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***RADIOCHEMISTRY IN EUROPE***  
***THE NEWSLETTER of the***  
***DIVISION of NUCLEAR and RADIOCHEMISTRY***  
**Issue 41–June 2008**

#### **EDITORIAL COMMENT**

Welcome to the forty-first newsletter for Radiochemists in Europe. The WebPages of the Division can be found at [www.euchems.org/Divisions/NRC](http://www.euchems.org/Divisions/NRC). From the home page the “Future Events”, updated each month or when fresh information is received, and Radiochemistry newsletters are readily available. Useful Links have also been established, including the Homepage of the Radiochemistry Group of RSC. If any other group would like their website to be linked, please send me the details.

The aims and objectives of the division as given in our Procedures and Practices are given below.

This is your newsletter for radiochemists in Europe. Articles, reports on meetings, laboratory profiles, courses, positions vacant, redundant equipment and any other item you feel may be of interest to other radiochemists are still urgently required. Also the early announcement of dates for meetings and conferences is important to avoid the possibility of organising two at the same time on similar topics within Europe. See the 10year Planning Calendar on the website. Details of any courses would also be of interest to extend the existing database.

May I remind readers to inform me of any change to their e-mail address?

Providing that information is available it is intended to compile this newsletter 4 times per year in March, June, September, and December/January. Please send information in good time for inclusion that is by the end of the month prior to publication. **Editor: Dr. Tony Ware (e-mail:tonyware@compuserve.com)**

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□ **DIVISION of NUCLEAR and RADIOCHEMISTRY.**

#### **Mission and Objectives**

The Division of Nuclear and Radiochemistry is a network of societies and their scientists working in nuclear and radiochemistry throughout Europe and aims to have close links to related institutions all over the world. A broad communicative basis is achieved by cooperation with relevant supranational bodies such as IUPAC and IAEA as well as with journals and newsletters. It endeavours to establish and maintain the highest quality standards in science and research. NRC accepts a role to harmonise education and training in all aspects of nuclear and radiochemistry and to offer a means of communication and collaboration between scientists working in the fields.

Objectives of the NRC are:

- To contribute to the advancement of nuclear and radiochemistry in Europe;
- To identify important areas in science, technology and other human activities relevant to nuclear and radiochemistry, and to stimulate actions in such fields;
- To address aspects of importance in or to nuclear and radiochemistry which need regulation, harmonisation, standardisation or codification, and to make recommendations as appropriate;
- To encourage cooperation between analytical chemists whether working in academia, industry or governance, in particular within the countries of the member societies of EuCheMS

- To foster close contacts and cooperation of NRC with the European Commission and other relevant institutions;
- To safeguard the interests of the nuclear and radiochemistry community, especially concerning recognition and legitimisation in matters of regulation and legislation as well as decision making in economic and in social areas;
- To assist and strengthen quality in teaching and training of nuclear and radiochemistry in education and in daily practice;
- To support the transfer and exchange of knowledge, equipment and personnel in the areas of NRC expertise both within Europe and in non-European countries;
- To hold a European Conference at least every other year;
- To assume a general promotion and coordination function for other conferences and courses in Europe related to NRC activities;
- To disseminate information to the wider scientific community and general public about nuclear and radiochemistry and its achievements.

#### **Priorities of the Division**

1. Constitution was established as Practices and Procedures with the aims and objectives given above.
2. The Division should continue editing the Newsletter as official information periodical of the Division with S. Jerome and A. Vertes agreeing to assist A. Ware in editing.
3. Web site. All members are asked to send any links, they would like to have listed here, to A. Ware.
4. Diary of future events (10-years Calendar) – has been established
4. Co-ordination of T&E in Radiochemistry and Review of Courses. A survey will be circulated to Division members for comments.
5. Contact has been made with the Technical Advisory Boards of both the NRC and Radchem series of meetings. The list of these and other Future Events are being maintained up to date on the website.

**If your country does not have a nominee to the Division, please press your Chemical Society to nominate a candidate.**

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#### □ **EUROPEAN ASSOCIATION for CHEMICAL and MOLECULAR SCIENCES** **DIVISION of NUCLEAR and RADIOCHEMISTRY**

#### **Message from the Chair**

Dear colleague

It is my great pleasure to inform you on the NEWSLETTER OF THE DIVISION OF NUCLEAR AND RADIOCHEMISTRY (DNRC) of the European Association of Chemistry and Materials Sciences (EuCheMS).

EuCheMS started as an umbrella organisation of European Chemical societies in 2006 with a Symposium at Budapest, attended by some 2500 participants. The idea is that EuCheMS represents the broad spectrum of disciplines in Chemistry - similar to the well-known ACS in USA.

Thanks to the very much appreciated engagement of Anthony Ware, our discipline Nuclear and Radiochemistry has been accepted as a Division, which we consider as a great honour. Since January 1st, 2008 I have replaced Tony as chairman of this division, which - by the way - is represented by members from 24 countries (see Newsletter at the web page).

As one of my first actions I distribute the web address of our Division, where you can find the Newsletter (edited four times a year by Tony Ware). The address is: [www.euchems.org/Divisions/NRC](http://www.euchems.org/Divisions/NRC)

I would be very pleased, if you could send me additional mail addresses of colleagues that might be interested in knowing about our Division and its web address.

With my best regards

Heinz W. Gaeggeler, Professor for Radiochemistry, Bern University, Switzerland. Chairman of DNRC of EuCheMS

#### **Editorial Comment**

The above message was sent individually to all for whom the DNRC had an e-mail address. Many countries have provided lists of addresses to Heinz. Unfortunately some countries, like the UK, cannot by law forward details without the individuals consent. In this case any messages are sent to the parent Chemical Society for onward delivery.

**If you would like direct information from DNRC could you please send your e-mail to Heinz Gaeggeler's secretary Angela Blattmann at [angela.blattmann@psi.ch](mailto:angela.blattmann@psi.ch)**

#### **NRC series of Conferences**

Dear colleagues

As some of you probably know, the NRC conference series is part of the "infrastructure" needed for Radio- and Nuclear Chemistry (DRNC) to be accepted as Division of EuCheMS (the umbrella organisation of Chemical Societies throughout Europe). The other official conference series belonging to this "infrastructure" is the Marianske Lazne Conference - to be held always in between the NRC conferences.

We therefore agreed upon deciding on future host countries of NRC conferences by mutual agreement between the organisers of the actual NRC conference and the Division on Radio- and Nuclear Chemistry.

In internal discussions of the DRNC we suggested Scandinavia as a possible future host area for a NRC conference, being it Helsinki (F), Goeteborg (S) or Oslo (N). On the other hand, it is my personal view that bottom-up suggestions come before political statements.

In that respect I suggest that the final decision - to be taken at the forthcoming NRC7 conference - should rely on proposals.

I therefore strongly support and very much appreciate the offer made by Mauro Bonardi to have the NRC8 conference be held in Italy. Nevertheless, I also strongly encourage other representatives of our field - especially those from the above listed Scandinavian countries - to evaluate, whether they could organise a NRC conference in future, so that we have a real choice to be made in September at NRC7 in Budapest.

With my best regards

Heinz Gaeggeler

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•LABORATORY/BUSINESS PROFILES

## ITC School of Underground Waste Storage and Disposal



Situated in the heart of Switzerland, the ITC School provides both theoretical and practical training and research in all aspects of science, engineering, decision-making and communication concerned with underground waste management and related environmental issues. The ITC holds many courses in or around its base in Meiringen in the heart of the Swiss Alps, but also organises courses worldwide. It can offer professional training at all levels: practical and theoretical courses, modules in association with universities, summer schools and retreat facilities for think-tanks and policymakers.

World-wide, there are many initiatives to store or dispose of radioactive and highly toxic chemical wastes in deep underground facilities. Geological disposal is seen as the only safe, practical and sustainable solution for many of the intractable residues that inevitably remain after waste minimisation and recycling. The timescale over which any one of these projects will be developed, operated and subsequently decommissioned is typically several decades. Those who initiate the planning of projects will be unlikely to implement them or see them through to completion. In some countries, there is already a problem of maintaining the expertise base and ensuring that trained scientists and engineers will be available when and where they are needed. This is particularly true of the nuclear energy sector.

### Background

The ITC School provides a focus for the propagation of knowledge and experience and the continued training and education of scientists, engineers and decision-makers to meet the future needs of industrial organisations and government agencies world-wide. The impetus to launch the School came from the radioactive waste management sector with the aim of meeting a long-term strategic need for trained experts in every national waste management programme. Planning involved waste organisations, regulatory bodies, government agencies and universities in Europe, Asia and North America and the founding members included, the Institute of Geological Sciences of the University of Berne, Switzerland, the Technical University of Catalonia, Spain, the Swiss Federal Nuclear Safety Inspectorate (HSK), Switzerland, the Radioactive Waste Management Funding and Research Centre (RWMC), Japan and the National Co-operative for the Disposal of Radioactive Waste (Nagra), Switzerland. The ITC now has 59 Member organisations from 16 countries – please see [www.itc-school.org](http://www.itc-school.org) for details.

The ITC is a non-profit educational association, operated for the benefit of its members. Its finances are arranged so as to cover its costs and allow a small development margin to provide extended services to the waste management community. The ITC needs to be able to provide a service to the broadest range of users if it is to achieve its aim of perpetuating knowledge in order to provide optimum waste management solutions. Consequently its programme and

objectives are not biased towards any sector (e.g. industry, regulators, research groups). This means that the Members have a clear voice in its operation and management and that its funding is not tied to any one source

### **Current courses**

The ITC regularly runs a range of courses and workshops every year, many specifically requested by ITC Members. The courses for the next half-year include:

**TIMODAZ training course** (7<sup>th</sup> to 9<sup>th</sup> July 2008, Lausanne, Switzerland)

The EC FP6 Integrated Project TIMODAZ (Thermal Impact on the Damaged Zone around a Radioactive Waste Disposal in Clay Host Rocks, [www.timodaz.eu](http://www.timodaz.eu)) runs for four years from 2006-2010 and will involve various training activities based upon the scientific and technical results of the project. This first 3-day training course has been organised by the Ecole Polytechnique Fédérale de Lausanne (EPFL) and ITC School, in collaboration with the TIMODAZ partners. A guided visit to the Mt. Terri Rock Laboratory ([www.mont-terri.ch](http://www.mont-terri.ch)) is also included.

**Geologic Disposal of High Level Waste** (2nd to 5th September 2008, Las Vegas, USA)

This course covers international experience in key aspects of deep geologic disposal of spent fuel and high level radioactive waste that are needed to form the components of a national programme, with a special emphasis on the current US HLW programme. The course will take place immediately before the 2008 International High-Level Radioactive Waste Management (IHLRWM) conference, which is also being held in Las Vegas.

**Fundamentals of Geological Disposal** (October 20th to 26th, 2008, Tokai, Japan)

This six-day course is run in collaboration with JAEA and is organised within the framework of the IAEA Network of Centres of Excellence. Consequently, potential students from countries participating in the Network may be eligible for IAEA support. As with previous ITC 'Fundamentals' courses, all aspects of geological disposal will be covered, but with special emphasis on factors in the Japanese programme.

The programme covers the origins and characteristics of wastes for geological disposal, environments for disposal, design and siting of geological repositories, site characterisation methodologies, tectonics and repository siting, engineered barrier performance, safety assessment and the societal aspects of disposal programmes. There will be visits to both the ENTRY and QUALITY large-scale experimental facilities at Tokai and to the Mizunami URL construction site and the Tono Geoscience Centre.

**Cement and cementitious materials in the geological disposal of radioactive waste** (15th-19th December, 2008 - Flums, Switzerland)

This course will be similar to the new ITC course on the uses of cement and cementitious materials in the geological disposal of radioactive waste (June 2008). The first presentation of this course has proved very popular and spaces for the June course were rapidly filled, well before the closing date for applications and so is repeated here only six months later. The 5 day programme for 15 – 19th December 2008 features seven, interlinked, modules which cover all aspects of the use of cementitious materials in radwaste disposal. Sufficient time will be allocated for questions and discussions in each presentation module and afterwards, over coffee, lunch and dinner. As the tutors stay in the same hotel as the students, there is also plenty of time to continue discussions into the evening.

Full details of all courses can be obtained on [www.itc-school.org](http://www.itc-school.org) or by contacting the ITC secretariat at [gabi.vonlanthen@itc-school.org](mailto:gabi.vonlanthen@itc-school.org). Alternatively, write to Prof. Neil Chapman, Chairman, ITC - School of Underground Waste Storage and Disposal, Postfach 5250, Taefernstrasse 11, 5405 Baden-Daettwil, Switzerland. Better still, become a Member – participate in training our future!

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### **●CONFERENCE AND WORKSHOP REPORTS**

#### **The NEA Committee on Radiation Protection and Public Health (CRPPH)**

The committee met on 20-22 May 2008 at OECD headquarters in Paris, France. During the meeting, the 2009 CRPPH programme of work was reviewed, which includes three events of wide interest. In early 2009, the Fifth Asian Regional Conference on the “Evolution of the System of Radiological Protection” will be held. Later in 2009, the implications of stakeholder involvement for post-accident consequence management will be examined during a workshop that will draw

on previous NEA work in this field. In late 2009, science and values in radiological protection will be the subject of a workshop to build on ongoing NEA work on radiological protection from a public health perspective. Delegates also held a topical session on recent developments in radiological protection science. The proceedings of the topical session are currently in preparation. More information is available at [www.nea.fr/html/rp/](http://www.nea.fr/html/rp/)

#### **Nuclear data services**

Participants in the Joint European Fission and Fusion (JEFF) nuclear data evaluation project met on 21-23 May 2008 in Aix-en-Provence, France. Meeting participants reviewed feedback from the verification and validation of the current version of the JEFF data library and discussed evaluations to be incorporated into a future release of the library. A new release of JEFF-3.1.1/RDD, the radioactive decay data library, is now available on CD-ROM. The full documentation for the radioactive decay data library is currently being prepared for publication. More information

is available at [www.nea.fr/html/dbdata/projects/nds\\_jef.htm](http://www.nea.fr/html/dbdata/projects/nds_jef.htm).

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### ●CONFERENCE AND WORKSHOP DETAILS

#### **The Seventh International Conference on Nuclear and Radiochemistry (NRC-7) Budapest, Hungary 24 – 29 August 2008**

NRC7 the next in the series of Nuclear and Radiochemistry Conferences will be held in Budapest at the Eötvös Loránd University. It is organised by the University supported by the Hungarian Chemical Society and sponsored by EuCheMS. The website can be found at [www.nrc7.mke.org.hu](http://www.nrc7.mke.org.hu) In keeping with previous conferences it aims to cover a range of topics in nuclear and radiochemistry. They include:

Fundamental nuclear chemistry, Actinides, Transactinides, Radioanalytical chemistry, Radionuclide production, Radiotracers in life sciences, Radionuclides in geo- and cosmochemistry, Radiochemistry in nuclear energy production, Radioecology and environmental sciences and Nuclear methods in material science and industrial applications. The deadline for submission of abstracts is 31 January 2008.

The Web page of the conference is now open for registration and abstract submission. For additional details please visit <http://www.nrc7.mke.org.hu/>

#### **2<sup>nd</sup> International Nuclear Chemistry Congress**

The 2nd International Nuclear Chemistry Congress (2nd-INCC) will be held between 13 -18 April 2008 in Cancún, Mexico. For further information please contact Professor Turan Unak or Professor J. M. Navarrete.

Turan Ünak, Professor of Nuclear Chemistry, INCS President

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Web: <http://incs.ege.edu.tr>

#### **Materials Research Society Symposium on “Scientific Basis for Nuclear power”, Dec 1 – 5 2008, Boston, USA**

In recent months, there have been many articles in the press about the renaissance of nuclear energy. Even many former opponents of nuclear energy are now considering the potential advantages of nuclear energy relative to fossil fuels. Electricity generated with nuclear power does not produce greenhouse gases, such as carbon dioxide that contribute to global warming. However, nuclear energy produces spent fuel or nuclear waste. Spent fuel is radioactive and requires thousands of years of isolation from plants, animals, and humans. Other radioactive waste-form types have been generated from the nuclear fuel cycle and from defence related activities.

Management of nuclear wastes remains a controversial topic. Waste management includes reprocessing of commercial nuclear fuel, waste form design and development, transportation, storage and disposal packaging, repository site selection, and performance assessment. A broad range of scientific and engineering disciplines is necessary to provide safe and effective waste management solutions and to address complex issues. This symposium offers an important forum for discussion of materials-related issues associated with nuclear waste management programs.

The topics for which there is a call for papers include Radioactive waste pre-treatment, Transuranic chemistry, Radionuclide solubility, speciation, sorption, separation, and migration

Details from symposium organisers Paul B Rebak e-mail: [rebak@ge.com](mailto:rebak@ge.com) Neil C Hyatt e-mail:

[n.c.hyatt@sheffield.ac.uk](mailto:n.c.hyatt@sheffield.ac.uk) and David A Pickett e-mail: [dpickett@cnwra.swri.edu](mailto:dpickett@cnwra.swri.edu)

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### NEWS FROM THE INTERNET

#### **Death of Professor Charles Madic**

It is with a great sadness that we learn about the death on 1<sup>st</sup> March 2008 of Professor Charles Madic at the age of 65. He was an eminent radiochemist and an outstanding figure in all aspects of life. He was a Research Director at the French Atomic Energy Agency (CEA) and a professor at the Institut National des Sciences et Techniques Nucléaire (INSTN). His funeral took place on Friday, March 7, at the Church Saint-Merri, Paris 4<sup>ème</sup>.

Charles Madic began his career at CEA in 1969, in the radiochemical laboratories at Fontenay-aux-Roses. In 1994 he took charge as of modelling studies at Marcoule and in 1995 became Director of Research.

At CEA he became a world leader in the separation of minor actinides and played a fundamental role for 15 years in the coordination of the European research programme in this area.

For his work on the chemistry of actinides he was awarded the Lauréat du Prix Yvan Peyches de l'Académie des Sciences in 2005.

### **Practical Gamma-Ray Spectrometry.**

Wiley Press have released the Second Edition of this book, for details see website <http://eu.wiley.com/> and Amazon The website associated with the book is <http://www.gammaspectrometry.co.uk> Nuclear Training Services Ltd. Can give information on Introductory and Practical Gamma-Ray Spectrometry Courses, (<http://www.nucleartraining.co.uk/program.htm>).

**(Dr Gordon Gilmore e-mail: [newadmin@nucleartraining.co.uk](mailto:newadmin@nucleartraining.co.uk))**

NOTE. Originally, Gordon had envisaged that the book would be accompanied by a CD-ROM containing nuclear data and other miscellaneous resources. Because of the changes in the way nuclear data is now being disseminated, that idea was shelved, but he is making the miscellaneous resources available on the new website:

<http://www.gammaspectrometry.co.uk> mentioned above. Helpful comments, suggestions and corrections of the content are welcome.

### **Room Temperature Scintillators**

Interesting information about gamma-ray spectrometry using room-temperature scintillator detectors can be found at: <http://www.westmeier.com/english/Application/application.html> and

[http://www.westmeier.com/english/Application/Application\\_3/application\\_3.html](http://www.westmeier.com/english/Application/Application_3/application_3.html)

With the aid of new hardware and software tools one can now solve quantitatively many spectrometric tasks using "warm" detectors that were in the domain of cooled HPGe detectors before, as shown in the Applications section addressed above.

High-precision alpha particle spectrometry using data from complex (U) samples or from thick powder samples is shown at: [http://www.westmeier.com/english/Software/\\_Alps/Screenshots/screenshots.html](http://www.westmeier.com/english/Software/_Alps/Screenshots/screenshots.html)

For the history and development of this business visit

[http://www.westmeier.com/english/About\\_us/Enterprise/enterprise.html](http://www.westmeier.com/english/About_us/Enterprise/enterprise.html)

### **“Core Issues -Dissecting Nuclear Power Today”, by Steve Kidd,**

Core Issues analyses the challenges faced by the nuclear power sector, and provides a practical overview of where the industry is today, where it is heading, and how it can overcome the many obstacles in its path to get there. The book covers the entire nuclear power business, particularly nuclear fuel, economics and public acceptance. Further information about Core Issues is available at: <http://www.neimagazine.com/hybrid.asp?typeCode=647&pubCode=1> Core Issues (ISBN 9781903077566) is published by Nuclear Engineering International, and now available in hardback and can be ordered online at: <https://www.wdis.co.uk/websubs/PROG/NEI/page1.php?rn=&promo=&area=UK>

Copies can also be ordered from: Nuclear Engineering International, Progressive House, Maidstone Road, Foots Cray, Sidcup, Kent DA14 5HZ, UK Tel: +44 20 8269 7773; Fax: +44 20 8269 7804 email: [info@neimagazine.com](mailto:info@neimagazine.com) website: [www.neimagazine.com](http://www.neimagazine.com)

### **Economics of Nuclear Power Report.**

The economics of nuclear power is a controversial subject, since multi-billion dollar investments ride on the choice of an energy source. Nuclear power plants typically have high capital costs for building the plant, but low fuel costs. Therefore, comparison with other power generation methods is strongly dependent on assumptions about construction timescales and capital financing for nuclear plants. Cost estimates also need to take into account plant decommissioning and nuclear waste storage costs.

On the other hand measures to mitigate global warming, such as a carbon tax or carbon emissions trading, may favour the economics of nuclear power. Analysis of the economics of nuclear power must take into account who bears the risks from future uncertainties. To date all operating nuclear power plants were developed by state-owned or regulated utility monopolies where many of the risks associated with construction costs, operating performance, fuel price, and other factors were borne by consumers rather than suppliers.

Many countries have now liberalised the electricity market where these risks, and the risk of cheaper competitors, are borne by merchant plant suppliers rather than consumers, which can lead to a significantly different evaluation of the economics of new nuclear power plants.

The research report, Exploring the Economics of Nuclear Power, studies the economics of nuclear power - looking at construction costs to fuel costs to capital costs. The analysis if broken up in to an analysis of fixed versus variable costs. O&M costs, decommissioning costs, etc., are all focused on in this report. The report also focuses on how much it costs to develop a new nuclear power plant, along with a country-wise analysis, which looks at the new orders for nuclear power plants.

Building costs for generation III and IV plants are also described in details in this report. The report concludes with an economical comparison between nuclear power and other renewable such as wind power, biomass, geothermal energy, and more. Major industry players are also analysed in the report.

For more information please click on:

[http://www.researchandmarkets.com/product/c7eae1/exploring\\_the\\_economics\\_of\\_nuclear\\_power](http://www.researchandmarkets.com/product/c7eae1/exploring_the_economics_of_nuclear_power)

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## JOB OPPORTUNITIES

### PhD Studentship in Nuclear Waste Immobilisation

Department of Civil and Environmental Engineering & Department of Materials, Imperial College, London

Applicants are invited for a PhD studentship that will investigate the reaction mechanisms, physical properties, microstructure and stability of geopolymer systems produced from metakaolin. The project will investigate actinide binding, Magnox swarf, and fuel element debris containment in geopolymer systems, with particular focus on long term stability. The project will be supervised by Dr Chris Cheeseman in the Department of Civil and Environmental Engineering and Dr Aldo Boccaccini in the Department of Materials at Imperial College London, collaborating also with Prof. Neil Alford (Department of Materials).

Geopolymers offer advantages of improved compressive strength, chemical resistance and reduced CO<sub>2</sub> footprint compared to conventional Portland cement. However, the suitability of these materials for LLW and ILW immobilisation, particularly the long-term stability and waste-binder interactions, have not been extensively studied. You will have a 2.1 or 1st class honours degree in the areas of Civil Engineering/Materials Science. The studentship is funded via an EPSRC project (bursary of £ 14,900 per annum and university fees at the home/EU student rate) and will commence October 2008.

For further information on the details of this project please contact Dr Chris Cheeseman at

[c.cheeseman@imperial.ac.uk](mailto:c.cheeseman@imperial.ac.uk) or Dr Aldo R. Boccaccini at [a.boccaccini@imperial.ac.uk](mailto:a.boccaccini@imperial.ac.uk).

The prospectus, entry requirements and application form (under 'how to apply') are available at:

[www.imperial.ac.uk/pgprospectus](http://www.imperial.ac.uk/pgprospectus). The position is open to UK and EU nationals. Further information on our research programmes and other PhD opportunities are available at:

<http://www.imperial.ac.uk/materials/research/phdopportunities>

**Applicants will be processed when received, with the expectation that the post will be filled by October 6, 2008**

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### •AND FINALLY

Please send information for inclusion in future issues to your Liaison Person or myself Dr Tony Ware, Avoncastle, South Lane, Sutton Valence, Maidstone, Kent ME17 3AZ, UK. Tel: +44 (0)1622 842627, e-mail: [tonyware@compuserve.com](mailto:tonyware@compuserve.com)

**IMPORTANT PLEASE** send me your e-mail address so that I can inform you when websites have been updated and any other news of immediate interest.

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