THE ROYAL SOCIETY

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Royal Society submission to the Royal Commission on Environmental Pollution study on the long-term effects of chemicals in the environment

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This submission has been prepared by a working group chaired by Professor John Enderby CBE FRS (Physical Secretary and Vice-President, Royal Society). The other members were Professor Ian Fleming FRS (Department of Chemistry, University of Cambridge); Dr Nicholas Leadbeater (Department of Chemistry, King's College London); Professor John Pickett FRS (Biological Chemistry Division, IACR Rothampsted); Dr Richard Sharpe (MRC Human Reproductive Sciences Unit); Professor John Sumpter (Department of Biological Science, Brunel University); Ms Sara Al-Bader (Secretary); Dr Nick Green (Secretary). This submission has been endorsed by the Council of the Royal Society.

Aim of Royal Commission study and the Royal Society response

The central aim of the Royal Commission on Environmental Pollution (RCEP) study is to analyse the key issues and make recommendations designed to reduce the chance that chemical use will cause long-term damage to the natural environment, or to human health. The RCEP invited a wide range of stakeholders and interested parties to submit evidence, suggesting issues of particular interest. Full details of the invitation to submit evidence, including details of the issues of particular interests can be found on the RCEP website[1]. The numbers by each issue correspond to the RCEP numbering used in the invitation to submit evidence.

The key point of our submission is that the current system is taking an ever increasing amount of time to assess fewer chemicals so a radical rethink of the current chemical policy is required. Consequently, we recommend a risk-based system radically different to the existing system giving highest priority to chemicals used in large quantities.

Underpinning assumptions

i Only a small fraction of industrially produced chemicals have been studied in any depth, and ignorance outweighs knowledge at every point in the risk assessment process

This is a bold assumption for the RCEP to make and we are in strong agreement that only a fraction of chemicals have been studied in depth and that there are great uncertainties associated with the risk assessment process.

ii Worrying trends in both human health and biodiversity may be at least partly attributable to chemicals

Regarding human health, more subtle effects are being seen because of longer life expectancy. However, some trends are worrying and are perceived to be linked to chemicals (eg increase of asthma) although the hard evidence for this is not entirely clear[2].

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[1] Royal Commission on Environmental pollution website - http://www.rcep.org.uk/cheminv2.html

[2] WHO (January 2000) *Bronchial asthma Fact Sheet No 206* http://www.who.int/inf-fs/en/fact206.html

Options for guiding principles for the control of chemicals

General points

We are in favour of increasing the amount of self-regulation, which would lead to savings for both the chemical industry and the regulators. The money saved by the regulators should then be reallocated to fund state sector research in more environmentally friendly chemicals. Small-to-Medium–sized Enterprises (SMEs) and larger companies could also be encouraged to undertake research and development of pioneering, sustainable technologies by utilising the money saved by the regulators via tax credits.

Owing to the quantities of chemicals used, large companies often set the pace for health and safety and incur proportionally larger costs. However, large companies can afford more than smaller organisations and many companies use this extra expenditure to raise their public profile.

It is desirable to have a system that takes into account the quantity of chemical used, such as in the proposed EC White Paper Strategy for a future chemicals policy[3], that is based on the quantity and risk of the material. The existing Control Of Substances Hazardous to Health (COSHH) regulations, which apply to industrial and state sector research, are quantity-independent. COSHH regulations are often over demanding for research laboratories, particularly for small quantities of hazardous chemicals that can be handled safely in order to minimise the associated risks.

1 & 2 Hazard or risk-based control

Both hazard- and risk-based control systems have associated advantages and disadvantages. A hazard-based system uses the greatest harm a chemical could potentially cause (or hazard) as its basis. A risk-based system takes into account in its assessment the likelihood of exposure to the environment or individual as well as the hazard.

The existing risk-based system has become considerably less efficient owing to lack of risk assessment data and is consequently taking more time to achieve less. Consequently, what is needed is a radical rethink, either a hazard-based system or a radically different risk-based system. Some of the most responsible commercial companies already internally operate a hazard-based system, which uses all available knowledge to identify potential problems with chemicals they consider using or manufacturing.

The disadvantage of hazard-based control is that all chemicals are hazardous to some extent if sufficient, and uncommon exposure, occurs. However, with appropriate containment measures the risk can be either reduced or effectively removed. Ultimately all chemicals will end up in the environment, and containment is a method of delaying this happening. Accidental leaks are an example of the failure of containment. Containment is better suited to smaller quantities of material, for example nuclear waste, rather than industrial chemicals produced on a large scale such as plastics or surfactants.

[3] European Commission's White Paper 'Strategy for a future chemicals policy', COM(2001) 88 final

Consequently, we recommend a radically different risk-based system that gives highest priority to chemicals used in large quantities. During the research and development stages such a system would not stifle the pioneering of innovative chemicals by the state research sector, SMEs or large companies. However, once the chemical starts to be produced in greater quantities, where successful containment becomes difficult, then more detailed risk assessment data would be required.

3 Assessment and/or control on the basis of environmental monitoring

Using environmental monitoring as the basis for assessment and/or control would not be feasible for three reasons.

- There are too many chemicals to monitor.
- There are too many different environments that would require monitoring.
- Some chemicals cause adverse effects at very low concentrations (eg tributyl tin), sometimes so low as to be difficult to monitor (eg ethinyl estradiol).

4 The degree of control should be related to the societal need for the chemical

It is important the degree of control takes into account some societal factors. For example, it would not be advisable for social reasons to ban the use of ethinyl estradiol (and hence the contraceptive pill) in order to prevent some cases of intersexuality in fish[4].

5 Using the substitution principle (basing decisions on the availability of safer alternatives)

It is hard to disagree with the theory of the substitution principle, as it has to be beneficial to replace an existing substance with a 'safer' material. However, determining whether one substance is 'safer' than another is a complicated matter that is central to any chemical testing strategy.

'Green chemistry' is where a less harmful chemical is used in place of a more harmful chemical, which is obviously desirable[5]. However, a large amount of information is required to be reasonably sure that the substitute is indeed less harmful than the original chemical. Considerations such as total energy costs and the requirements of special equipment may alter the attractiveness of an alternative. For example, supercritical CO_2 has been used a 'green' solvent but it requires the use of high pressure vessels and a full energy assessment may show that on balance it is not an appropriate alternative to substitute.

7 Placing a much stronger onus on the manufacturer/marketer to find out how a chemical is being used and accept liability for any long-term damage caused (top down approach)

A practicable system must show that the manufacturer/marketer is knowingly negligent of the damaging effects. When manufacturers or marketers of a product have been shown to be wilfully negligent then they should accept responsibility for their products or actions. However, during the research stages it is important that new (and potentially environmentally friendlier) chemicals can be developed. This highlights the importance of a quantity-based system that focuses on large quantity chemicals.

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[4] Royal Society (June 2000) *Endrocrine disrupting chemicals (EDCs)* London

[5] For further information see the Royal Society of Chemistry journal *Green Chemistry* and associated website at http://www.rsc.org/is/journals/current/green/about.htm

8 Increasing the responsibility on downstream users and retailers to prevent long-term damage from chemicals incorporated in products they make or sell (bottom up approach)

It is not practical for downstream retailers to be principally responsible for prevention of long-term damage. Retailers are not best positioned to advise customers, and are more likely to be influenced by specific manufacturer's marketing rather than assessing the merits of individual products.

9 Requirements to make information available so that all buyers can make informed decisions on products containing chemicals of concern

Generally increasing the openness of the chemicals industry would increase the trust of the general public in the chemicals industry. However, there are a number of difficulties in determining exactly what information would help to achieve this. Making information available on chemicals in products is unfortunately not automatically going to allow consumers to make informed decisions about different products. Scientists themselves have difficulty in understanding data relating to long-term environmental effects; consumers can hardly be expected to rationalise the information. There is also the related issue of public perception of risk. For example, many people continue to smoke despite the proven links to life-shortening diseases and extensive media coverage of the effects. In contrast, there is a widespread public concern about the health effects of genetically modified food despite the evidence to date that the associated risks are similar to conventional food[6].

Making information available on products raises issues with the publication of commercially sensitive information and intellectual property considerations.

10 Risk assessment

There is no evidence that synthetic chemicals introduce qualitatively different risks to those posed by naturally occurring chemicals. However, it must be noted that a chemical designed to be hard-wearing, such as brominated flame retardants, is likely to be environmentally persistent.

Environmental monitoring is important part of risk assessment but it needs to take into account the source of the pollution. For example, pollution from public transportation is responsible for a large amount of pollution in some locations and the relative contribution of different sources of pollution must be taken into account. The long-term effects of the release of a small quantity of industrial chemical may be minute in compared to the pollution produced from public and commercial transportation.

In vivo animal testing is required in order to determine how particular chemicals will impact on humans, as *in vitro* testing can be helpful but cannot give the full picture. However, some animal testing can be and has been replaced by methods such as *in vitro* testing and modelling. The Society strongly endorses the principle of 'the three R's': to *replace* the use of live animals by non-animal alternatives; to *reduce* the

[6] Royal Society (February 2002) *Genetically modified plants for food uses and human health – an update* London

number of animals used in research to the minimum required for meaningful results; and to *refine* the procedures so that the degree of suffering is kept to a minimum[7].

There will always be inherent uncertainties in chemical risk assessment as unexpected effects will occasionally occur and by their very nature it will not be possible to test for these in advance. In order to reduce the risk of exposure, efforts need to be focused on the containment of potentially hazardous materials.

12 Roles and responsibilities in chemical control

The government can encourage the development of more environmentally friendly chemicals by a variety of methods. In the state sector research this can be achieved by funding research proposals via the research councils. For SMEs and larger companies this can be achieved through tax credits for pioneering research, or through a similar scheme to the US Presidential Green Chemistry Challenge[8] that recognises innovations in greener, cleaner and smarter chemistry. For example, awards in 2000 and 2001 were given to both large companies, Bayer Corporation and Dow AgroSciences, as well as academic establishments, Tulane University and Scripps Research Institute.

'Green chemistry' is to be encouraged as its core principles are thinking about the impact of the manufacture and use of chemicals, considering whether better alternatives either exist or could be developed and to the impact of chemicals on the environment. However, the funding of high quality chemistry research remains important and should not suffer at the expense of specific initiatives, as basic research underpins broader chemical knowledge that in turn will lead to specific products and new technologies.

Please send any comments or enquiries about this submission to:
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[7] Royal Society (January 2002) *Statement of the Royal Society's position on the use of animals in research* London

[8] For further details see http://www.epa.gov/opptintr/greenchemistry/presgcc.htm

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