HOW THE EU CHEMICAL DIRECTIVE CREATED A DARK AGE IN EUROPE

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At Rolls-Royce Plc in Derby, they are precision-casting the turbine blades for the Trent 1000, the lead engine for the Boeing Dreamliner. Developed by materials scientists at Rolls, the UK has maintained a lead in the technology to make high-pressure single crystal turbine blades for the past twenty-five years. Here a blade is grown through a ceramic core from complex molten alloy that comprises titanium, cobalt, tantalum, chrome, hafnium, molybdenum, tungsten, aluminium and rhenium on a base of Nickel. In a single disc-stage of a typical gas turbine, there are perhaps one hundred blades meant to withstand turbine inlet temperatures of up to 1600° centigrade. It is said that the force driven by each blade into the disc is approximately 18 tonnes or, put another way, the centrifugal pressure on the tip of each blade is equivalent to the weight of a double-decker bus.

Who would have thought then, that the rather simpler task of supplying elements needed to make these blades would now be a greater problem than the material science? But as governments around the globe wring their hands on the subject of strategic metals, and cast about for solutions, there is a danger that if this problem is not analysed correctly the matter could be made even worse.

As a dissident to the view that strategic metal price rises are only to be blamed on Chinese export quota restrictions, or fears that they are about to run out, I would offer the suggestion that a far greater threat to UK and EU manufacturing lies in the unintended consequences of the EU Chemical Directive.

With its origins in a UK Royal Commission enquiry into pesticides, the EU Chemical Directive later emerged from Brussels as something altogether rather more far reaching. Taking as its starting point Section 5/Environment/Article III-233 of the, as yet un-ratified, European Constitution *"Union policy on the environment shall…be based on the precautionary principle"* the law that emerged did not limit itself to warding off the threat posed to EU citizens by pesticides but, with mission creep, came to encompass almost all substances – chemicals, alloys, compounds, and pure elements.

With so wide a stroke of the EU biro, this clause had thrown away 2000 years of western civilisation by curbing the natural invention of man to experiment with elements and substances. With this law, we have to ask, would the single crystal turbine blade or a host of other modern applications of minor metals ever have emerged at all?

Before going further, though, I should like to make clear that the following article is not an anti-environment luddite diatribe. In fact I see no conflict between the demands of business for the free flow of raw materials and the need to ensure that the by-products of manufacturing do not pollute. My case is that the EU Chemical Directive does not achieve this. By regulating elements, which were not in the original frame of reference, it duplicates and exceeds the perfectly workable Dangerous Substances Act and the practical guidelines established by the International Maritime Organisation for transport of dangerous goods. Further, by pushing the metallic by-products of manufacturing, such as turnings, off-cuts and residues, to be classified as 'waste' rather than 'metal for re-melting', or 'material for recycling', the excessive zeal of the law has caused the disposal of some toxic substances to landfill that would once have been safely recovered.

Mooted as a law to protect (un-provably) the lives of 30,000 EU Citizens from direct contact with chemical substances, the EU Chemical directive possibly now threatens

the livelihoods of many more than that number through its unintended consequences.

In order to make the EU Chemical Directive a bit more real to anyone not directly affected by it, it is worth just running through the main points. Dubbed REACH, which stands for 'registration', 'evaluation' and 'authorisation' of 'chemicals', the law requires a dossier to be created on every substance that passes across the borders of the EU. In practice, some chemicals contain formulations so complex that they have had to be removed entirely from the European market. In the case of elements, alloys and compounds, it has meant that once fierce rivals in the marketplace have been ordered to come together for registration in consortia, where knowledge, but not market information, must be shared. Tests required by REACH on each substance include those for carcinogenicity, mutagenicity, and reprotoxicity (CMRs), aquatic dispersal and many more. The law also dictates that old science submitted for dossiers is not valid, which in practice means new tests (many on animals) conducted according to current EU best lab practice.

Even simple elements such as Iron require a dossier. Three years in, and very few consortia have completed their dossiers, and some elements or substances have been orphaned with not enough critical mass to invest in compiling the data. On items with complex compounds these dossiers may take up to eight years to complete. The costs are astronomic. The International Molybdenum Association has so far spent US$5.5 million over 5 years and 11 substances, while the Cobalt Development Institute has spent €7 million for the testing of the 30 or so Cobalt bearing substances – and both are still counting.

In practice the importer has two choices – either share the cost of testing as a member of a consortia or pay later for a 'letter of access' to the information that a consortia has compiled. In the case of our small private company, we have decided to be part of a consortia for one of our critical elements, Rhenium, for which we have budgeted about £100,000, whereas for an element such as Titanium we will opt for a letter of access which will cost €40,000 if the projected annual quantity imported is less than 1000 mt (It would be €60,000 if more than 1000 mt). For a private UK merchanting company, founded by my father in 1953, it all adds up to quite a bill when translated across the 20 or so different substances we supply to customers during the year. With a company net worth of about £2 million, we could easily spend all of that just on registration.

As a board member of *The Minor Metals Trade Association* (MMTA), the organisation that has been occupied since 1973 with the smooth running of the trade in minor metals, I often visit manufacturers round the UK who are REACH-affected. Last week, I visited two companies in the north-west bravely trying to make unique world-leading products in the face of the twin towers of Chinese rare earth quota restrictions and REACH; two ground-breaking UK manufacturers making products which, ironically enough, use minor metals in products which promote environmentally favourable outcomes.

At *Magnesium Elektron*, in Swinton, Manchester, their unique patented magnesium alloys are present in the Airbus A380, where weight reduction is paramount, increasing fuel efficiency. Due to new formulations originated here, which have increased the corrosion resistance in magnesium-base alloys, the prospect for wider use in aerospace is very exciting. But now, with so much time spent both securing rare earth metals from China, and then compliance with REACH, who in their right mind would set up a manufacturing operation in the UK today, if you were not already here?

Another UK manufacturer similarly affected is *Less Common Metals* in Birkenhead. Here, the UK possesses the only European manufacturer of Neodymium-Boron-Iron permanent magnets (as required by wind turbines) who also, at present, depend upon China for their rare earths. To free themselves of this dependency, LCM recently reversed into a Canadian entity called *Great Western Minerals Group* who in the future will be a primary supplier of rare earth metal oxides. But where will the conversion into metal take place? Ideally this would be in the UK next to the plant in Birkenhead, but REACH dictates that a full dossier will need to be produced for each element and compound within the rare earth complex. With only a handful of companies to share the dossier, costs of relatively data-poor elements such as these could stretch to many millions of pounds. Meanwhile, China, which believes rare earths to be national treasure, bears none of these costs, and in a further blow to European competitivity, is able to deliver freely articles which may have been made with such elements but with none of the REACH safeguards.

What applies to the two examples above also applies to Rolls Royce, but on an even greater scale. Here, by their own account, the world's second largest manufacturer of gas turbine engines does not actually know precisely how many substances go into a typical engine – it could be as many as 5000, and one way or another the EU wants to regulate all of them.

Using the example of single crystal turbine blades, where Britain is a world leader, we may take the example of Rhenium, one of the rarest elements (77th least abundant in the earth's crust) and the last naturally occurring element to be separated in 1925, which also happens to be un-substitutable in this application.

Here we have an element that starts its life at 0.4 parts per billion in the earth's crust, is never mined for itself, and only recovered from certain types of copper ores, where the flue dusts of by-product molybdenum are roasted. Its life is precarious to begin with, but it is not toxic and it is the key element which gives the turbine blade its resistance to deformation, which in turn leads to all the other outcomes desired by airlines and law makers – higher operating temperatures, fuel efficiency, longevity, lower emissions of nitrous oxides to the upper atmosphere.

However, despite its tiny production – the entire annual world output of 45 mt would easily fit into a Parliamentary Select Committee Room – the EU Chemical directive dictates that it could harm EU Citizens and must therefore be controlled.

The same procedure that applies to copper, whose annual world production is 15 million

metric tons, is applied to Rhenium with 45 mt. Three years into the process and we still do not know how much the exercise will eventually cost. The lawyers who run the consortia, according to EU rules, tell us that once registered we shall recoup our cost from other importers who will have to purchase a 'letter of access' to acquire the information we have created, the price of which will be determined by the amount that the consortia have already spent divided by the numbers of those requiring access. In practice, though, the machinery of registration, evaluation and authorisation is a steam-roller with no reverse gear and we do not expect funding to be returned to us; which is more likely to be gobbled up in the maintenance and reparation of the steam-roller.

Over the last two years, we have moved towards implementation, and industry has been swept into the process, dedicating vast amounts of time and money to compliance. We have seen decisions about investment abandoned and plant, equipment and processes hurried overseas to locations where neither the laws nor the controls are as great.

The great irony is that elements are not good or bad, they are substances with sometimes conflicting properties and uses. One of the best examples is Thallium. Used as rat poison by the Victorians, a few milligrams is enough to kill the human organism. And yet Thallium has a unique co-efficient of diffraction and, today, when doped in glass, is essential in fibre-optic repeaters to boost light signals. It is also used entirely safely in digital camera lenses and photocopier glass. But Thallium comes from lead and zinc ores and is refined out as a by-product on the route to making pure 99.9% Lead and Zinc. The problem for Thallium is that no consortia exists to register it under REACH. The cost would simply be too great. The puritanical zeal of the law, which effectively classifies elements not for their scientific and chemical properties but because of their moral worth to the environment, is shutting out the production of Thallium in Europe for ever, as well as any prospect of its further use. What will happen to the Thallium atoms you may ask? They will most likely go to landfill.

The problem for any business advocate of the removal of a piece of environmental legislation is that current orthodoxy means it is doomed to failure. However, as the EU Chemical Directive rolls out, and the EU slowly becomes a clean room, Europe is also becoming cleaned of manufacturing and innovation. The hypocrisy is that we remain content to import articles from other parts of the world made under circumstances and conditions which are far inferior to those being implemented under REACH. The net effect is the export of both jobs and morals. It is truly a dark age we are entering.

SCIENCE AND CITIZENSHIP

The Rt Hon the Lord Jenkin of Roding

Opening speech at Science and Citizenship conference held by the British Council at the Wellcome Collection Conference centre on 14th and 15th December 2010 to mark the Tenth Anniversary of the "Science and Society" Report of the House of Lords Select Committee on Science and Technology.

When the British Council invited me to open this important international conference – an event intended to mark the tenth anniversary of the House of Lords Select Committee on Science and Technology's Report "Science and Society" – I did not at first realise the full implications of what I would be taking on. The presence here today of so many delegates from countries outside the United Kingdom brings it home to everyone just how important across the world it has become to find ways to engage the public with science. Indeed, though I and my colleagues hoped that our Report might be useful, I certainly did not begin to realise that its influence would reach across the world. I believe the British Council is to be warmly congratulated on mounting this event and I am delighted to see so many visitors here in the hall.

My task has been described as "setting the scene". Perhaps I might start by briefly describing how the House of Lords Select Committee on Science and Technology works, how the subject of our Report came to be chosen, and how I – someone who never did any science at all at school or university – came to be invited to chair it.

Over recent years both Houses of Parliament in the UK have found that one of the most effective ways to hold Ministers to account, and to explore policy issues more deeply than can be done in debates on the Floor of the House, was to establish specialist Select Committees; the House of Lords set up the Science and Technology Committee nearly 30 years ago, and since then it has established itself as an authoritative and respected body whose Reports are widely studied and in many cases acted upon.

The House of Lords is fortunate in having among its Members scientists and engineers of great distinction, as well as Peers who are expert in other branches of learning and of course people who have held high office in previous governments. When selecting Members to sit on the Science and Technology Committee, the House has a rich store of experience and expertise on which to draw. The Select Committee is free to choose its