

ENVIRONMENTAL
PHYSICS GROUP

NEWSLETTER

FEBRUARY 1994



THE INSTITUTE OF PHYSICS

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Contributions

Contributions, news items or meeting notices are welcome from members and non-members alike and should be sent to:

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The deadline for issue number 9 is 31 April, 1994.

EPG Membership

IoP/EPG membership enquiries are encouraged from both physicists and non-physicists with an interest in topics in "Environmental Physics". For further details contact:

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Welcome to issue 8.

First may I wish all members of the EPG a belated **Happy New Year**. It has been almost twelve months since I took over from Susanna Lithiby as editor of our newsletter. Since then I have tried to bring in different features in an effort to expand the range of information the newsletter can offer. It is the only real contact many members of the EPG have with the Committee and the IoP in general. Obviously, we are limited in what we can do so I need to know if this is the kind of newsletter members want. With this in mind, I would like to offer you, the membership – and anyone else who reads the newsletter, IoP member or not – an invitation to respond to me with comments about the newsletter, ideas for articles, or suggestions of activities for the EPG in general. We will soon have our AGM and so some of you will be able to discuss these points with me, or the other Committee members, in person.

Now to issue number 8. In *Research Focus* I try to find topical articles which reflect current research activity and this time I have included a piece by Professor Keith Browning from the University of Reading, our speaker for the AGM in May. In fact the article is an edited version of a longer piece which appeared in *NERC News* in July last year and, in this version, it gives a brief summary of the GEWEX programme which we have featured in the past. Since Professor Browning has agreed to be our speaker at the annual lecture/AGM the article will provide a good general introduction to the subject for members wishing to attend.

The book reviewed in this issue is a recent report published by the Department of the Environment. In the last newsletter, I included a review of a HMSO publication about air pollution from road vehicles. This time it is the general problem of air quality in the UK which is considered. To review this publication, I asked Mick Duggan, an EPG member and private consultant involved in air quality work, to offer his opinion of this report. Mick spent the first sixteen years of his professional life in the field of radiological protection – initially with the Medical Research Council and then with the National Radiological Protection Board, where he initiated the work on radon in dwellings. He then moved to the environmental sciences group of the Greater London Council, and was concerned with measurement and assessment of air pollution from various sources – in particular, road traffic, and asbestos in schools. Since the abolition of the GLC he has been a private consultant.

Finally, an apology. I had a few problems with e-mail before Christmas and I know some members tried to contact me via that media. The problems have now been sorted out so if you haven't had a response and would like one, could you re-mail your original message and I will deal with it as soon as I can.

Geoff Hassall

From the Chair

On Thursday, 12 May at 6.15pm, there will be an evening lecture by Professor Keith Browning of the Joint Centre for Mesoscale Meteorology at Reading University. He will describe the Global Energy and Water Cycle Experiment (GEWEX) which has been featured before in this newsletter. Following the lecture there will be a brief Annual General Meeting of the Environmental Physics Group. This is your opportunity to meet with members of the EPG Committee, to pass on your views of the EPG personally, and to suggest future activities and meetings you would like to see the Committee organise for you.

If you wish to nominate yourself, or somebody else, to be a member of the Committee then these must be with the Honorary Secretary, Alistair McCartney by 24 March.

I hope to see you in May.

J B Stewart, Chairman

In our series of articles by Committee members, Ranjeet Sohki tells us how and why he found himself actively involved in Environmental Physics research.

Transition from Atomic to Environmental Physics – A Personal View

While studying innershell ionisation processes at Aston University for my PhD degree, I felt that I was involved in pure, unadulterated physics. This work forged in my mind the idea of what physics was all about.

The research group at Aston consisted of students working on applications of ion-atom collisions to measure trace contaminants in medical, metallurgical and environmental samples using Particle Induced X-Ray Emission (PIXE) technique. This gave me the opportunity to work on my particular project while, at the same time, observing how principles of atomic collision physics were being applied in a host of areas that seem to have direct relevance to people.

After completing my PhD, I moved to the University of Southampton investigating auto-ionisation and Auger transitions in atoms caused by low energy electrons, and although I enjoyed my stay at Southampton, the combination of the change of direction of scientific research being pushed by the Government, and my own desire to explore the applied physics route, persuaded me to look for a different kind of post.

The opportunity arose at the School of Physics and Space Research at the University of Birmingham where I worked for the next few years as a Research Fellow. Here I made some impact in generating income for the Dynamitron accelerator facility as well as developing my growing interests in the environmental field. I was able to interact with environmental

and medical scientists, chemists, metallurgical scientists and civil engineers. One of the main advantages of working in applied physics is that you have the opportunity to meet and work with people of various disciplines who, in many cases, are not familiar with your subject. It was interesting to note the way scientists from different disciplines view a particular problem. A physicist would probably like to understand the fundamental controlling processes and would painstakingly ensure that every measurement was of the highest precision and that they were reproducible. A precision of more than a few percent would be unacceptable. An engineer or environmentalist investigating the impact of contaminants on the environment, on the other hand, may only be interested in the overall trends or the general impact on an ecosystem. I hope I am not being unfair to engineers or environmentalists! The physicists may fail to realise the grand picture whereas the environmentalist may fail to appreciate the role of the finer details of the problem. Both views have a role to play in understanding our environment and both approaches, in many cases, are complementary and are essential to provide the 'complete' picture.

At Birmingham I was able to collaborate on research projects investigating the transport of contaminants in the atmosphere and in estuarine systems. I also had the opportunity to teach courses on environmental physics and environmental radiation modelling. Later, I was able to pursue my research interests in the environmental field, in particular, in the atmospheric dispersion of contaminants, at the Department of Trade and Industry's Warren Spring Laboratory. As a result of the Government rationalisation policy, it was announced that WSL will be merged with some parts of AEA Technology to form the new National Environmental Technology Centre at Culham. This was an ideal moment to review the direction of my career. Instead of moving to Culham I moved to my present post at the School of Environmental Sciences, University of Greenwich. In addition to teaching undergraduates and postgraduates the benefits of environmental modelling, I am involved in research programmes on modelling of atmospheric contaminants particularly in the urban environment.

Looking back on my career so far I have had to make a few twists and turns. Unfortunately, in present economic and political climate it is necessary to be versatile in ones ambitions in order to stay in a reasonably secure job. Fortunately for me, however, I have always been able to use my knowledge of physics; which is what I hoped for when I decided to study this subject. In particular, it is the positive and essential contributions that physics makes to our understanding of the environment and the impact we have upon it that has provided me with the rewards and satisfaction in my career.

*Ranjeet S Sohki,
Senior Lecturer*

*School of Environmental Sciences,
University of Greenwich*

Pollution Transport through Unsaturated Soils

12 January, 1994

Institute of Physics, Belgrave Square, London

This half-day meeting was organised by the EPG in collaboration with the British Soil-Water Physics Group, an informal discussion group formed in 1990 to bring together workers in diverse fields concerned with the physics of soil water. The purpose of the meeting was to explore the processes involved in the transport of pollutants through unsaturated soils that can be contaminate underground aquifers. The talks reflected the practical issues involved in reducing this contamination.

The meeting began with a talk by **Peter Leeds-Harrison** (Silsoe College, Cranfield University) on the basic physics of transport processes in soils, who skillfully reduced a full lecture course to thirty minutes. While pollutants occurred in the form of solids, liquids and gases, the main concern is that of dissolved solutes in the soil water that pose difficult problems of convective and diffusive transport in the complex network of pores in which flow velocities vary spatially. Particular problems are associated with complicating factors such as hysteresis phenomena in soil properties, soil heterogeneity, soil swelling and shrinking, and soil aggregation.

After this introduction the meeting turned its attention to specific aspects of pollutant transport that occur as a result of agricultural and industrial activities. **David Cooper** (Institute of Hydrology) described the problems associated with the leaching of nitrates into groundwater aquifers associated with the intensification of agriculture. Nitrates originating from the increase in nitrification as a result of cultivation and from any excess of applied fertilizers appear in the ground water many years later. Results of experiments monitoring the nitrate transport down soil profiles at a number of sites in England were described.

Andrée Carter (Soil Survey and Land Research Centre) outlined the physico-chemical and hydraulic processes that determine the fate of pesticides that are used in agriculture. The processes include volatilisation, adsorption and desorption on soil particle surfaces, biodegradation, hydrolysis and photolysis. Of particular importance in the movement of pesticides in soils are fissures that can produce preferential pathways for transport to depth. Experimental work was described that is aimed at validating predictive models of pesticide transport into groundwater in order to develop risk assessment procedures.

The last talk was given by **Howard Wheeler** and **Adrian Butler** (Imperial College) who described their work on radio-chemical transport in vegetated soils. The objectives of this work were to improve our understanding of the processes involved, to create a data-base to support safety assessments regarding the handling and storage of radioactive chemicals, and lastly to develop appropriate modelling methods to describe the transport

of radio-chemicals through soil. Experimental work using lysimeters and laboratory soil columns was described, and this was followed by an account of the modelling procedures being used.

After these invited talks, the meeting concluded with a discussion session, chaired by Jim Wallace of the Institute of Hydrology. Prominent in the discussion was the inadequacy of classical soil physics theories to describe pollutant transport in many soils, particularly the role of soil cracks and fissures, and this was illustrated in the work on pesticide movement described by Andrew Johnson of the Institute of Hydrology. The meeting was also reminded that transport processes in soils are described in theories at the Darcy scale that are inappropriate at the larger regional scale of importance when used in numerical models with large length increments. The aim must be to bridge the gaps of scale by applying the understanding of soil physical processes at the smaller scale to the field scale of practical concern.

The meeting was attended by about sixty delegates, of which about one third were post-graduate students.

Edward Youngs

Silsoe College, Cranfield University.

Visit to The Institute of Hydrology, Wallingford

28 October 1993

Visitors to the Institute of Hydrology at Wallingford, Oxon, gained a fascinating insight into several major areas of research activity at IH. These included aspects of the TIGER (Terrestrial Initiative in Global Environmental Research) programme which is organised from Wallingford (members will have seen several reports of TIGER activities in previous issues of the EPG newsletter), the instrumentation section, and the ABRACOS (Anglo-Brazilian Amazonian Climate Observation Study) project to compare the surface fluxes and climatology of forested and deforested areas in Amazonia. EPG members were also told of the IH contributions to the Hapex - Sahel experiment which is part of the ISLSCP (International Satellite Land Surface Climatology Project), involving measurements of the surface fluxes, the planetary boundary layer and the amount and movement of water in the soil.

Although only 10 members attended, the visit was reported to be well worth the effort and hence quite successful.

John Stewart

Institute of Hydrology, Wallingford, Oxon

The Global Energy and Water Cycle

Professor Keith Browning FRs

Joint Centre for Mesoscale Meteorology*, University of Reading

Water, in all its forms, is the life-blood of the climate system. As water vapour, it is the principal contributor to the greenhouse effect. As cloud, it dominates the planetary albedo and the radiative energy available at the surface of the earth. The balance between precipitation and evaporation controls the availability of freshwater at the ground and its supply to living material and, by affecting the salinity of the ocean surface, it also influences the circulation of the ocean. The global water cycle is a key component of the energetics of the Earth system through atmospheric transport, latent and radiative heating, and through redistribution of water over the surface.

This is a multi-scale and multi-disciplinary subject offering an enormous scientific challenge. It brings together meteorologists, hydrologists, oceanographers and others in the study – via observations, modelling and theory – of mechanisms on scales ranging from the global circulation to small-scale processes whose effects are felt both regionally and globally. It is a growing field of research internationally, with major activities coordinated by the World Climate Research Programme (WCRP) and by the International Geosphere-Biosphere Programme (IGBP). The largest concentration of effort in this field is within WCRP's Global Energy and Water Cycle Experiment (GEWEX). Liaison across related activities in the UK is achieved within the Royal Society's GEWEX Forum. This article gives a flavour of some of the key issues.

Clouds are a topic in which the UK has a long tradition of research. Activities are now moving toward the development of improved methods of modelling and observing clouds in ways that address their global impact. An important tool being developed as part of the GEWEX Cloud System Study are cloud resolving numerical models capable of representing the coupling between various physical processes. One of the greatest impediments to understanding the radiative effects of clouds is our ignorance of their vertical distribution. Clouds with different vertical distributions produce different vertical profiles of atmospheric heating. Such differences have a substantial effect on the performance of General Circulation Models (GCMs), and vertical cloud profiles need to be measured globally in order to develop and validate the GCMs. Problems of observation are not restricted to the clouds themselves. Despite its known importance in many climate processes, the global distribution of the resulting precipitation is also very poorly observed. No single measurement technique offers anything like a complete solution and so the Global Precipitation Climatology Project (GPCP) aims to develop the best possible climatology of

* The Joint Centre for Mesoscale Meteorology is supported by the Meteorological Office and the University of Reading, Department of Meteorology

precipitation using a combination of available satellite and ground-based measurements and numerical weather-prediction models.

Energy and water exchanges are particularly important at the interfaces between the atmosphere and sea, ice and land surfaces. Air-sea interaction is central to an understanding of the global water and energy budget because the ocean can store and transport heat and freshwater, releasing them to the atmosphere at locations and times different from those at which they entered. The ocean circulation is itself controlled by the surface fluxes of heat and water as well as by momentum. However, knowledge of the fluxes over the global ocean, and in particular of their spatial and temporal distribution, is poor. For climate purposes, the accuracy requirements for surface fluxes are very stringent. For example, sea surface temperature – a key variable in the computation of surface fluxes – should be measured with an absolute accuracy of 0.3 K. Although many of the relevant parameters have been measured to high accuracy from surface platforms, earth-observing satellites such as Europe's ERS-1 offer considerable potential, in that sensors provide data from large areas of ocean in a relatively short time with more uniform coverage than is possible using surface-based systems. However, some vital parameters cannot yet be reliably determined from space alone.

Energy and water exchanges at the land surface are important because the possible changes in man-made climate forcing originate there, and it is at the land surface where the human impacts of possible climate change are apparent. There are many difficult questions to be answered in deciding how the land surface interacts with the atmosphere on daily, seasonal or interannual time scales. The questions become more complicated when longer time scales are considered, as vegetation grows, or even as plant communities change in response to different climates. Thus, a further problem is that of making reasonable predictions of the behaviour of this interaction under climate conditions different from those in which the observations have been made. Climate predictions are usually made using GCMs, but these average the processes spatially and can represent processes only simply. Thus new formulations are needed to represent the land-surface processes both simply and realistically, at large spatial scales. Systematic observations of the land surface are now available from space for the first time, and ways must be developed for using them, along with the more conventional surface observations, to constrain the GCMs.

Clearly the task of understanding the global energy and water cycles is so multifaceted and so challenging that it must be addressed by means of a well coordinated long-term programme of research which may extend well into the next century.

This is an edited version of an article which first appeared in NERC News, July 1993, and is published here by kind permission of the author.

Environmental Sensors

IoP Publishing, Bristol

"*Environmental Sensors* provides authoritative, timely and concise coverage of environmental monitoring and instrumentation, with analysis of important technology, market developments and insights into trends. Subject areas include sensor science and technology, applications of innovative environmental monitoring, company and product news, new publications and forthcoming events. It is essential reading for managers and senior technical staff whose companies have an environmental impact." *Env. Sensors*

For more details or a free sample copy contact:

Geraldine Pounsford

IoP Publishing, Techno House, Redcliffe Way,
Bristol, BS1 6NX, UK.

Tel: (0272) 297481, Fax: (0272) 294318.

The UK Global Environmental Research (GER) Newsletter: "The Globe"

The theme for issue 16 (December, 1993) of "The Globe" is *Polar Regions and Global Environmental Change*:

"Polar regions are the sites of major interactions between the atmosphere, ice, oceans, biota and, in the Arctic, the land surface. These interactions influence the total Earth system through feedbacks, biogeochemical cycling, deep ocean circulation, atmospheric transport and changes in ice mass balance. It is impossible, in such a short article, to do justice to the full range of environmental research effort. However, this issue of "The Globe" attempts to give some idea of its scope and to provide insights into the different influences exerted by the two regions. A number of people have contributed to the article which focuses on the natural science interests. Nevertheless it is important to emphasise that there is also a growing body of social science research examining the global environmental issues within these regions." *The Globe*

Future issues will consider *Education and Global Environmental Change* (issue 17, due out 10 January '94) and *The Hydrological Cycle in Global Environmental Change* (issue 18, 14 March '94). The UK GER Office is jointly funded by the Agricultural and Food Research Council, Economic and Social Research Council, Medical Research Council, Natural Environmental Research Council and the Science and Engineering Research Council.

For further information about UK GER activities, products and service, contact:

UK GER Office, Polaris House, North Star Avenue, Swindon SN2 1EU

Tel: 0793 411 734/768/779, E-mail UKGEROFF@UK.AC.SWMIS

Urban Air Quality in the United Kingdom:

First Report of the Urban Air Review Group, January, 1993.

The Government's White Paper on the environment, *This Common Inheritance* (1990), gave a commitment to make information about the environment available to everyone. The report reviewed here is an example of the DoE's response. The Quality of Urban Air Review Group (QUARG) is a working group of experts brought together by the DoE to review current knowledge on urban air quality in the UK, and to make recommendations. It consists of sixteen members, drawn from academia, Government Departments and agencies, and commercial consultancies.

Their first report runs to about 200 pages and provides the most comprehensive and authoritative review of our urban air quality that is currently available. It is much more than a summary of the measured concentrations of various pollutants, and gives information on and discussion of – for example – trends in emissions and concentrations, spatial and temporal distributions, some atmospheric chemistry, compliance with standards and guidelines, and recommendations for future research.

The first chapter of substance *A background to urban air quality* is, in effect, a short introductory textbook. It gives a succinct overview of: sources of urban air pollution, emission regulations, air quality criteria, meteorological influences, modelling urban air quality, monitoring urban air quality, air quality data dissemination, public exposure to urban pollutants, effects on buildings and materials, effects on plants, and visibility.

The heart of the report is a series of chapters on individual pollutants or groups of pollutants: nitrogen compounds, sulphur compounds, carbon monoxide, particulate matter, oxidants, metals, and organic compounds. They are a mine of useful data for anyone with a professional interest in air pollution. The amount of information given varies from pollutant to pollutant, but this is simply a reflection of the varying amounts of data available. The thirty-page chapter on nitrogen compounds, for example, is hardly light reading; although the data are presented clearly (and mostly in graphical form), there is simply so much to digest. By contrast, there is only about a page on dioxins.

For such a well-produced book, the binding is very inferior – I gave up trying to stick the pages that fell out back in again, after the first couple of weeks of use. However, in view of the quality and scope of the report this is a niggling complaint. The more so since the report is available free of charge from: *Department of the Environment, PO Box 135, Bradford, West Yorkshire BD9 4HN*

M J Duggan

Banstead, Surrey

Energy and the Environment

Edited by Sir Bryan Cartledge, Principal of Linacre College, Oxford

Oxford University Press, 1993. £7.99

"Heat, light, industrial production, transport – every government, in its energy policy, has to balance the competing claims of economic benefit, public opinion, and environmental impact. In this book, leading representatives of the various types of energy generation – coal and oil, gas, nuclear power, and alternative technologies – set out the pros and cons of these energy sources and discuss their environmental consequences. Chapters deal with special problems faced by the countries of the developing world, by the new democracies in Central and Eastern Europe, and by the republics of the former Soviet Union. Readers will be able to form a balanced judgement on the direction which energy policies could or should take in order to maximize economic efficiency while minimizing the greenhouse effect, acid rain, and atmospheric pollution." *Energy and the Environment*

Since 1990, Linacre College in Oxford has been host to a series of lectures given by eminent scientists, politicians on different aspects of the environment. This book is a collection of the second series of lectures held during 1991-92. I should admit to a little bias here. I attended some of these lectures although I wish I could have been at them all. The range of expertise of the lecturers covers every aspect of the theme in question. For this series it was energy and the environment and the opinions expressed by each speaker when taken as a whole, gave a well balanced view of the current state of thinking. The ideas put forward were always thought provoking and often contentious as one might expect from a speaker list including: Jonathon Porritt, Zhores Medvedev, Hermann Bondi, Walter Marshall, Denis Rooke, Peter Hardi, John Rae and Peter Chester.

As I mentioned earlier, this is the second book based on the Linacre Lecture series. The first, called *Monitoring the Environment*, contained lectures from the period 1990-91 and was again edited by Sir Bryan Cartledge. Although the book was published in 1992, it should still be available and should be essential reading for anyone wishing to understand how current scientific and political thinking has evolved and how it will develop in the future. The list of speakers was again a rich mixture and included: Michael Heseltine, James Lovelock, Ghillean Prance, John Mason, Crispin Tickell, Richard Southwood, John Phillipson and John Woods. The book was published by OUP and is priced at £7.99. I highly recommend these books for they form a unique snapshot of the current environmental philosophy from which future scientific and political thinking will be derived.

More recent lecture series will also be published in book form in time. *Ed.*

EPG Meetings:**Colonial Observatories and Observations:****Meteorology and Geophysics****8–10 June, 1994**

Venue: St. Mary's College, University of Durham

This is a joint meeting of the History of Meteorology and Physical Oceanography Group of the Royal Meteorological Society and the Environmental Physics Group (in association with the Association of British Climatologists). Following the highly successful 1991 conference on *Observatories and Climatological Research*, this meeting has been arranged with the emphasis on work overseas. Themes include:

- The establishment of meteorological networks overseas during the nineteenth century.
- The voyage of the British First Fleet to Port Jackson, 1787-1788 and its impact on meteorology in Australia.
- Observatories and observations in Australia, South Africa, Malta, Gibraltar, Hong Kong, East Africa and Antarctica.
- The trials and tribulations of getting there in the first place - some interesting archives.
- Personal experience of work overseas; a look beyond in space and time at observatory work in China and Korea - the medieval to Jesuit periods.

The programme is almost full but could be adjusted to include additional oral presentations and there will be poster presentations and other displays up throughout the weekend.

Further details and conference booking forms are available from:

Miss Joan Kenworthy, Principal,

St. Mary's College, University of Durham, Durham DH1 3LR

Tel: (091) 374 2700, Fax: (091) 374 7473, E-mail: J.M.Kenworthy@Durham.ac.uk

The Global Energy and Water Cycle**18–22 July, 1994**

Venue: The Royal Society, London

This meeting is organised by the UK GEWEX Forum and is supported by The Royal Society, The Royal Meteorological Society, The British Hydrological Society, The Remote Sensing Society and others including the Environmental Physics Group. It will bring together meteorologists, hydrologists and others across Europe involved in the study, via observations, modelling and theory, of processes affecting the energy and water cycle. Session headings include atmospheric processes, precipitation measurement and analysis, land-atmosphere interactions, ocean-atmosphere interactions, continental-scale water budgets, and global modelling.

For further information contact:

The Executive Secretary, The Royal Meteorological Society,

104 Oxford Road, Reading, Berks RG1 7LJ

Other Meetings:**UKGA-18**

6-8 April, 1994

Venue: *University of Liverpool*Organised by *United Kingdom Geophysical Assembly*.

The programme includes Thematic and General sessions as well as a joint session with the Challenger Society (7 April). This relates to geophysical investigations of the ocean basins and their margins. This time, the Bullerwell Lecture will be given by M Lovell (Leicester) entitled *The art of borehole geophysics*.

The general sessions include: gravity and geodesy, geomagnetism and paleomagnetism, exploration and earthquake seismology, marine geophysics, geothermics, tectonophysics, planetary studies, mineral physics, geophysical fluid mechanics, applied geophysics, electrical and electromagnetism.

The thematic sessions include: Mantle convection, plumes and large igneous provinces (P Tackley, Caltech), High Resolution dating and stratigraphy (D Kent, Lamont), Technical challenges to petroleum geophysics for the next decade (D Bamford, BP and A Ziolkowski, Edinburgh), Subduction Zone Processes (D Gubbins, Leeds), Determining land contamination and ground water pollution (J Mather, Egham).

Registration details are available from:

UKGA, University of Liverpool, Department of Earth Sciences,

Brownlow St., Liverpool L69 3BX

Fax: (051) 794 5170, E-mail: ukga@liv.ac.uk

Instrumentation and Data Analysis**in Environmental Science**

11-22 April, 1994

Contact: *Dr Stephen Hicks, Dept. of Biological Sciences,*

University of Warwick, Coventry CV4 7AL

Tel: (0203) 523540 Fax: (0203) 523701

Buildings and the Environment

16-20 May, 1994

Venue: *Building Research Establishment, Garston, Watford*

Organised by *CIB Task Group 8 (Environmental Assessment of Buildings)*. Contact:

Andrew Cripps

c/o Building Research Establishment,

Garston, Watford, WD2 7JR

Global Forum '94

25 June-3 July, 1994

Global Forum '94 has the theme "Cities and Sustainable Development- Strategies for a Sustainable Future". The programme includes an academic conference examining the implementation of Agenda 21, adopted at the UNCED in Rio, June 1993. It will consist of a number of parallel workshops and specialist speaker sessions.

Further details are available from:

Global Forum Conference Organiser,

Dept. of Env. and Geog. Studies, Manchester Metropolitan University,

John Dalton Extension Building, Chester Street, Manchester M1 5GD

Tel: (061) 247 1583, Fax: (061) 236 7383

Exchange of trace gases between land and atmosphere

12-13 July, 1994

Discussion meeting organised by Professor D Fowler, D S Jenkinson, J L Monteith and M H Unsworth. Further details are available from:

The Royal Society,

6 Carlton House Terrace, London SW1Y 5AG

NATO Advanced Research Workshop:**Prospects for Carbon Sequestration in the Biosphere**

18-22 August, 1994

Contact: *Professor O W Heal, ITE-North,*

Edinburgh Research Station,

Penicuik, Midlothian EH26 0QB

Exhibitions:**Environmental Technology 94**

22-24 March, 1994

Venue: *Hall 9, NEC Birmingham* This years event promises to be even bigger and more

impressive than ET'93 (see issue 6 for a review). It will cover all aspects of the environment, including: Air Monitoring and Treatment, Noise and Vibration, Waste Treatment and Disposal, Waste Water and Effluent Treatment, Recycling, Land Remediation, and Environmental Consultancy and Services. In addition to this there will be an Energy Management Centre providing advice and technical solutions to energy efficiency, and a series of 40 informative and cost effective *Expert Briefings* covering a wide range of environmental topics.

For tickets to visit the exhibition and a seminar programme call:

Reed Exhibition Companies (UK) Ticket Hotline on 081-984-7733.

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Cranfield Institute of Technology

[†] Newsletter Editor: See contents page for full address.