

**CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES**

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**TRIP REPORT**

**SUBJECT:** 9<sup>th</sup> International Congress of Marine Corrosion and Biofouling,  
Visits to Exeter and Surrey Universities

**DATE/PLACE:** July 11-26, 1995  
Portsmouth, Hants., UK

**AUTHOR:** Peter Angell

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# CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

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## TRIP REPORT

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**AUTHOR:** Peter Angell

**PERSONS PRESENT:** Peter Angell (see attached attendance list)

### BACKGROUND AND PURPOSE OF TRIP:

The author attended the 9<sup>th</sup> International Congress of Marine Corrosion and Biofouling held at Portsmouth University in the UK. The conference was concerned with the formation of biofilms and subsequent corrosion of materials exposed to the marine environment. Despite the emphasis on the marine environment many of the papers were extremely relevant to the Yucca Mountain (YM) site. While in the country the opportunity was also taken to visit the laboratories of Dr. A.H.L. Chamberlain at the University of Surrey and Dr. H. Lappin-Scott at the University of Exeter. These groups are working on either microbial corrosion or sulphate-reducing bacteria (SRB) from extreme environments, both of which have direct relevance to the Integrated Waste Package Experiment program.

### SUMMARY OF PERTINENT POINTS:

The congress at Portsmouth was extremely well attended with over 200 delegates from more than 20 countries. The keynote talk (Bunker Memorial Lecture) was given by Prof. D.C. White and dealt with new methods employed to study Microbially Influenced Corrosion (MIC). A number of these are relevant to the work of the program and arrangements have been made to gain access to the facilities at Center for Environmental Biology (CEB, University of Tennessee), should they be required. This was followed a number of invited speakers who dealt with various aspects of MIC and biofilm formation. The recurrent point made at the meeting by many speakers is that biofilms can no longer be viewed as homogeneous layers of bacteria and exopolymeric substances (EPS). Rather they are extremely heterogeneous both in types of bacteria and structure, with many columns and channels composing the biofilm. This is of direct relevance to any computer models which are developed to incorporate microbial effects, making all the processes far more complex.

The author presented a paper on his previous work at CEB, University of Tennessee, which dealt with some early results with the bacteria *Shewanella putrefaciens* SP200, a marine strain, which suggests

that this bacteria is extremely aggressive to 304L stainless steel when sulphide production is possible, but also that a low level of corrosion also occurs in the absence of sulphide production.

Other papers of interest were those of Dr. B. Little who emphasized that bacterial numbers can not be directly related to the level of corrosion, rather it appears to be linked with metabolic activity. This confirms the approach being taken by Center for Nuclear Waste Regulatory Analyses (CNWRA) in looking at the effect of bacterial metabolism on the corrosion potential of candidate metals. Another interesting paper was presented by Dr. I. B. Beech on the use of the atomic force microscope in MIC studies, in which evidence was presented that some attack of the metal could be visualized around bacteria. However, it was noted that the work of Prof. G. Geesey needs to be considered which showed that bacteria preferentially colonize grain boundaries and other depressions in the metal surface. The question that needs to be answered is whether the depression or apparent attack seen by Beech is due to the bacteria, or whether they have colonized a pre-existing depression? Dr. B. Keevil presented some excellent footage that demonstrated how light microscopy (fluorescence and Normaski DIC) can be used in biofilm studies. This is of direct relevance to the current work being set up to examine the formation and effects of biofilms on tuff.

The visit with Dr. A.H.L. Chamberlain at the University of Surrey included a presentation of work done by the author on microbial corrosion. The ensuing discussion confirmed the relevance of the bacterial strain MR1 of *Shewenalla putrifaciens* in the studies of microbial corrosion, particularly sulphide production. It was concluded that this avenue of research could prove to be very profitable. Useful discussion also took place on the role of bacterial EPS on the corrosion of copper. Although this material is not currently in the IWPE program, Alloy 400 (a Ni-Cu alloy) has recently been forwarded as a candidate material in advanced conceptual design of Department of Energy. A discussion was also held on methods of extracting biofilms for quantitative and qualitative analysis of bacterial species present. This is an area of concern for both groups, and although no methodology was formulated, both groups are now aware of what has been tried and some potential methods were suggested.

The trip to Exeter University was perhaps one of the most useful aspects of the trip. This group, under the direction of Dr. H. Lappin-Scott, has been looking at SRB isolated from extreme environments, particularly oil fields. This is of direct relevance as these are sub-terrain bacteria that have been exposed to elevated temperatures. A number of thermophilic SRB (TSRB) have been isolated with growth being examined up to 70 °C. One item of particular note is an apparent switch in one community which failed to reduce sulphate to sulphide at 30 °C, although some growth was evident. However, at higher temperatures (>45 °C) abundant sulphide production was evident. This raises the question as to whether or not the elevated temperatures expected in the repository at the YM site, might not lead to sulphide production not currently seen at lower temperatures. There is now ample evidence that TSRB are readily isolated from many sites, including normal seawater (this group has not routinely looked at fresh water). Another project being undertaken is to examine the water activities at which these bacteria are active. This is very similar to the work being proposed in the IWPE project to look at the relative humidities at which bacteria are active. Despite the slight difference in emphasis, and the early stage of both projects, some useful exchange took place.

#### **SUMMARY OF ACTIVITIES:**

Successful meetings were held with groups both at Surrey and Exeter Universities, which provided useful information for the IWPE project. A number of interesting papers were attended at the Congress in Portsmouth where the author also presented a paper. A number of useful discussions were held

with various researchers outside of the meeting rooms which should prove beneficial to the project at CNWRA.

**CONCLUSIONS:**

Overall it was concluded that the conference and University visits were worthwhile, with a number of interesting and useful ideas being discussed in the areas of MIC and biofilm formation.

**PROBLEMS ENCOUNTERED:**

None

**PENDING ACTIONS:**

None

**RECOMMENDATIONS:**

It is suggested that collaboration with other groups be explored allowing access to some of the state of the art equipment not currently available at CNWRA.

**SIGNATURES:**

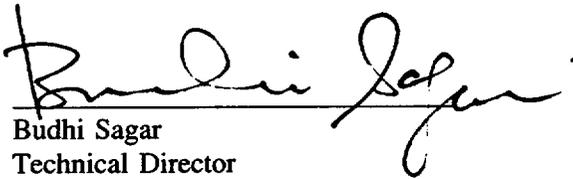
  
Peter Angell  
Visiting Scientist

8-9-95  
Date

**CONCURRENCE:**

  
Narasi Sridhar, Manager  
Engineered Barrier System, Element

8/9/95  
Date

  
Budhi Sagar  
Technical Director

8/9/95  
Date

# **9 International Congress on Marine Corrosion and Fouling**

**17 - 21 July 1995**

## **LIST OF DELEGATES**

## 9 INTERNATIONAL CONGRESS ON MARINE CORROSION AND FOULING

### LIST OF DELEGATES

<b>Dr S Abarzua</b>	Department of Biochemistry, University of Rostock, Doberaner Street 143, 18051 Rostock, GERMANY
<b>Ms R Albuquerque</b>	Department of Timber and Construction, Buckinghamshire College, Queen Alexandra Road, High Wycombe, Bucks HP11 2JZ, ENGLAND
<b>Dr C D Anderson</b>	Courtaulds Coatings, Stoneygate Lane, Felling, Gateshead, Tyne & Wear NE10 0JY, ENGLAND
<b>Dr P Andreassen</b>	Jotun A/S, P O Box 2021 Hasle, 3235 Sandefjord, NORWAY
<b>Dr P Angell</b>	Southwest Research Institute, 6220 Culebra Road, San Antonio, Texas 78238, USA
<b>Dr D W T Au</b>	Department of Biology and Chemistry, City University, Tat Chee Avenue, Kowloon, HONG KONG
<b>Dr L Bartole</b>	Dipartimento di Biologia, Via L. Giorgieri 10, 34127 Trieste, ITALY
<b>Mrs C J Bass</b>	Department of Biological Sciences, University of Exeter, Hatherly Building, Prince of Wales Road, Exeter EX4 4PS, ENGLAND
<b>Dr G G Bausch</b>	Dow Corning Corporation, 2200 West Salzburg Road, Auburn, MI 48611, USA
<b>Dr A E Bayliff</b>	Courtaulds Coatings, Stoneygate Lane, Felling, Gateshead, Tyne & Wear NE10 0JY, ENGLAND
<b>Dr K Becker</b>	Institute of Zoology, University of Kiel, Olshausenstrasse 40, D-24098 Kiel, GERMANY
<b>Dr I B Beech</b>	Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND
<b>Dr G S Beloglazov</b>	Perm State University, 15 Bukireva ul. 614600, Perm, RUSSIA
<b>Prof S M Beloglazov</b>	Department of Physical Chemistry, Kaliningrad University, 14 A Nevskiy Street, Kaliningrad 236041, RUSSIA
<b>Dr H-D Berger</b>	Limno-Mar, Bei der Neuen Münze 11, D-22145 Hamburg, GERMANY
<b>Prof P L Bonora</b>	Department of Materials Engineering, University of Trento, 38050 Mesiano, Trento, ITALY
<b>Dr G A D Briggs</b>	Department of Materials, University of Oxford, 12/13 Parks Road, Oxford OX1 3PH, ENGLAND
<b>Dr M E Callow</b>	School of Biological Sciences, University of Birmingham, Birmingham B15 2TT, ENGLAND
<b>Dr S A Campbell</b>	Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND
<b>Dr C Cambon</b>	CTSN/MDTC/CDM, BP 28, 83800 Toulon Naval, FRANCE
<b>Ms M S Carepo</b>	Department of Chemistry, Universidade Nova Lisboa, 2825 Monte de Caparica, PORTUGAL

Dr J F Carney Olin Chemicals, 350 Knotter Drive, Cheshire, CT 06410-0586, USA

Mr W Carta The Marine Laboratory, University of Portsmouth, Ferry Road, Hayling Island, PO11 0DG, ENGLAND

Dr J A Cella GE Corporate Research and Development Center, P O Box 8, K1, 4B7, Schenectady, NY 12301, USA

Mr J Chadwick Health and Safety Executive, Room 138B, Magdalen House, Stanley Precinct, Bootle, Merseyside L20 3QZ, ENGLAND

Dr A H L Chamberlain School of Biological Sciences, University of Surrey, Guildford, Surrey GU2 5XH, ENGLAND

Mr S C W Cheung Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

Dr A S Clare Marine Biological Association, Citadel Hill, Plymouth PL1 2PB, ENGLAND

Dr J H Cleland Lithgow Associates, The Corrosion Centre, 87a Pennine Way, Farnborough, Surrey GU14 9JA, ENGLAND

Dr G Coates Bugico SA, 308 route de Saint Cergue, CH-1260 Nyon, SWITZERLAND

Dr S A Codolar Pinturas Hempel SA, Carretera de Sentmenat 108, 08213 Polinya, Barcelona, SPAIN

Dr K E Cooksey Department of Microbiology, Montana State University, Bozeman, MT 59717-0398, USA

Dr A Cornish Zeneca Specialties, P O Box 42, Hexagon House, Blackley, Manchester M9 8ZS, ENGLAND

Dr S M Cragg Department of Timber and Construction, The Buckinghamshire College, Queen Alexandra Road, High Wycombe, Bucks HP11 2JZ, ENGLAND

Dr M Dahling Jotun A/S, P O Box 2021 Hasle, 3235 Sandefjord, NORWAY

Mr A Davis B15/2, SM42, Defence Research Agency, Holton Heath, Poole, Dorset BH16 6JU, ENGLAND

Mr M Davis Fawley Aquatic Research, Laboratories Ltd, Fawley, Southampton SO45 1TW, ENGLAND

Ms H Debard Université de Perpignan, CNRS - URA 461, Centre de Phytopharmacie, 52 avenue de Villeneuve, 66860 Perpignan, FRANCE

Ms S de Gregorio The Marine Laboratory, University of Portsmouth, Ferry Road, Hayling Island, PO11 0DG, ENGLAND

Dr G Denuault Department of Chemistry, University of Southampton, Highfield, Southampton SO17 1BJ, ENGLAND

Dr R de Nys Centre for Marine Biofouling and Bio-Innovation, University of New South Wales, Sydney 2052, AUSTRALIA

Prof S R de Sánchez INTEMA, National University of Mar del Plata, Av. Juan B Justo 4302, 7600 Mar del Plata, ARGENTINA

Dr M Driver Biocompatibles Ltd., Brunel Science Park, Kingston Lane, Uxbridge, Middx UB8 3PQ, ENGLAND

Dr S Durham International Paint, 24-30 Canute Road, Southampton SO14 3PB, ENGLAND

**Dr R A Eaton** School of Biological Sciences, University of Portsmouth, King Henry Building, King Henry I Street, Portsmouth, PO1 2DY, ENGLAND

**Mr D P Edwards** Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Prof L V Evans** Clore Laboratory for Life Sciences, University of Buckingham, Buckingham MK18 1EG, ENGLAND

**Dr S M Evans** Dove Marine Laboratories, Cullercoats, Tyne and Wear NE30 4PZ, ENGLAND

**Miss S Evans** Department of Geology, Royal School of Mines, Imperial College, London SW7 5BP, ENGLAND

**Ms M J Feio** Instituto de Tecnologia, Rue de Quinta Grande No 6, APT 127, 2780 Oeiras, PORTUGAL

**Dr D Feron** CEA/SCECF, BP No 6, 92265 Fontenay-aux-Roses, FRANCE

**Dr P Flammang** Laboratoire de Biologie Marine, Universite de Mons-Hainaut, 19 Ave Maistriau, B-7000 Mons, BELGIUM

**Dr H-C Flemming** TU München, Am Coulombwall, D-85748 Garching, GERMANY

**Dr R L Fletcher** The Marine Laboratory, University of Portsmouth, Ferry Road, Hayling Island, PO11 0DG, ENGLAND

**Prof I T E Fonseca** CECUL, University of Lisbon, Rua da Escola Politecnica 58, 1294 Lisbon, PORTUGAL

**Prof C Fu-shiang** Department of Biology, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon. HONG KONG

**Mr A Gab-Alla** School of Biological Sciences, University of Portsmouth, King Henry Building, King Henry I Street, Portsmouth, PO1 2DY, ENGLAND

**Mr T Gannicliffe** Health and Safety Executive, Room 137, Magdalen House, Stanley Precinct, Bootle, Merseyside L20 3QZ, ENGLAND

**Prof G G Geesey** College of Engineering, 409 Cobleigh Hall, Montana State University, Bozeman, MT 597117-0398, USA

**Dr J R Geiger** Olin Chemicals, 350 Knotter Drive, Cheshire, CT 06410-0586, USA

**Dr R George** RDTE Div 521, NCCOSC, Rm 267D, 53475 Strothe Road, San Diego, CA 92152-6325, USA

**Dr S Geraci** Istituto Corrosioni Marine, Consiglio Nazionale Ricerche, Via de Marini 6, 16100 Genova, ITALY

**Dr U Gerigk** Witco GmbH, P O Box 1620, D-59 Bergkamen, GERMANY

**Dr M Gerin** VN SpA, Via Caboto 19, 34147 Trieste, ITALY

**Mr J Gerrard** Zeneca Resins, P O Box 8, The Heath, Runcorn, Cheshire, ENGLAND

**Dr I V Grigolava** Scottish Association for Marine Science, P O Box 3, Oban, Argyll PA34 4AD, SCOTLAND

**Mr R Gubner** Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Dr T D Hall** Welaptega Marine, 65 Wentworth Street, Unit #4, Dartmouth, Nova Scotia B2Y 2T4, CANADA

**Prof W A Hamilton** Molecular and Cell Biology, Marischal College, University of Aberdeen, Aberdeen AB9 1AS, SCOTLAND

**Dr P S Handley** School of Biological Sciences, Manchester University, 1800 Stopford Building, Oxford Road, Manchester M13 9PT, ENGLAND

**Mr L Hanjongsit** Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Mrs E G Haslbeck** Carderock Division, Naval Surface Warfare Center, 3A Leggett Circle, Code 641, Annapolis, MD 21402-5067, USA

**Ms S M Henderson** Department of Timber and Construction, Buckinghamshire College, Queen Alexandra Road, High Wycombe, Bucks HP11 2JZ, ENGLAND

**Dr B N Herbert** Shell Research Ltd, Sittingbourne Research Centre, Sittingbourne, Kent ME9 8AG, ENGLAND

**Dr S D Hewitt** Gordon and Breach Publishers, P O Box 90, Reading, Surrey RG1 8JL, ENGLAND

**Mr S L Hodson** Department of Aquaculture, University of Tasmania, PO Box 1214, Launceston, Tasmania 7250, AUSTRALIA

**Dr B S Holmes** Naval Sea Systems Command, Code 03M1, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160, USA

**Dr C Holmström** School of Microbiology and Immunology, University of New South Wales, Sydney 2052, AUSTRALIA

**Dr D R Houghton** 227 Devonshire Avenue, Southsea, PO4 9EE, ENGLAND

**Dr J E Hunter** Courtaulds Coatings, Stonegate Lane, Felling, Gateshead, Tyne & Wear NE10 0JY, ENGLAND

**Ms N Ingham** Courtaulds Coatings, Stonegate Lane, Felling, Gateshead, Tyne & Wear NE10 0JY, ENGLAND

**Dr S M Jackson** Jotun A/S, P O Box 2021 Hasle, 3235 Sandefjord, NORWAY

**Dr S Jakubowski** Department of Biochemistry, University of Rostock, Doberaner Sreet 143, 18051 Rostock, GERMANY

**Mr M Jennings** Marine Safety Agency, Spring Place, 105 Commercial Road, Southampton SO15 1EG, ENGLAND

**Prof E B G Jones** School of Biological Sciences, University of Portsmouth, King Henry Building, King Henry I Street, Portsmouth, PO1 2DY, ENGLAND

**Mr J Jonker** Elf Atochem Vlissingen BV, P O Box 70, 4300 AB Vlissingen, THE NETHERLANDS

**Dr M Kalaji** Department of Chemistry, University of Wales, Bangor, Gwynedd LL57 2W, WALES

**Ms H Kang** Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Dr C J Kavanagh** Florida Institute of Technology, 150 West University Boulevard, Melbourne, FL 32901, USA

**Mr A Kawabe** F590-01, 3-10-3 Takeshiro-dai, Sakai, Osaka, JAPAN

**Dr C W Keevil** CAMR, Salisbury, Wilts SP4 0JG, ENGLAND

**Dr E B Kjaer** Hempels Marine Paints A/S, Lundhoffvej 150, DK-2800 Lyngby, DENMARK

**Prof N Kouloumbi** Department of Chemical Engineering, National Technical University, 9 Iroon Poytechniou Street, Athens 157 80, GREECE

**Dr R J Kurz** Naval Sea Systems Command, PMS 390T132, 2531 Jefferson Davis Hwy, Arlington, VA 22242-5160, USA

**Miss E Lake** British Gas plc, Gas Research Centre, Ashby Road, Loughborough, Leics LE11 3QU, ENGLAND

**Dr R Länge** Schering AG, Muellerstrasse 178, D-13342 Berlin, GERMANY

**Dr D Lapota** Naval Command, Control & Ocean Surveillance Center, Code 522, 53475 Strothe Road, San Diego, CA 92152-6310, USA

**Ms C S C Lee** Marine Biology Laboratory, Department of Zoology, National University of Singapore, Kent Ridge, SINGAPORE 0511

**Prof Z Lewandowski** Centre for Biofilm Engineering, 409 Cobleigh Hall, Montana State University, Bozeman MT 597117-0398, USA

**Mr J A Lewis** Aeronautical and Maritime Research, Laboratory, DSTO, GPO Box 433, Melbourne, Victoria 3001, AUSTRALIA

**Mr T Leya** Biologische Anstalt Helgoland, Zentrale Hamburg, Notkestrasse 31, D-22607 Hamburg, GERMANY

**Prof A R L Lino** Instituto de Tecnologia, Rue de Quinta Grande No 6, APT 127, 2780 Oeiras, PORTUGAL

**Dr B J Little** Naval Research Laboratory, Stennis Space Center, Code 7330, MS 39529-5004, USA

**Mr G Lobina** The Marine Laboratory, University of Portsmouth, Ferry Road, Hayling Island, PO11 0DG, ENGLAND

**Mr B Loiseau** CTSM/MDTC/CDM, BP 28, Toulon Naval 83800, FRANCE

**Dr A Marchese** VN SpA, Via Caboto 19, 34147 Trieste, ITALY

**Dr E Marsh** British Steel Technical, Swindon Technology Centre, Moorgate, Rotherham S60 3AR, ENGLAND

**Ms R Maximilien** Centre for Marine Biofouling and Bio-Innovation, University of New South Wales, Sydney 2052, AUSTRALIA

**Dr J D McKenzie** Scottish Association for Marine Science, P O Box 3, Oban, Argyll PA34 4AD, SCOTLAND

**Miss S McNath** Centre for Environmental Health Engineering, University of Surrey, Guildford, Surrey GU2 5XH, ENGLAND

**Dr M Merrett-Jones** Robens Institute, University of Surrey, Guildford, Surrey GU2 5XH, ENGLAND

**Mr A Milne** Occam and Morton, 39 Sanderson Road, Newcastle upon Tyne NE2 2DR, ENGLAND

**Dr R M Moate** EM Unit, Faculty of Science, University of Plymouth, Plymouth PL4 8AA, ENGLAND

**Prof H P Molitoris** Institut für Botanik, Universität Regensburg, Universitätstrasse 31, D-93040 Regensburg, GERMANY

**Ms A Monni** The Marine Laboratory, University of Portsmouth, Ferry Road, Hayling Island, PO11 0DG, ENGLAND

**Dr T G Nevell** Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Miss A Neville** Department of Mechanical Engineering, University of Glasgow, James Watt Building, Glasgow G12 8QQ, ENGLAND

**Dr R C Newman** Corrosion and Protection Centre, UMIST, P O Box 88, Manchester M60 1QD, ENGLAND

**Miss D I Norkett** CAMR, Salisbury, Wilts SP4 0JG, ENGLAND

**Prof A A Novakova** Department of Physics, M V Lomonsov State University, Voroblevi Gori, 117234 Moscow, RUSSIA

**Dr T Ooba** Nakabohtec Corrosion Protection, 417-16 Nakaarai, Ageo City, Saitama 362, JAPAN

**Dr A Parr** Marine Technology Centre, University of Glasgow, James Watt Building, Glasgow G12 8QQ, SCOTLAND

**Dr S Pedley** Robens Institute, University of Surrey, Guildford, Surrey GU2 5XH, ENGLAND

**Dr R Pellenbarg** Naval Research Laboratory, 4555 Overlook Ave SW, Washington DC 20375-5320, USA

**Mr I Penegar** Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Mr S Perceival** School of Metals, University of Leeds, Leeds, LS2 9JT, ENGLAND

**Dr J C Petrille** Betz Water Mangement Group, 4636 Somerton Road, Trevoise, PA 19053-6783, USA

**Dr A J Pitman** Department of Timber & Construction, Buckinghamshire College, Queen Alexandra Road, High Wycombe, Bucks HP11 2JZ, ENGLAND

**Dr S B Pointing** Southampton Institute of Higher Education, Newtown Road, Warsash, Southampton, S03 9ZL, ENGLAND

**Dr G Polson** Olin Chemicals, 350 Knotter Drive, Cheshire, CT 06410-0586, USA

**Mrs C A Powell** Poughn Hill, Caynham, Ludlow, Shropshire SY8 4JY, ENGLAND

**Dr W Press** Witco GmbH, P O Box 1620, D-59 Bergkamen, GERMANY

**Mr R A Pullin** Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Miss K Pye** The Marine Laboratory, University of Portsmouth, Ferry Road, Hayling Island, PO11 0DG, ENGLAND

**Ms M-L Qui** National Taiwan Ocean University, Keelung, Taiwan 21224, REPUBLIC OF CHINA

**Mr G Radford** Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Prof M A Reis** Department of Chemistry, Universidade Nova Lisboa, 2825 Monte de Caparica, PORTUGAL

**Prof G Relini** Universita di Genova, Istituto di Zoologia, Via Balbi 5, 161 20 Genova, ITALY

**Dr J D Rich** GE Corporate Research and Development, P O Box 8, K1, 5A64, Schenectady, NY 12301, USA

**Dr J Robinson** Department of Physics, University of Warwick, Gibbet Hill Road, Coventry CV4 7AL, ENGLAND

<b>Dr J Rogers</b>	CAMR, Salisbury, Wilts SP4 0JG, ENGLAND
<b>Dr H W Rossmore</b>	Biosan Laboratories Inc., 1950 Tobsal Court, Warren, Michigan 48091-8978, USA
<b>Mr G A Rowe</b>	Department of Oceanography, University of Southampton, Highfield, Southampton SO17 3AP, ENGLAND
<b>Dr S Sandrock</b>	Bioplan, Joachim-Jungius-Strasse 9, 18059 Rostock, GERMANY
<b>Dr M Schultz</b>	Florida Institute of Technology, 150 West University Boulevard, Melbourne, FL 32901, USA
<b>Dr P Schultz</b>	Witco GmbH, Postfach 16 20, 59180 Bergkamen, GERMANY
<b>Miss C Scott</b>	The Marine Laboratory, University of Portsmouth, Ferry Road, Hayling Island, PO11 0DG, ENGLAND
<b>Dr J Sharman</b>	Alcan International Ltd., Southam Road, Banbury, Oxon OX16 7SP, ENGLAND
<b>Dr J B Sigurdsson</b>	Marine Biology Laboratory, Department of Zoology, National University of Singapore, Kent Ridge, SINGAPORE 0511
<b>Dr M Singer</b>	Zeneca Biocides, P O Box 42, Hexagon House, Blackley, Manchester M9 8ZS, ENGLAND
<b>Mr H R Singh</b>	Department of Zoology, University of Malaya, 59100 Kuala Lumpur, MALAYSIA
<b>Prof Th N Skoulikidis</b>	Department of Material Sciences, National Technical University, Iroon Polytechniou 9, 157 80 Athens, GREECE
<b>Mr H D Smidt</b>	DTI Plastics Technology, Danish Technological Institute, Teknologiparken, DK-8000 Arhus C, DENMARK
<b>Miss M Smith</b>	Department of Mechanical Engineering, University of Glasgow, James Watt Building, Glasgow G12 8QQ, SCOTLAND
<b>Dr S Snyder</b>	Naval Research Laboratory, 4555 Overlook Ave SW, Washington DC 20375-5320, USA
<b>Dr R Sowdon</b>	Biomet Laboratories Limited, 10 Manor Lane, Ettington, Stratford-upon-Avon, Warwicks CV37 7TE, ENGLAND
<b>Dr A Speyer</b>	Carnaud Metal Box, Downs View Road, Wantage, Oxon OX12 9BT, ENGLAND
<b>Mr A Steele</b>	Division of Chemistry, University of Portsmouth, St Michael's Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND
<b>Dr P D Steinberg</b>	Centre for Marine Biofouling and Bio-Innovation, University of New South Wales, Sydney 2052, AUSTRALIA
<b>Mrs R Stephenson</b>	Courtaulds Coatings, Stonegate Lane, Felling, Tyne and Wear NE10 0JY, ENGLAND
<b>Dr U Stewen</b>	Witco GmbH, P O Box 1620, D-59180 Bergkamen, GERMANY
<b>Mrs K Sturgess</b>	Department of Timber and Construction, Buckinghamshire College, Queen Alexandra Road, High Wycombe, Bucks HP11 2JZ, ENGLAND
<b>Dr G W Swain</b>	Office of Naval Research Europe, 224 Old Marylebone Road, London NW1, ENGLAND
<b>Ms C Swords</b>	School of Metals, University of Leeds, Leeds, LS2 9JT, ENGLAND

**Mr C J L Taylor** Location 106, Nuclear Electric, Barnet Way, Barnwood, Glouc.  
GL4 7RS, ENGLAND

**Miss R Taylor** The Marine Laboratory, University of Portsmouth, Ferry Road,  
Hayling Island, PO11 0DG, ENGLAND

**Dr S L M Teo** Marine Biology Laboratory, Department of Zoology, National  
University of Singapore, Kent Ridge, SINGAPORE 0511

**Mr Terashima** Kansai Paint Europe Ltd, 14th Floor, Bastion House, 140  
London Wall, London EC2Y 5JT, ENGLAND

**Dr J C Thomason** UMBSM, Millport, Isle of Cumbrae, SCOTLAND KA28 0EG

**Dr J S Tonge** Dow Corning Corporation, 2200 West Salzburg Road, Auburn,  
MI 48611, USA

**Dr K R Trethewey** Department of Engineering Materials, University of  
Southampton, Highfield, Southampton SO17 1BJ, ENGLAND

**Dr N Tuck** Courtaulds Coatings, Stoneygate Lane, Felling, Tyne and Wear  
NE10 0JY, ENGLAND

**Prof A Tunlid** Department of Microbial Ecology, Lund University, Ecology  
Building, S-223 62 Lund, SWEDEN

**Dr S Turgoose** Corrosion and Protection Centre, UMIST, P O Box 88,  
Manchester M60 1QD, ENGLAND

**Dr R M Turner** Health and Safety Executive, Room 103, Magdalen House,  
Stanley Precinct, Bootle, Merseyside L20 3QZ, ENGLAND

**Dr M Van der Flaas** Janssen Research Foundation, Turnhoutseweg 30, B-2340  
Beerse, BELGIUM

**Mr M van Donk** KEMA, Utrechtseweg 310, 6812 AR Arnhem, THE  
NETHERLANDS

**Prof P Vassiliou** Department of Material Sciences, National Technical University,  
Iron Polytechniou 9, 157 80 Athens, GREECE

**Dr G Ventura** Istituto Corrosioni Marine, Consiglio Nazionale Ricerche, Via  
de Marini 6. 16100 Genova, ITALY

**Dr H A Videla** University of La Plata, INIFTA Bioelectrochem. Sect. CC 16  
Suc 4. 1900 La Plata, ARGENTINA

**Dr A Wagh** National Institute of Oceanography, Dona Paula, Goa 403 004,  
INDIA

**Dr D Wagner** Institut für Instandhaltung GmbH, Kolkofen 4. 58638 Iserlohn,  
GERMANY

**Dr J T Walker** CAMR, Salisbury, Wilts SP4 0JG, ENGLAND

**Prof F C Walsh** Division of Chemistry, University of Portsmouth, St Michael's  
Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Dr O Wanner** EAWAG, System Sciences Group, Ueberlandstrasse 133, 8600  
Dubendorf, SWITZERLAND

**Miss L K Warden-Owen** Department of Chemistry, University of Wales, Bangor,  
Gwynedd LL57 2W, WALES

**Mr P Watkins** Division of Chemistry, University of Portsmouth, St Michael's  
Building, White Swan Road, Portsmouth PO1 2DT, ENGLAND

**Dr D C White** Center for Environmental Biotechnology, 10515 Research Drive,  
Suite 300, Knoxville, TN 37932, USA

<b>Dr T S Whitham</b>	Shell Research Ltd, Sittingbourne Research Centre, Sittingbourne, Kent ME9 8AG, ENGLAND
<b>Dr M Whittam</b>	Courtaulds Coatings, Stoneygate Lane, Felling, Tyne and Wear NE10 0JY, ENGLAND
<b>Mr P Willemsen</b>	TNO Coatings, P O Box 57, 1780 AB Den Helder, THE NETHERLANDS
<b>Prof D E Williams</b>	Department of Chemistry, University College London, 20 Gordon Street, London WC1H 0AJ, ENGLAND
<b>Dr J J E Williams</b>	Marinetech South, Tizard Building, University of Southampton, Highfield, Southampton SO17 1BJ, ENGLAND
<b>Dr P Williamson</b>	School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, ENGLAND
<b>Dr G L Willingham</b>	Rohm and Haas Company, 727 Norristown Road, P O Box 904, Spring House, PA 19477-0904, USA
<b>Dr J W T Wimpenny</b>	School of Pure and Applied Biology, University of Cardiff Wales, Cardiff CF1 3TL, WALES
<b>Prof C S Wu</b>	National Taiwan Ocean University, 2 Pei-ning Road, Keelung 202, Taiwan, REPUBLIC OF CHINA
<b>Prof D K Yfantis</b>	Department of Chemical Engineering, National Technical University, 9 Iroon Poytechniou, Athens 15780, GREECE
<b>Mr B A C Zaal</b>	Transocean Marine Paint Association, Prins Hendrikkade 14, 3071 KB Rotterdam, THE NETHERLANDS
<b>Dr V Zupo</b>	Laboratorio di Ecologia del Benthos, Punta S Pietro, 80077 Ischia (NA), ITALY