *Friday **2nd October*** 2009: 2.00 pm to 3.30 pm: **Annual General Meeting** in the Glazebrook Room, IOP, 76 Portland Place, London, W1B 1NT

For these and other events see our website at: http://eng.iop.org

Your Engineering Physics Group Committee 2007/08

Eur Ing Dr John Battye (Chair)	john.battye@physics.org
Dr Samantha Davidson (Hon. Secretary)	s.davidson@physics.org
Dr Paul Bartlett (Hon. Treasurer)	paul.bartlett@ucl.ac.uk
Dr Victoria Weiss	VLWEISE@qinetiq.com
Dr Mohammad Sanduk	m_sanduk@physics.org
Mr Christopher Bell	cpb42@hermes.cam.ac.uk
Dr John H. Milner	J.H.Milner@city.ac.uk
Mr Kenneth Jones	KSJones@iop.org
Dr Robin Payne	Robin.S.Payne@astrazeneca.com

This newsletter is also available on the web and in larger print sizes

The Institute of Physics, 76 Portland Place, W1B 1NT, UK.

Tel: 020 7470 4800 Fax: 020 7470 4848