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Editorial

As we approach the 21st century, we depend increasingly on advanced technologies and continuous economic progress in a world more aware of long term environmental implications of technological and industrial developments.

The past five years have been crucial to this change in attitudes and awareness levels. The Single European Act and its specific provisions on the environment, the "Brundtland Report" on sustainable development, the European Year of the Environment are evidence of the increasing importance given to environmental considerations at every level of society be it political, public or economic. The change which has taken place in the latter sector is perhaps the most significant. Industry, once held to be the major cause of environmental degradation, has come to realise in recent years that environmental protection need not be a profit reducing costly exercise; it could even be a source of economic growth, new markets, new jobs, as well as a more efficient use of resources and enormous savings in clean-up activities.

From 1993 onwards, both industry and consumers will have a greater possibility to choose more adapted technology or products as required. The Single European Act states that all actions relating to the achievement of the internal market shall take as a base a high level of environmental protection. Environmental standards will necessarily become stricter, and their respect will be not only legal obligations, but essential requirements for any industry which hopes to compete on the free market. Public opinion in the 1990s is fuelled by well-informed sophisticated pressure groups who know the facts and see through marketing strategies and cosmetic adjustments. Real action based on thorough research policies and effective technologies is needed from a commercial as well as environmental points of view.

Any action truly effective must take place in a context which supports its implementation. Awareness levels must be raised and maintained, information improved, new technologies applied, and existing structures and policies strengthened and adapted at every level integrating environmental considerations. Of particular interest is the imminent establishment of the European Environment Agency. This body will liaise closely with thematic and national information centres and research institutions to develop better response strategies, and coordinate, gather and transmit objective and harmonised information on the state of the environment.

Clearly, no single element of a long-term strategy of environmental protection and improvement can be effectively put into practice without the solid backing of research, science and technology. Research into the causes and long-term effects of environmental damage and preventive solutions is essential to respond realistically and effectively to the enormous and urgent problems which threaten our environment at a global level. The technological and scientific understanding of all issues involved is essential. The EC Joint Research Centre, and its Newsletter in particular, provide admirable examples of international cooperation and information exchange so vital in this respect. I congratulate all those who have been involved in bringing about the progress realised to date, and feel confident that the next five years, and beyond, will see yet major advances in this vitally important field.

Editor

Myriam Borlè-Talpaert, Ph.D.
Environment Institute
Joint Research Centre
I-21020 ISPRA (VA), ITALY

Tel. + 39 332 789 724
Telefax + 39 332 789 001
Telex 380 042 EUR I

L.J. Brinkhorst
Director-General DG XI
Environment, Nuclear Safety and Civil Protection

Programme News

EC R&D Programmes STEP and EPOCH - DG XII/E (1989-1992)

The Community R&D programmes for the years 1989-1992 include in particular one on **Science and Technology for Environmental Protection (STEP)** and another on **European Programme On Climatology and Natural Hazards (EPOCH)**.

Topics of interest to the STEP programme cover research on environment and human health, assessment of risks associated with chemicals, atmospheric processes and air quality, water quality, soil and ground-water protection, ecosystem research, protection and conservation of the European cultural heritage, technologies for environmental protection, major technological hazards and fire safety.

EPOCH includes research in past climates and climatic change, climate

processes and models, climatic impacts and climate related hazards as well as seismic hazards.

Cost-shared contract proposals received following official calls have either been selected or are being considered for acceptance. Details are given for each respective topic.

Further information can be obtained respectively for STEP and EPOCH from:

- H. Ott, DG XII/E1, Tel. +32 2 2351182/2350415
- R. Fantecchi, DG XII/E2, Tel. +32 2 2355735/2351686
CEC, 200 rue de la Loi, B-1049 Brussels.

EC R&D Programme MAST (1989-1992)

Information on the **MArine Science and Technology (MAST)** programme (1989-1992) was already given in Environmental Research Newsletter N° 4.

Selection of proposals for shared-cost contracts

Following the call for proposals published in OJ No C 75, 23.03.1989, 45 research projects involving approximately 230 participants were selected for funding.

In **basic and applied marine science**, the 22 selected projects concern physical oceanography and modelling of the European regional seas; ecosystem modelling; biogeochemical fluxes and cycles; air-sea interaction; marine biological processes and marine ecosystems, including coastal ecosystem studies.

In **coastal zone science and engineering**, 6 projects will be carried out on the following subjects: coastal morphodynamics, sediment transport and properties; waves and current; and coastal structures.

In **marine technology**, 17 projects cover a package of topics including most disciplines in underwater acoustics; some pilot projects in robotics; some work to improve and develop existing materials for use in the marine environment.

The largest project to be funded by MAST focuses on coastal morphodynamics and involves 15 participants from 9 coastal states. The overall aim of this project is to develop a well-validated modelling concept for morphological problems in coastal areas.

Most projects involve at least three partners from different EC countries and all will encourage the transfer of knowledge or technology. They cover a geographical area including the North Sea, the Channel, seas off the Iberian Peninsula and the Mediterranean.

Results of the first evaluation and selection of proposals for funding will be published in the coming months in a catalogue of MAST projects. It will include summaries of each project selected as well as names and addresses of participants.

In addition to funding R&D projects, MAST actively encourages cooperation and coordination of activities in marine science and technology under the Support Initiatives part of the programme. Initiatives include the development of a European ocean data exchange system, the exchange of information on research cruises, scholarships and training courses for young scientists, the preparation of standards, modelling coordination, and new approaches to surveying and mapping.

Survey of the European marine instrumentation industry

Studies are also undertaken to define future requirements in specific research areas, e.g. at present MAST is carrying out a survey of the European marine instrumentation industry which will lead to the publication of a buyer's directory and an inventory of existing instrumentation in use in European laboratories. This directory will be available in fall 1990 and will be distributed free of charge to all participants to the survey.

Specific programme on Marine Science and Technology under the Third R&D Framework Programme (1990-1994)

With the adoption of the new Framework Programme for Research and Technological Development by the Council of Ministers on 23 April 1990 (see also below), further funds have been allocated to research on Marine Science and Technology. Pending discussions in the European Parliament and Council on this programme, a call for proposals will be made in early 1991.

Further information can be obtained from:

- J. Boissonnas, DG XII/E, CEC, 200 rue de la Loi, B-1049 Brussels.
Tel. +32 2 2356787.

EC R&D Programme on Competitiveness of Agriculture and Management of Agricultural Resources - DG VI/F (1989-1993)

This Fourth Community R&D Programme was adopted by the Council on 26 February 1989 for a period of five years (**Council Decision 90/84/EEC**). It is part of the overall Community efforts on research and technological development covered by the second Framework programme. It is managed by DG VI (Agriculture) in close coordination with

the biotechnology (BRIDGE) and agro-industrial (ECLAIR and FLAIR) research programmes.

The objectives are:

- helping farmers to adapt to the new situation created by over-production and a restrictive policy on prices and markets;

- maintaining incomes from holdings and encouraging structural reform whilst controlling output and reducing production costs;
- caring for and improving the agricultural situation, in line with the market situation, in all regions which have been slow to develop and where agricultural structures are inadequate, thereby contributing towards greater economic and social cohesion in the Community;
- conserving natural resources and preserving the countryside by ensuring that the application of the technologies to be developed and of changes in production systems will improve the environment;
- developing agricultural information services and infrastructures to improve the dissemination of research results within and between Member States.

Research activities have been divided into four sectors:

1. Conversion, diversification, including extensification of production, cost reduction and protection of the rural environment

- Introduction of new and improved varieties of crops, out of season products, and by-products, especially to encourage higher added value;
- Alternative livestock systems to avoid surpluses involving in particular goats, sheep, suckler cows, horses and game;
- Examination of farm woodland production systems, integrated forest grazing systems, and the cultivation of a wider range of crops in woodland and forest undergrowth;
- Improved biological and integrated pest control, better utilisation and reduction in the use of fertilisers, fungicides, herbicides, pesticides in farming systems;
- development of alternative agricultural practices, especially of organic farming, aimed at conserving natural resources and the countryside;
- Support for the development of the common agricultural structures policy by providing the range of data necessary for its conception, evaluation and management;
- Identification of alternative uses for land which may no longer be required for agriculture, including the establishment, in environmentally sensitive areas, of systems of land and water use and management.

2. Product quality, new uses for traditional products, and aspects of plant and animal health

- Definition, measurement and determination of quality in products where market opportunities might exist especially where there are possibilities for higher added values;
- Pre- and post-harvesting techniques, including transport and storage, to improve quality;

- Effects of residues, toxins and other noxious substances occurring in agricultural products;
- Preparation for and packaging of agricultural products to ensure better quality and environmental safety;
- Detecting and controlling crop and animal diseases that threaten the Community and improving the welfare of farm animals;
- Developing alternative uses and improving the quality of traditional products.

3. Socio-economic aspects and specific actions for regions lagging behind in development

- Assessment of the structural, social and economic consequences of applying the agricultural policies of the Community in these regions;
- Investigation of constraints to development in these regions and orientation of subsequent research and development actions;
- Specific regional problems arising from the conversion, diversification and extensification of crop and animal production;
- Specific regional problems arising from the conversion into woodland and forest production;
- Specific regional actions to overcome the problems posed by the poor composition, excess and/or lack of water;
- Actions to improve agricultural mechanisation in specific regions;
- Integrated rural development.

4. Methods and services to disseminate agricultural research information particularly from this programme

- Integrated Community Agricultural Research Information Systems to improve access, to disseminate results to research and extension services and to respond to the needs of the common agricultural policy and the rural society;
- Developing agricultural information technology to avoid duplication, to improve the quality of agricultural research in the Community, and to increase its added value;
- Applying computers and information modelling to agricultural production systems to better identify the research and information needs of Community programmes.

A call for proposals was published in the Official Journal of the European Communities (OJ No C 269, 21.10.1989). The first selection will be from proposals received by 7 March 1990. The second selection will be on those received by the 11 October 1990 and the final selection will be after the 31 December 1991 when the call for proposals expires.

Further information can be obtained from:

DG VI/FII.3, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2358939. Telefax +32 2 2363029.

Framework Programme of Community Activities in the Field of Research and Technological Development (1990-1994)

Following the formal adoption by the Council (23 April 1990) of the third framework programme of Community research and technological development (1990-1994) (OJ No L 117, 08.05.1990), the Commission adopted on 25 April 1990 proposals for 13 specific programmes. Five concern **enabling technologies**: 1) information technologies, 2) communications technologies, 3) development of telematic systems in areas of general interest, 4) industrial and materials technologies, 5) measurement and testing. Seven deal with the **management of natural resources**: 6) environment, 7) marine sciences and technologies, 8) biotechnology, 9) agricultural and agro-industrial research, 10) biomedical and health research, 11) life sciences and technologies for developing countries, 12) non-nuclear energies. One is devoted to the **management of intellectual resources**: 13) human capital and mobility. These programme proposals will be submitted to the European Parliament and Council.

The content of specific programmes concerning the environment, as well as related aspects, is as follows:

Environment

The programme aims at improving scientific and technical knowledge in the field of environment, in particular the impact of human activities, as

well as establishing common quality, safety and technical standards. It is divided in four areas:

- **Participation in the Global Change Programme**: focuses on "greenhouse effect", ocean-biosphere-atmosphere interactions, deterioration of the ozone layer, biogeochemical cycles, dynamics of ecosystems, etc.
- **Technologies and engineering for the environment**: include the development of equipment for the analysis, control and monitoring of the environment (control of atmospheric pollution and water quality), as well as improvement of the technologies for the protection and rehabilitation of the environment (processing of toxic waste, protection and restoration of buildings and historic monuments, etc.).
- **Research on social and economic aspects of environmental issues**: concerns the incorporation of environmental parameters in economic methodology, cost/benefit analyses, development of environmental quality indicators, ethics of the environment, environmental impacts of tourism, etc.
- **Integrated research projects**: cover in particular those addressing vast transnational problems calling for an interdisciplinary approach, such as seismic and meteorological hazards, forest fires, technological hazards, problem of desertification in the Mediterranean regions, etc.

Marine Science and Technology

The programme aims at promoting the application of advanced technologies (remote sensing satellites, data processing systems, offshore intervention technologies, etc.) to the study, management and protection of coastal waters in Europe. It is divided in three areas:

- **Research on marine science:** includes various aspects of the functioning of marine systems such as circulation and dynamics of water masses, biogeochemical processes (i.e. quantification of carbon flows and understanding of the carbon cycle in coastal, continental and deep seas), geophysical role of sediments, behaviour of ecosystems, etc.
- **Research on coastal engineering:** focuses on currents, effects of waves, behaviour of sediments and impact of various factors on the stability of coastal structures so as to establish guidelines for coastal engineering in Europe.
- **Research on marine technology:** covers technologies for observation and intervention in the marine environment, such as automatic measurement systems, acoustic transmission, marine robotics, acoustic and optical imaging, etc.

Biotechnology

The programme aims at improving basic biological knowledge and developing technologies applied to agriculture, industry, medicine, nutrition, etc. taking into account industrial, ethical and social aspects. It is divided into three areas:

- **Approaches at molecular level:** include structural and functional studies of genes and proteins involved in the essential functions of living cells
- **Approaches at cellular and organised level:** focus on cell regeneration and development mechanisms, intercellular communication systems, *in vitro* toxicity tests of new molecules, etc.
- **Study on ecology and biology of populations:** includes the impact of biotechnology (genetically modified organisms) on the environment and the incidence of modern agricultural and stock breeding practices on the loss of genetic diversity.

Agricultural and agro-industrial research

The programme aims at improving the quality and variety of agricultural products and at raising the competitiveness of firms in the agricultural and agro-industrial sector while improving the management of the rural space and protecting the environment. It includes:

- **Primary production in agriculture, forestry, aquaculture and fisheries:** aims at developing the scientific and technical basis which underline the preparation of new food or non-food products, i.e.

value-added products, plants to be used for energy production, new cultivation techniques, etc.

- **Agricultural and forestry production factors:** includes development of more profitable production with due consideration for the environment, i.e. genetically improved plant species, integrated and biological pest control, control and monitoring systems, etc.
- **Processing of biological raw materials:** concerns the development of new separation, extraction and transformation processes as well as processing methods to improve the use of by-products and reduce waste, etc.
- **End use of products:** covers the improvement of knowledge and development of safer methods of manufactured product (food or non-food), including toxicological and quality control of food products, new processing technologies, development of biodegradable materials and chemical substances with a biological basis such as detergents, lubricants, etc.

Non-nuclear energies

The programme aims at developing new energy options both economically viable and respectful for the environment. It covers four areas:

- **Analyses and modelling:** to evaluate the technological strategies and the strategies for harnessing energy by improving the understanding of the mechanisms of interaction between energy, economy and environment.
- **Improved use of fossil fuels:** through the improved efficiency of methods for the production of energy (combined-cycle production methods, appropriate substitutes for conventional fuels in the transport sector). This area also includes the development of better tools for the study of the CO₂ cycle (responsible for the "greenhouse effect") and of methods to reduce emissions of this gas and/or of techniques for separating and fixing it.
- **Renewable energy sources:** include the development and integration of photovoltaic solar cells and modules, wind turbines, techniques for exploiting tidal and wave energy as well as processes for the production of energy and electricity from biomass residues and cultivated plants, etc.
- **Rational use of energy and energy saving:** focuses on the development of fuel cells allowing 30% to 40% energy savings, high temperature heat pumps, economic heating and air-conditioning methods for buildings, new insulating materials, etc.

Further information can be obtained from:

- M. André, Tel. +32 2 2360781 (languages: F, ES, PO, IT)
- E. Bock, Tel. +32 2 2354132 (languages: DE, EN, DA, N)
- P. Wragg, Tel. +32 2 2360126 (languages: EN, F, GR)
DG XII, CEC, 200 rue de la Loi, B-1049 Brussels.

Air

EC Research Programme and Support Activities to the Commission

Detailed information on activities managed by DG XII/E in the framework of the 4th Environmental R&D Programme (1986-1990) and by DG XII/JRC Ispra was given in Environmental Research Newsletter N° 2, September 1988. These activities are still going on and consider "tropospheric chemistry including analysis, sources, transport and deposition of pollutants (1), stratospheric chemistry and ozone depletion (2). They are implemented by shared-cost, concerted and direct actions. Besides its research contribution, the JRC Ispra carries out support

activities related to the implementation of regulatory actions (DG XI) within the Central Laboratory for Air Pollution and the EMEP Station in Ispra (3). Results are expected to contribute a basis for future research activities on "Global Change".

Recent results are presented below together with information on the new STEP Programme. Activities related to "Air Pollution Effects on Terrestrial and Aquatic Ecosystems" will be referred to in the next issue of Environmental Research Newsletter.

1. Tropospheric Chemistry - Analysis, sources, transport, transformation and deposition of pollutants

Research managed by DG XII/E aims at elucidating important physico-chemical processes in the troposphere to eventually contribute to the design of strategies for the reduction of emissions in the atmosphere and provide data necessary for the assessment of air pollution effects on health and ecosystems. It is implemented by shared-cost contracts (1.1.) and by the Concerted Action "Physico-Chemical Behaviour of Atmospheric Pollutants" COST Project 611 (1.2.). Research at the JRC Ispra contributes the concerted action with studies on chemical transformations and transport phenomena (1.3.).

1.1. Shared-cost contracts

The shared-cost contracts managed by DG XII/E, in the framework of the **Fourth R&D Programme of the CEC on Environmental Protection (1986-1990)**, in the Air Quality area deal with atmospheric processes and measurements. Most of them started in early 1988 for a three year-period. Ten of them have been listed in Environmental Research Newsletter N° 2 together with the participating institutes. More recent ones are:

Formation and conversion of hydrogen peroxide and organic peroxides in forests

The objective is to clarify the mechanisms of formation and transformation of peroxides in relation to their possible damage to needles and leaves of trees.

Participating institute:

- Institut für Spektrochemie, Dortmund, FRG (D. Klockow).

Ionization and dissociation studies of molecules in liquid and high density media

The objective is to investigate the mechanisms of photoionization and fragmentation of polycyclic aromatic and natural hydrocarbons of environmental significance mainly responsible for the production of free radicals.

Participating institute:

- Technical University of Crete, Greece (K. Siomos).

In the framework of the research area "Atmospheric Processes and Air Quality" of the **STEP Programme (1989-1992)** six projects on tropospheric chemistry were selected from the proposals received in response to the Preliminary Call published in O.J. C 162, 29 June 1989. These projects cover (i) analysis of pollutants, (ii) laboratory research to investigate kinetics and mechanisms of chemical transformations of trace species and (iii) field measurements aimed at quantifying transport and deposition of pollutants. They are complementary to the programme of the EUREKA project EUROTRAC. These projects were initiated on 1.2.1990.

Atmospheric degradation of volatile organic compounds: peroxy radical reactions

The objective is to improve knowledge on peroxy radicals chemistry important in the degradation of volatile organic compounds.

Participating institutes:

- Max Planck Institut für Chemie, Mainz, FRG (G.K. Moortgat);
- United Kingdom Atomic Energy Authority, Harwell, UK (G. Hayman);
- Université de Bordeaux, France (P. Lightfoot);
- Bergische Universität Wuppertal, FRG (K.H. Becker);
- Universität Hannover, FRG (R. Zellner).

Kinetics and mechanisms for the reactions of halogenated organic compounds in the troposphere

The objective is to provide rates and mechanisms for the oxidation of halogenated compounds other than CFCs in the troposphere to estimate chlorine and bromine fluxes into the stratosphere.

Participating institutes:

- University College Dublin, Ireland (H.W. Sidebottom);
- University of Oxford, UK (R.P. Wayne);
- Risø National Laboratory, Roskilde, Denmark (O.J. Nielsen);
- Centre National de la Recherche Scientifique, Orléans, France (G. Le Bras);
- Max Planck Institut für Chemie, Mainz, FRG (G.K. Moortgat);
- Bergische Universität Wuppertal, FRG (K.H. Becker);

- Université de Bordeaux, France (R. Lesclaux);
- United Kingdom Atomic Energy Authority, Harwell, UK (G. Hayman);
- Universität Hannover, FRG (R. Zellner).
- The JRC Ispra's activity (J. Hjorth) is scientifically coordinated within this project.

Reactions of OH radicals with aromatics and formation and fate of the adducts and other intermediates in the presence of NOx and O₃

The objective is to study the atmospheric oxidation mechanisms of selected organic compounds to better understand ozone formation.

Participating institutes:

- Fraunhofer Institut, Hannover, FRG (C. Zetzsch);
- Risø National Laboratory, Roskilde, Denmark (P. Pagsberg);
- Université de Lille, France (P. Devolder);
- University of Patras, Greece (S. Glavas).

Laboratory studies of the aqueous chemistry of free radicals, transition metals and formation of acidity in clouds

The objective is to improve knowledge on the key reactions controlling the aqueous chemistry of clouds and fogs.

Participating institutes:

- Max Planck Institut für Chemie, Mainz, FRG (P. Warneck);
- Ecole Européenne des Hautes Etudes des Industries Chimiques, Strasbourg, France (J. Lagrange);
- Universität Witten/Herdecke, FRG (R. Van Eldik);
- National Power Technology and Environmental Center, Leatherhead, UK (W.J. Mc Elroy);
- University of Lund, Sweden (L.J. Elding);
- University of Leeds, UK (G.A. Salmon).

Regional cycles of air pollutants in the West Central Mediterranean Area

The objective is to determine the long range transport and regional deposition mechanisms for the pollutants emitted in the Mediterranean area.

Participating institutes:

- Centro de Investigaciones Energeticas Medioambientales y Tecnologicas, Madrid, Spain (M. Millan);
- Consiglio Nazionale delle Ricerche, Rome, Italy (I. Allegrini);
- Commissariat à l'Energie Atomique, Saclay, France (J. Carbonnelle);
- Instituto Nacional de Meteorologia y Geofisica, Lisbon, Portugal (R.A.C. Carvalho).

The fate of N compounds around the North Sea

The objective is to better understand the fate of N compounds in the North Sea region and their impact on tropospheric chemistry.

Participating institutes:

- Netherlands Organisation for Applied Scientific Research, TNO, Delft, The Netherlands (R. Guicherit);
- National Power Technology and Environmental Centre, Leatherhead, UK (P. Lightman);
- N.V. KEMA, Arnhem, The Netherlands (F.G. Römer);
- United Kingdom Atomic Energy Authority, Harwell, UK (G.J. Dollard);
- Institute of terrestrial Ecology, Midlothian, UK (D. Fowler).

Following the call for proposals published in OJ C 248, 29 September 1989, 6 projects were selected. These relate to the improvement of analytical methods, laboratory investigation of important reactions as well as major field experiments in the Mediterranean and the North Sea. A selection parameter was complementarity to the EUREKA project EUROTRAC.

Further information and reports can be obtained from:

G. Angeletti, DG XII/E1, CEC, 200 rue de la Loi, B-1049 Brussels.
Tel. +32 2 2358432.

1.2. Concerted Action "Physico-Chemical Behaviour of Atmospheric Pollutants" (COST Project 611).

As already mentioned in Environmental Research Newsletter N° 2, September 1988, a restructuration occurred through the regrouping of

some Working Parties (WP). A Task Group on Stratospheric Ozone was established with as aim the design and implementation of a coordinated European research programme on stratospheric ozone. This programme is based on national research ones promoted by the EC and EFTA (European Free Trade Area) States.

Appropriate links with EUROTRAC will foster scientific rather than organizational work.

One symposium and several workshops were organized in the framework of the various Working Parties.

Fifth European Symposium on "Physico-Chemical Behaviour of Atmospheric Pollutants".

Varese, Italy, 25-28 September 1989.

The symposium was organized by the CEC within the framework of the Concerted Action "Physico-Chemical Behaviour of Atmospheric Pollutants".

The aim of the symposium was to review the current studies and technical progress achieved in the various sectors of the Concerted Action since the fourth symposium held in Stresa (Italy) in September 1986. Special attention was placed on components and processes contributing to acid deposition, photochemical pollution and stratospheric ozone depletion. The scientific programme was planned in accordance with the new structure of the Working Parties and included the discussion meetings of the EUROTRAC projects HALIPP and LACTOZ, jointly coordinated by COST 611 and by EUROTRAC.

Significant contributions in the main areas of atmospheric chemistry were presented. These are a result of an intensified effort in the field of atmospheric chemistry research in many European countries and within the CEC. This effort should gain further momentum as the STEP programme develops.

The emphasis over the years has shifted from the study of local pollution problems in Europe to regional and global aspects of air chemistry, and how the activities of man perturb the chemical cycles between the earth and the atmosphere.

Major part of the scientific programme of the COST 611 meeting has been devoted to reporting joint projects which cross over institutional and national barriers.

Results from joint projects in the following topics were reported: (i) instrument intercomparison under controlled conditions to improve the comparability of measurements and to establish primary standards; (ii) the role of the marine atmosphere in the determination of the composition of air coming into Europe from the Atlantic including field and laboratory studies; (iii) composition of the remote marine atmosphere as measured in the Polarstern cruise one year ago; (iv) heterogeneous chemistry (HALIPP project); (v) chemical processes related to tropospheric ozone with special emphasis on dark reactions (LACTOZ project); (vi) fog composition experiment; and (vii) instrumentation for dry deposition measurements.

Stratospheric work has been reported with papers on possible chemical processes underlying the release of atomic chlorine in the Antarctic stratosphere, and on reactions involving the ClO radical.

The highlights of the scientific matter presented at the Symposium are summarized below for each working party.

Proceedings entitled *Physico-Chemical Behaviour of Atmospheric Pollutants*, ed. G. Restelli and G. Angeletti, were published by Kluwer Academic Publishers, P.O. Box 17, 3300 AA Dordrecht, The Netherlands (Air Pollution Research Report N° 23), EUR 12542, ISBN 0-7923-0700-3.

Working Party 1: Development of analytical methods to measure trace components of the atmosphere (WP1)

This Working Party incorporates the activities of the previous WPs 1 and 3. Its objective is the development of analytical methods, instrumentation and practises, including harmonization of measurement methods to provide consistent experimental data for environmental parameters. In the medium and short term it should be focussed on particularly important aspects of the general problems of providing adequate sampling and analytical methods for atmospheric trace species. In the long term this will lead to improved experimental observations of an extended list of trace gases. New devices and technologies will become available to the scientific community.

Field Intercomparison Exercise on Nitric Acid and Nitrate Measurement, Methods and Data.

Rome, Italy, 18-24 September 1988.

This exercise was jointly organised by the CEC in the framework of WP1

of COST 611 and by the Istituto sull'Inquinamento Atmosferico of the Italian National Research Council. Sixteen groups, from eleven European countries, participated to the intercomparison exercise.

The main objective of the study carried out in the Area della Ricerca di Roma was the evaluation, under field conditions, of the methods at present available for the measurement of nitric acid and particulate nitrate. All measurement methods fell into one of three categories: teflon-nylon filter packs, impregnated filters and denuder techniques.

The intercomparison gave a very interesting set of data (meteorological parameters, ancillary measurements, self-consistency, and nitric acid permeation source test) which may allow the participants to evaluate the performance of each method, even without making any correlation with the results of other groups.

A critical evaluation of the data as well as further interpretation have been presented at the 5th European Symposium on Physico-Chemical Behaviour of Atmospheric Pollutants, Varese, Italy, 25-28 September 1989.

Proceedings edited by I. Allegrini, A. Febo and C. Perrino were published by the CEC as Air Pollution Research Report N° 22, ISBN 2-87263-016-3, 1989.

Symposium on Monitoring of Gaseous Pollutants by Tunable Diode Lasers.

Freiburg, FRG, 17-18 October 1988.

The second international symposium on monitoring of gaseous pollutants by tunable diode lasers was organized by the Fraunhofer Institut für Physikalische Messtechnik, Freiburg, in collaboration with the COST 611 WP 1. The meeting was attended by 90 scientists from 13 countries, contributing 29 papers covering the following subjects: atmospheric trace gas and exhaust gas analysis, diode laser development, components and techniques, special applications. As in the first symposium, an alternative technique, in this case photoacoustic detection, was reviewed at the meeting.

Of special interest was the session devoted to lead chalcogenide diode laser development which presented results and perspectives from three laboratories most active in the field in the FRG, Japan and the United States. Papers presented indicated the validation by functional tests of the performance of TDL instrumentation already anticipated at the first symposium: long open path monitoring, car exhaust analysis. On the other hand, the existence of problems still limiting the implementation of promising new techniques was underlined, as for example the case of frequency modulation spectroscopy for high sensitivity atmospheric trace gas detection.

The overall impression was that the application of tunable diode laser spectroscopy to trace gas measurement has technically reached a high standard, but that a number of improvements both on components and techniques are still needed and can be expected within reasonable future.

Proceedings edited by R. Grisar, G. Schmidtke, M. Tacke and G. Restelli were published by Kluwer Academic Publishers, P.O. Box 17, 3300 AA Dordrecht, The Netherlands, as Air Pollution Research report N° 18, EUR 11956, 1989, ISBN 0-7923-0334-2.

Varese Symposium. September 1989.

Fourteen oral presentations and ten posters were presented and the work covered the most important parts of tropospheric chemistry.

Many types of diffusion denuders have been developed and applied. The unique ability of denuders to modulate the sampling efficiency of different compounds, has been applied to an interesting series of automatic instruments characterized by a rather short response time. The diffusive properties of trace compounds have also been employed for screening and measurement of species relevant to acid deposition. Work on denuders and diffusion samplers should continue to identify and correct for interferences which might impair the measurement in particular at low concentrations in remote locations.

Diffusion properties have also been applied to characterize airborne particulate matter, resulting in an aerosol size spectrometer able to cover the most important size region for atmospheric pollution studies.

Laboratory and field studies have been carried out to characterize interstitial air and trace compounds in the liquid phase; much remains to be done in the analysis of peroxides and organic compounds. Even for the measurement of liquid water content, there is no agreement among presently used techniques. The sampling step is probably the determining factor for the analysis of clouds and fogs, and it is strongly recommended to develop and test in the field dedicated impactors with well characterized penetration efficiencies.

Improvement of the quality of observations has been addressed in many papers. Many components important for acid deposition and related processes, are present only at very low concentrations in the atmosphere, and precise and accurate analytical techniques are required. Inter-comparability of the data requires that proper field inter-comparisons and quality assurance/quality control protocols are performed and elaborated.

In this context results from the intercomparison on nitric acid in gas phase and nitrates in particulate matter carried out in Rome in September 1988, have been reported and discussed. It has been shown for the intercomparison carried out in Rome that when species and potential interferents are measured simultaneously in a very intense way the exercises might easily turn into a field experiment which, at least in principle, give rise to significant advancements in the understanding of chemical processes in the atmosphere. New exercises have been devised for the near future as a significant part of the COST 611 action. Ammonia and volatile organics (VOC) are the species for which top priority has been established.

A substantial number of papers reported measurements on trace components of environmental significance such as those related to halogenated organic compounds in marine environments. Since oceans and seas appear to be important sources of several species of interest for tropospheric chemistry, activities related to the analysis of naturally emitted compounds should be continued and encouraged.

Instrument development was reported in a series of papers. The need for a better scientific understanding of complex instruments prior to their use in the field was underlined.

Papers related to Working Parties 1 and 3 presented during the symposium show a major need for airborne instrumentation. Such instruments can answer questions related to the regional budget of atmospheric pollutants including their deposition and chemical evolution.

Proceedings are available (see above).

Field Intercomparison Exercise on Ammonia in Gas Phase and Ammonium Ion in Particulate Matter.

Rome, Italy, 30 April- 4 May 1990.

This exercise was jointly organised by the CEC in the framework of WP1 of COST 611 and by the Istituto sull'Inquinamento Atmosferico of the Italian National Research Council. Twenty three groups, from twelve European countries, participated to the intercomparison exercise.

The main objective of the study carried out in the Area della Ricerca di Roma was the intercomparison of sampling methods for ammonia and ammonium.

Proceedings are pending.

Working Party 2: Atmospheric Chemical and Photochemical Processes

This WP deals mostly with laboratory projects and aim at understanding the chemical transformations, in the gas and in the condensed phase, of atmospheric trace gases. Field studies focussed towards the understanding of a specific chemical transformation process are included. This WP incorporates the two EUREKA-EUROTRAC sub-projects LACTOZ (Laboratory Studies of Chemistry related to Tropospheric Ozone) and HALIPP (Heterogeneous and Liquid Phase Processes) and the project OCEANOX (Study of the Influence of Atlantic Air Masses on Oxidation Processes over Western Europe).

Meeting on Mechanisms of Gas Phase and Liquid Phase Chemical Transformations in Tropospheric Chemistry.

Norwich, UK, 20-22 September 1988.

This joint COST-EUROTRAC meeting was held at the School of Chemical Sciences, University of East Anglia, Norwich.

Papers reported on the two EUROTRAC sub-projects LACTOZ and HALIPP as well as the CEC programme OCEANOX.

The meeting was attended by 67 participants which presented 30 research papers concerning exclusively laboratory studies of rate constants, reaction mechanisms and photochemistry required for solution of some of the high priority problems of pollutant behaviour in the atmosphere.

The first part of the meeting was devoted to discussion of results on gas-phase chemistry and the second concentrated on newly emerging detailed studies of liquid phase processes and heterogeneous catalysis.

Papers presented reported results of NO₃ chemistry determination of rate and absorption coefficients, sulphur and halogen kinetics, high

precision photoabsorption cross-section for ozone in UV region and for peroxyxynitric acid as well as photodissociation of acetone. Other reports concerned the kinetics and mechanism of oxidation of volatile organic compounds.

The emerging picture seems to point to an important temporary sink for NO_y in the form of various organic nitrates. Progress has also been made in determining the activity of organic nitrates and peroxyxynitrates towards the OH radical.

The heterogeneous and liquid phase studies considered surface and phase change phenomena and liquid phase chemical reaction kinetics and mechanisms. Data collected will be used for detailed models of wet deposition of acidic substances. The liquid phase chemistry studies showed that the atmospheric chemistry was at least as complex as the gas phase. Some quantitative data on rate constants obtained by sophisticated and unequivocal direct spectroscopic methods has been reported.

Reports of measurements of absorption cross-sections and spectra for key temporary reservoir species for stratospheric halogen were given as well as kinetics measurements of a novel reaction between ClO and CH₃O₂.

Proceedings edited by R.A. Cox were published by the CEC as Air Pollution Research Report N° 17, EUR 12035 EN, ISBN 2-87263-009-0, 1988.

Informal Workshop on NO₃ + Alkenes Reactions.

Brussels, Belgium, 28 November 1988.

This workshop organized by the JRC Ispra was attended by scientists from six laboratories in the FRG, Norway, Sweden, UK and the JRC-Ispra investigating the tropospheric chemistry related to reactions of the NO₃ radical. Discussions focused on experimental difficulties, results of studies in progress, future work and collaboration. Special attention was given to the kinetics, mechanisms and products evaluation of the night-time tropospheric reaction between the nitrate radical NO₃ and unsaturated hydrocarbons.

Varese Symposium.

September 1989.

The scientific work related to Working Party 2 was presented at the symposium in three separate sessions. The first two sessions were devoted to reports of work in the two EUROTRAC subprojects, HALIPP and LACTOZ, which are currently coordinated within the framework of COST 611. The third session covered other activities within the Working Party including the CEC programme OCEANO-NO_x, concerned with atmospheric chemistry in the coastal boundary layer together with laboratory studies on stratospheric chemistry.

Seventeen papers were presented in the two EUROTRAC sessions. Eight papers given in the third session included three devoted to stratospheric ozone. In addition 13 poster presentations were displayed.

HALIPP Workshop

The heterogeneous and liquid phase studies fall into two areas: a) surface and phase change phenomena and b) liquid phase chemical reaction kinetics and mechanism.

The presentations at the symposium relating to the first area included laboratory experimental evidence for increased radical production in a smog chamber in the presence of aerosols. Other studies demonstrated a photochemical oxidation process of aromatics on solid aerosols.

Progress has been made in providing data for a realistic picture of the detailed cloudwater processes leading to scavenging and oxidation of sulphur dioxide and nitrogen compounds.

New measurements of the trace gas exchange kinetics at the air/water interface provided values for the mass accommodation coefficients of nitrogen compounds.

The kinetics and mechanism of the aqueous phase oxidation of bisulphite ions, HSO₃⁻ has been investigated by the elementary reaction approach. Both the uncatalysed and Fe²⁺ catalysed systems have been studied. The rate coefficients for the sequential oxidation reactions of the radical ions SO₃⁻, SO₄⁻ and SO₅⁻ have been determined by kinetic spectroscopy and various mechanistic approaches have been made.

The main conclusion from this work is that the rates of liquid phase oxidation reactions are likely to cover a wide range due to the critical dependence of the rate on oxidising agents such as H₂O₂ or catalysts such as Fe²⁺, the atmospheric abundance of which is very variable. There are particular problems remaining in the rate and mechanism of the H₂O₂ mediated reaction and concerning the Fe²⁺ oxidation. It has been shown

that current cloud chemistry models are based on an incorrect mechanism which overpredicts the rate of Fe(II) oxidation. In addition, quantum yield measurements on Fe(II)-hydroxy complexes show that photolysis in clouds probably contributes significantly to OH production in the aqueous phase.

LACTOZ Workshop

The primary aim of the EUROTRAC sub-project LACTOZ is to provide the necessary chemical and photochemical data for a proper description of the formation of tropospheric ozone. This involves the chemistry which controls the degradation of volatile organics and the life cycles of nitrogen oxides in the troposphere. Laboratory results on a number of different aspects of this problem were presented at the symposium.

One of the most important species in the nitrogen oxides chemistry is peroxyacetyl nitrate (PAN) and new information on both the formation and loss of this compound was presented.

Other reactions involving nitrogen-containing molecules have also been investigated and results were reported which enable the lifetimes of the organic nitrates and the scavenging of organics by reaction with NO₃ to be quantitatively described. An interesting mechanistic outcome of these studies is that the conversion of NO_x to HNO₃ via the H-abstraction reaction of NO₃ with organics is rather slow. The more rapid reactions of NO₃ with unsaturated molecules, e.g. olefins, gives rise to formation of organic nitrates, which are removed rather slowly from the atmosphere. Data was also presented on the reaction of NO₃ with other radicals, which has more interest for stratospheric chemistry (see below). Good progress has also been reported in the understanding of peroxy radical chemistry.

Kinetic data have also been reported for the more complex peroxy radicals formed in the atmospheric oxidation of volatile organics. The data base necessary to establish the effect of different organic structures on the reactivity of peroxy radicals is starting to be consolidated.

Mechanistic and kinetic information on the formation and reaction of the adduct formed in the reaction of OH with benzene and toluene was reported. Both studies show that a very fast reaction occurs between the adduct and NO₂, but the rate of reaction of the adduct with O₂ is slow and the NO₂ reaction (which presumably forms nitroarenes) may compete under atmospheric conditions. However, it is clear that other pathways exist in the oxidation mechanism of the simple aromatics, since a range of oxygenated products are found under pseudo atmospheric conditions. Sorting out these mechanisms continues to present a major challenge to laboratory chemists. Finally a comprehensive set of rate data for the reaction between ozone and simple alkenes was presented.

Kinetic studies related to the Marine Boundary Layer Chemistry OCEANO NO_x PROJECT

Several papers were presented concerning the chemistry of iodine and sulphur compounds relevant to the marine boundary layer. Data for the reaction of NO₃ and IO radicals with dimethyl sulphide (DMS) and other sulphur compounds were presented. The data for kinetics of the reactions of I and IO with NO_x and HO_x species is now starting to consolidate and it should be possible to describe the iodine radical chemistry in the marine boundary layer with much greater certainty by the end of this project.

Tropospheric halogen chemistry

There is a renewed interest in the tropospheric chemistry of halogenated organic compounds at the present time, in view of the foreseen introduction of replacement compounds for the fully halogenated CFCs. The potential replacements contain H atoms as well as fluorine and chlorine (in some cases) in the molecule. These molecules undergo attack by OH in the troposphere which result in a reduced atmospheric lifetime and consequently a lower potential for depletion of stratospheric ozone than the fully halogenated CFCs. In addition to the need to establish the rate constants for reaction with OH for these compounds, there is a requirement to establish the degradation mechanisms and products, so that the full environmental impact of these molecules can be assessed.

Papers were presented at the symposium on the atmospheric behaviour of the chloroacetaldehydes, which are model compounds for the expected products of the hydrochlorofluorocarbon degradation. Very little information has been available on this topic and interesting and novel data were reported.

Stratospheric Chemistry

Chemistry relating to stratospheric ozone is included under the new terms of reference of COST 611 Working Party 2. There is a particular interest at the present time in the chemistry related to polar ozone depletion in the lower stratosphere.

At the conference, papers were presented on some of the latest experimental data pertaining to the BrO + ClO reaction and the formation and loss of the chlorine oxide dimer, Cl₂O₂. These allow ozone depletion by these catalytic cycles to be modelled and a comparison to be made with observed ozone depletion in the polar springtime (the "Antarctic Ozone Hole").

Proceedings are available (see above).

Working Party 3: Field Measurements and their Interpretation

WP 3 incorporates previous WPs 4 and 5. It is concerned with field measurements, and their interpretation, of trace gases and aerosols in the atmosphere (troposphere and stratosphere). Emphasis is placed on gases involved in acid deposition and ozone formation and destruction.

The priority research projects mainly concerned with field measurements and modelling activities are: (i) European joint project on the budget of photooxidants and related species over the North Sea region; (ii) Source-receptor relationship of NO_x in Europe; (iii) Natural emissions of VOC in Europe; (iv) Regional cycles of air pollutants in the Mediterranean area; and (v) Historical records of atmospheric trace substances.

Workshop on Field Measurements and their Interpretation.

Villefranche sur Mer, France, 3-4 May 1988.

The workshop included three sessions devoted respectively to: (i) atmospheric cycles of NO_x and related compounds; (ii) field experiments in coastal and marine environment; and (iii) other topics of general interest such as emissions, transport and deposition of air pollutants.

In the first session, most papers were concerned with investigations of dry and wet removal of NO_x, HNO₃, PAN, nitrates, NH₃ and NH₄⁺ derived from emissions of NO_x and NH₃ on the European continent. In the second session, papers mainly dealt with investigations on air pollutants in marine areas in the western Mediterranean region, i.e. Northern Spain, Southern France and Corsica, Southern Italy, Malta. A major goal was to evaluate the deposition fluxes of trace metals and other air pollutants (nutrients, organics) and to integrate them over the marine region using experimental data from various coastal sampling stations and research vessels along with deposition velocities for particles and gases reported in the literature. Most papers in the third session were concerned with measurements of photochemical oxidants like O₃, PAN and H₂O₂ followed by investigations of the interaction of trace gases and aerosols with cloud, fog and rain droplets.

Proceedings edited by S. Beilke, J. Morelli and G. Angeletti were published by the CEC as Air Pollution Research Report N° 14, EUR 11690 EN, ISBN 2-87263-001-5, 1988.

Varese Symposium.

September 1989.

Forty six papers were presented in the sessions devoted to the activities coordinated in the WP3.

A comparative analysis of the scientific matter discussed at this symposium with that presented in the previous one clearly shows the shift of interest from the problems of acid deposition to that of photochemical oxidant formation.

There is a growing evidence of an increase in tropospheric ozone over the last decades. In addition, episodes with elevated ozone concentrations have been observed. Models to interpret these episodes have been developed, but they still require more data for their validation. This explains why most of the 63 projects assigned up to now to the WP3 are concerned either directly or indirectly with the problem of photooxidants in the lower troposphere. A situation which appears also for the priority projects in STEP.

Twelve papers discussed field measurements and interpretation of observations concerning ozone, precursors and photooxidants like PAN, H₂O₂ or indicators like CH₂O. Pertinent to this research project are also the 15 papers concerning atmospheric observations performed during the 1988 Polarstern cruise ANT VIII/I aiming at gathering information on the sources, sinks and transformation processes in marine air.

In spite of the large planet's area covered by oceans, little is known about the contribution to the global atmospheric chemistry of the oceanic environment, e.g. it is not clear whether the remote marine troposphere is a net source or sink of ozone. The papers have been grouped in a special session to stress the character of a major international cooperative project in the field.

As far as acid deposition is concerned, the most important research needs have moved from SO₂ to the other gases involved (NO_x, NH₃,...).

Some emphasis appeared to be given to air pollution problems in the Southern Mediterranean countries accounting also for the difference in meteorology as compared to North and Central Europe.

Finally important observations were presented on the interaction of pollutants with the atmospheric dispersed liquid phase (fog, dew,...). This reflects the increasing importance attributed to heterogeneous physical and chemical transformations in the interpretation of phenomena concerning the atmospheric chemistry, both on the local (fog, rain) and on the global (clouds) scale. Studies of dry deposition on special surfaces, from the sea to prairie grasslands completed the review of the WP3 activities.

Proceedings are available (see above).

Workshop on Field Measurements and Interpretation of species derived from NO_x, NH₃ and VOC emissions in Europe.

Madrid, Spain, 12-14 March 1990.

This workshop was organised jointly by the CEC and the CIEMAT Research Centre (Spanish Ministry of Industry) in Madrid. It covered field and modelling activities aiming at investigating the physico-chemical behaviour of NO_x, NH₃ and VOC and their reaction products HNO₃, NH₄⁺, nitrates NO₃, N₂O₅, HNO₂, O₃, PAN, radicals etc. In particular, the following items were considered: (i) natural and anthropogenic sources of NO_x, NH₃ and VOC, (ii) vertical and horizontal concentration profiles of NO_x, NH₃, VOC and derived species, (iii) transport (fluxes) and conversion of these compounds, (iv) dry and wet deposition.

Proceedings are pending.

Further information can be obtained from:

G. Angeletti, DG XII/E1, CEC, 200 rue de la Loi, B-1049 Brussels.
Tel. +32 2 2358432.

1.3. Air Quality Research at the Environment Institute of the JRC Ispra

1.3.1. Kinetics and mechanisms of gas phase reactions of nitrogen containing pollutants

Kinetics and mechanisms of tropospheric reactions have been investigated in the laboratory (see Environmental Research Newsletter N° 2) focusing on the role of the NO₃ radical (night-time atmospheric chemistry). Priorities were given to the reactions involving products of biochemical origin (in cooperation with the Chemistry Dep. of the Univ. of Odense, DK) and to reactions controlling the NO₃ concentration in ambient air (NO_y interconversion).

Reaction between NO₃ and alkenes

Products and mechanisms of the reactions between the NO₃ radical and a series of alkenes (propene, isobutene, cis- and trans-2-butene, 2-methyl-2-butene, 2,3-dimethyl-2-butene) were investigated to understand the degradation of terpene and isoprene in air. The product distribution of carbonyl and nitrate species was found to be dependent on the alkyl substitution at the double bond.

The ratio between simple carbonyl compounds and organic nitrates was found to be independent of the NO₂ concentration; it follows that this ratio, as determined in laboratory studies, can be considered representative also of ambient tropospheric conditions.

Evidence was also found for a fast reaction between NO₃ and peroxy-radicals; it should be considered in modeling atmospheric chemistry.

Extension of these studies to the products and mechanism analysis of the reaction between NO₃ and dialkenes, butadiene and isoprene is in progress.

Reaction between NO₃ and dimethylsulphide

DMS is emitted in large quantities from oceans (algae) and is estimated to account for 25% of the total, natural and anthropogenic emitted sulphur. DMS is expected to be oxidized to SO₂, to methanesulphonic acid and to sulphuric acid; these last acids characterized by important aerosol forming properties in the atmosphere. The reaction with NO₃ is expected to contribute to the oxidation of DMS to an extent comparable to the reaction with OH.

A mechanism for the reaction DMS-NO₃, based on the identification of intermediates and end products has been proposed. Evidence has been obtained for H-atom abstraction as the first step of the reaction; but the formation of an intermediate adduct which then decomposes with release of HNO₃ cannot be definitively excluded.

Work is in progress to clarify the details of the reaction mechanism

leading to methanesulphonic acid, and to analyse the reaction of NO₃ radicals with other organosulphur compounds (CH₃SSCH₃, CH₃SH etc.).

Reaction between NO₃ and aromatic hydrocarbons

Products and mechanisms of the reaction between NO₃ radicals and aromatic hydrocarbons in air have been investigated in a study performed in collaboration with the University of Milano (Chemistry Department). This study conducted in parallel in the gas and in the liquid phase is in progress.

Reaction between NO₃ and halogenated unsaturated hydrocarbons

Studies have been undertaken in cooperation with the University of Oslo.

Reaction between NO₃ and NO₂

The chemical scheme controlling the concentration of NO₃ in air was studied. The equilibrium constant of the reaction between NO₃ and NO₂ forming N₂O₅ and the rate constant of the alternative pathway leading to formation of NO, NO₂ and O₂ were determined.

These activities are scientifically coordinated in the frame of the EURO-TRAC sub-project LACTOZ and of the COST 611 WP2.

Further information can be obtained from:

- G. Restelli, tel. +39 332 789225,
- J. Hjorth, tel. +39 332 789076,
Environment Institute, CEC-JRC Ispra, I-21020 Ispra.

1.3.2. Analytical spectroscopic techniques

The evaluation of spectral parameters required for application of spectroscopic analytical techniques has proceeded with the focus on line or band intensities and on broadening coefficients. Evaluation has used Fourier transform (FT) and/or tunable diode laser (TDL) infrared spectroscopy.

CH₃Cl

CH₃Cl is the most important halogen containing atmospheric trace gas of natural origin (oceans, fungi, biomass burning). It contributes through its absorption in the infrared part of the spectrum to the earth's radiative balance and to the chemistry of the stratosphere.

Analysis of the line/band intensities of the CH₃³⁵Cl parallel ν_2 band and perpendicular ν_5 band in the region 1310-1540 cm⁻¹ has been performed in collaboration with the Laboratoire Infrarouge, Univ. Paris Sud, Orsay (F). The theoretical analysis of these results is in progress. Preliminary data have been collected for the broadening coefficients.

HCOOH

Formic acid is a product of photooxidation detected in smog chamber studies and in the atmosphere. Analytical techniques based on optical spectroscopy have been applied, but they suffer from a lack of validated spectral parameters.

Following a study of the reactions leading to HCOOH formation in air, the absolute intensities of the three most important bands of H¹²COOH and the air broadening coefficient have been evaluated. Results confirm, within error limits, our previous evaluations of the ν_6 band intensity at 1105 cm⁻¹ and give values for the ν_3 band at 1776 cm⁻¹ and for the ν_2 band at 2944 cm⁻¹.

Using the software package (see Environmental Research Newsletter N° 2), which has been fully developed for PC use, a search has been performed to identify transitions in the ν_6 band fulfilling requirements in terms of interference free and intensity characteristics for use in a second derivative TDL monitor.

These activities are contributing to the Eurotrac sub-project JETDLG.

Further information can be obtained from:

- G. Restelli, tel. +39 332 789225,
- F. Cappellani, tel. +39 332 789228,
Environment Institute, CEC-JRC Ispra, I-21020 Ispra.

1.3.3. Mass balance and transport of pollutants

The Environment Institute of the JRC Ispra tests and develops advanced tropospheric air monitoring systems which could become an integrated part of a European Monitoring Network. It participates with its own staff and instrumentation in regional, national and international field campaigns. It also initiates and manages field campaigns and measuring programmes with general scientific objectives.

A commercial open path differential optical absorption monitor (DOAS from the firm OPSIS) has been installed at the vicinity of the JRC Ispra EMEP station and a good agreement for the species O₃ and NO₂

was found between the 700m optical path data and the conventional point data from the EMEP station. The sensitivity to measure atmospheric formaldehyde is not yet sufficient. During the TRANSALP October 1989 field exercise the system was in operation for continuous long-path O₃ and NO₂ measurements.

Passive diffusion tube samples for NO₂ prepared and analysed at the JRC Ispra have been shown to perform excellently in comparison with those prepared elsewhere and also with conventional NO₂ monitors. These very simple and inexpensive devices consist in small plastic tubes in which NO₂ is chemically absorbed on a triethynolamine film which is analysed in the laboratory following a 3 days to 3 weeks exposure (according to NO₂ ambient level). They have been used in NO₂ distribution studies in Athens, Paris, Varese and other locations for the design of new sampling networks and the validation of existing ones.

Knowledge of **the ozone distribution** in the southern fringe of the Alps is of interest since the maximum admitted concentrations (120 ppb in CEC, 60 ppb in Switzerland) are frequently exceeded. The impact on human health and the natural environment has raised major public interest. For this reason the JRC Ispra, in collaboration with the Swiss Ticino cantonal authorities, carried out a systematic study using an ad-hoc monitoring network of tropospheric ozone formation in these southern alpine valleys. Results show that during the summer extremely high values are due to the afternoon breeze transporting anthropogenic ozone which is formed mainly by up-valley automobile traffic.

The JRC Ispra happens to be the one and only European laboratory employing the **perfluorocarbon tracer technique** (developed by the US Brookhaven National Laboratory) on a routine basis. This technique allows to study atmospheric transport and diffusion over complex terrain in the mesoscale (100-200 km) giving a straight relation between the artificial tracer source and the down-wind concentration field (ground and aircraft sampling).

The following field exercises were conducted:

- Campo dei Fiori experiment (Varese, Italy, July 1988): investigation of the atmospheric dispersion in a complex lake-mountain area. A strong vertical channeling effect on the plume was found to be determined by the heated mountain slope near the cold lake surface.
- MECAPIP experiment (Castellon, Spain, July 1989): investigation of the atmospheric transport from the eastern Spanish coast to the central plateau induced by mediterranean thermal lows. In the frame of this field exercise organised by the Spanish CIEMAT Institute, the tracer plume was detected at high concentrations up to 80 km distance. Tracer sampling by an instrumented aircraft equipped with in-situ wind measurement and computerized navigation systems proved to be an extremely powerful tool to describe flow over complex terrain (contract by Fraunhofer Institut, Garmisch-Partenkirchen).
- TRANSALP pre-experiment (Canton Ticino, Switzerland, October 1989). In this first pre-experiment in the TRACT/TRANSALP-EUROTRAC proposal the channeling of air masses in the Ticino area was investigated in collaboration with Swiss and Italian laboratories. The tracer was detected up to the St. Gotthard and Lucomagno passes driven by local winds ("Inverna") developing under sunny conditions.

Further information can be obtained from:

A.G. Stingele, Environment Institute, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789960.

1.3.4. Role of terpenes in the dry deposition of O₃/SO₂ mixtures onto forest trees

The previously described studies aiming at quantifying the natural plant emissions of terpenes as well as their role in the formation of acidic pollutants (e.g. H₂SO₄) in the presence of acid precursors and ozone have been continued (see Environmental Research Newsletter N°2).

Laboratory experiments are carried out to quantify the formation of aldehydes and organic acids which can be seen as the final product of the terpene/O₃ reaction. Preliminary results clearly indicate the formation

of formaldehyde, acetaldehyde, formic and, in lesser content, acetic acid upon reaction of α - and β -pinene and isoprene with ozone in the gas phase. A more quantitative evaluation of the importance of this mechanism to the generation of secondary pollutants (e.g. aldehydes) and of acidic products (e.g. formic acid) in remote and semi-remote areas is in progress.

Further information can be obtained from:

D. Kotzias, Environment Institute, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789647.

1.3.5. Modelling atmosphere-biosphere interactions in plant exposure systems suited to balance gas exchange (SO₂, O₃, CO₂, H₂O, VOC)

A laboratory experimental activity at the JRC Ispra aims at studying the contribution of plant canopy layers as source/sink terms in the balance of gas exchange between atmosphere and biosphere. At plant surface/atmosphere interfaces different processes of emission, deposition and physical/chemical transformation are involved simultaneously and cannot be clearly separated and quantified under ambient conditions. However, the quantitative determination of elemental input to ecosystems has to be ascertained before risks due to changed atmospheric chemistry can be assessed. On the other hand, atmospheric contents of radiatively (H₂O, CO₂) and chemically (VOC) active gases are influenced by plant canopies. Obviously the interactions between air constituents of natural and anthropogenic origin in the plant surface/atmosphere boundary layer play a key role with respect to ecological effects as well as to eventual climatic change.

As a first step, the study focused on low level, continuous exposure of spruce (*Picea abies*) canopies in dry conditions to the gases SO₂ and O₃, either alone or in combination, to monitor simultaneously the mass balance of the pollutants, of photosynthetic gas exchange and of biogenic hydrocarbon emissions.

Continuous Stirred Tank Reactors (CSTR's) as developed by Heck and coworkers (Raleigh, USA) for gas uptake studies with crops were modified to be used with tree canopies in a continuously monitored airflow. The CSTR-systems were designed to give ideal and instantaneous mixing of components entering the chamber in a linear airflow with components present in the chamber. Controlled turbulence as generated by an impeller at the chamber top was adjusted to set atmospheric and leaf boundary resistances to zero. A shared-time gas distribution unit supplied sample air to the commercial gas analyzers (O₃, SO₂, NO, NO₂, CO₂, H₂O). Samples for GC-analysis of biogenic hydrocarbons were obtained discontinuously. The mass balance of the canopy gas exchange was calculated as $q_c = f(C_{in} - C_{out}) - q_w$, where flux density (q_c) to or from the canopy is balanced by the product of flowrate (f) and concentration difference ($C_{in} - C_{out}$) between inlet and exhaust duct, minus flux density to and from the walls (q_w).

The system performance test indicated gas concentrations at the outlet representing any point within the reactor. Mass fluxes to and from the walls as observed in a chamber without plants was near zero. Results on gas exchange per canopy surface area show close relations between climatic/edaphic parameters, photosynthetic gas exchange, pollutant deposition and VOC emission. Photosynthetic gas exchange (CO₂, H₂O) representing stomatal conductance, is strongly related to radiation, air temperature, humidity, and soil moisture. The deposition velocity of SO₂ and O₃ in dry conditions is dominated by stomatal conductance with respect to diurnal changes as well as to the absolute values in different seasons. Regular differences of VOC-emission and photosynthetic activity were not obtained yet due to pollutant exposure. Chemical sinks were not observed in the reactors containing VOC+SO₂, VOC+O₃, SO₂+O₃, but were pronounced in atmospheres containing VOC+SO₂+O₃. Work is in progress to balance the products of chemical transformation.

Further information can be obtained from:

G. Seufert, Environment Institute, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 785784.

used oil was developed at the Environment Institute of the JRC Ispra in support to the implementation of the relevant Community Directives.

The specific method is based on capillary column gas chromatography with electron capture detection. The identification of PCBs 28, 52, 101, 105, 118, 128, 149, 153, 163, 170 and 180 (IUPAC nos) without interference was performed on a 60m column with bis-cyanopropyl polysiloxane as stationary phase combined with the analysis on a 50m column with 5% phenyl methylsiloxane as stationary phase.

A selective extraction of aromatic species from aliphatic waste oil with dimethylsulphoxide allowed an accurate (85-95% recovery) and precise (5-10%CV) analysis of PCB congeners in waste oil in the 100-1500ppb range.

The fast screening of PCBs in waste by dechlorination with sodium and successive colorimetric chloride determination by commercially available test kits was tested. A pre-clean-up of the oil over sulphuric acid impregnated silica reduced the interferences due to chlorine. Interlaboratory ring tests in this rapid screening method will be organized and carried out in 1990 and 1991.

Further information can be obtained from:

S. Facchetti, Environment Institute, CEC-JRC Ispra, I-21020 Ispra.
Tel. +39 332 789970.

2. Reduction of pollution: Emission Abatement

DG XII/E supports shared-cost contracts aiming at developing advanced technologies for the reduction of pollution (2.1.). The JRC Ispra is involved in the development of processes reducing the emission into the atmosphere of sulphur and nitrogen oxides from flue gases (2.2.).

2.1. Shared-cost contracts

The shared-cost contracts managed by DG XII/E in the framework of the **Fourth R&D Programme of the CEC on Environmental Protection (1986-1990)** in the field of reduction of pollution aim at developing advanced technologies for waste water treatment and reduction of water pollution. They were initiated in 1987 for a three year-period and were listed in Environmental Research Newsletter N° 3 together with the participating institutes.

In the framework of the research area "Technology for Environmental Protection" of the **STEP Programme (1989-1992)** the shared-cost contracts concern emissions to the atmosphere and waste water treatment. The former focus on the reduction of emissions from stationary sources, including retrofitting, from small combustion units, incinerators and other emission sources (emission reduction from large combustion units is covered by the Joule Programme). The latter focus on improved and more cost-effective technologies (including computer assisted optimisation) such as biotechnological processes for waste water treatment, development of modules with bacteria films to purify effluents with low pollutant concentration, algal ponds with high efficiency in Mediterranean regions.

A call for proposals was published in OJ No C 326, 30.12.1989 with a deadline of 30 March 1990. Eighty three proposals originated from EC Member States as well as EFTA countries. Evaluation of proposals will be completed by end of June 1990 and final selection by 16 July 1990.

Further information can be obtained from:

- for emissions to the atmosphere:
J.H. Büsing, DG XII/E1, CEC, 200 rue de la Loi, B-1049, Brussels.
Tel. +32 2 2355625.
- for waste and waste water treatment:
P. L'Hermite, DG XII/E1, CEC, 200 rue de la Loi, B-1049, Brussels.
Tel. +32 2 2355163.

3. Reduction of pollution: Clean Technologies

DG XII/E supports shared-cost contracts aiming at developing clean or low emission technologies. These are defined as new or modified production processes generating significantly less pollution and/or waste and/or consuming less energy than conventional processes; they may involve process-integrated abatement techniques to avoid "end of pipe" emission reduction.

The shared-cost contracts managed by DG XII/E in the framework of the **Fourth R&D Programme of the CEC on Environmental Protec-**

2.2. Ispra MARK 13A Process for Flue Gas Desulphurisation at the Environment Institute of the JRC Ispra

The Ispra MARK 13A process for flue gas desulphurisation is a patented method for removing sulphur dioxide from flue gases, particularly in fossil flue-fired power stations. It was developed at the JRC Ispra Establishment. The process is based on the oxidation of sulphur dioxide to sulphuric acid by bromine and the subsequent recovery of bromine by electrolysis of hydrobromic acid with formation of hydrogen (see also Environmental Research Newsletter N° 3).

Following a feasibility study and a bench-scale step, a pilot plant was built at the site of the SARAS Refinery in Sarroch, Sardinia. The owner and responsible of the plant is the Ferlini Technology of Genova, Italy which sub-contracted the design, engineering and construction to the Kraftanlagen Heidelberg, FRG. The European Community contributed 50% of the expenses and supervised the project. The plant, designed for a throughput of 32000 m³/h of flue gas (max. 40000 m³/h) with SO₂ contents of up to 4500 mg/m³, was ready in December 1988. During 1989, the pilot plant has been in operation to test all major plant components for more than 2 500 hours. Process performance was satisfactory and desulphurisation rates of more than 90% could be obtained. A number of unforeseen technical difficulties with various plant components (e.g. acidic liquid recirculation pumps, reactor liquid recirculation lines, acid flowmeters, etc.) called for further technical improvements yet to be tested.

The complementary research aiming at extending the Ispra MARK 13A process to a combined denoxing/desulphurisation process made good progress and is presently in a bench-scale phase. The most promising method consists in the absorption of the nitrogen oxides in an aqueous solution containing Fe(II)EDTA as a complexing agent, followed by the electrochemical decomposition of the Fe(II)EDTA.NO complex. This leads to the reduction of NO into NH₄⁺ in the cathodic part of the electrolytic cell. This latter is oxidised to N₂ in the anodic part, in the presence of bromide ions. Experiments with synthetic waste gases were successfully carried out. It is planned to test the method with real flue gases obtained by the combustion of heavy fuel oil containing 2.7 % S.

Further information can be obtained from:

D. Van Velzen, Environment Institute, CEC-JRC Ispra,
I-21020 Ispra. Tel. +39 332 789124

tion (1986-1990) were initiated in 1987 for a 3 year-period and were listed in Environmental Research Newsletter N° 3 together with the participating institutes.

In the framework of the research area "Technology for Environmental Protection" of the **STEP Programme (1989-1992)** the shared-cost contracts concern in priority the following sectors: chemical industry, metallurgy, metal finishing and coating, fibres and textiles, tannery and paper industry.

and reusing waste and for locating and restoring contaminated sites as well as methods for measuring and monitoring the quality of the natural environment (4).

Research in this area is complementary to the programme "Recycling

and Utilization of Waste" (REWARD) aimed at the recovery of raw materials and energy from waste.

Recent results are presented below together with information on the new STEP Programme.

1. Waste Research

Research on waste managed by DG XII/E is implemented by shared-cost contracts (1.1.) and by a Concerted Action on "Treatment and Use of Organic Sludge and Liquid Agricultural Waste" (1.2.). The JRC Ispra's contribution to chemical waste includes research (1.3.) and support activities (1.4.).

1.1. Shared-cost contracts

The shared-cost contracts managed by DG XII/E in the framework of the **Fourth R&D Programme of the CEC on Environmental Protection (1986-1990)** in the field of waste deal with toxic and dangerous material, and abandoned disposal sites. These were initiated in 1987 for a 3 year-period. They were listed in Environmental Research Newsletter N° 3 together with participating institutes.

In the framework of the research area "Technology for Environmental Protection" of the **STEP Programme (1989-1992)** the shared-cost contracts focus on specific and new processes for the treatment of toxic and dangerous waste, safe disposal of waste and methods for the assessment of risks from abandoned disposal sites as well as restoration techniques.

A call for proposals was published in OJ No C 326, 30.12.1989 with a deadline of 30 March 1990. Eighty seven proposals originated from EC Member States as well as EFTA countries. Evaluation of proposals will be completed by end June 1990 and final selection by 16 July 1990.

Further information can be obtained from:

P. L'Hermite, DG XII/E1, CEC, 200 rue de la Loi, B-1049, Brussels.
Tel. +32 2 2355163.

1.2. Concerted Action "Treatment and Use of Organic Sludge and Liquid Agricultural Waste" COST Project 681

The structure and terms of reference of working parties remain unchanged. Activity covers: organic sludge and liquid agricultural wastes processing, including odour problems (WP1), chemical contamination of sludge and soils (WP2), hygienic aspects related to the treatment and use of organic sludge (WP3), agricultural value of sewage sludge and liquid agricultural waste (WP4) and environmental effects of organic sludge and liquid agricultural waste (WP5) (see also Environmental Research Newsletter N° 3).

A symposium on "Treatment and Use of Sewage Sludge and Liquid Agricultural Wastes"

will be held in Athens, Greece, on 1-4 October 1990.

The symposium is organized by the CEC and the National Technical University of Athens, Division of Water Resources. The programme will cover the following topics: (i) technical and economic aspects of treatment and disposal of sewage sludge and slurries; (ii) long-term environmental effects in connection with the use of sewage sludge and liquid agricultural wastes; (iii) analysis and risk assessment of organic micropollutants; (iv) risk assessment of the occurrence of pathogens in sewage sludge and effluent from livestock; and (v) implementation of regulations, practical experiences and public perception.

A final activity report of the Concerted Action will be published in complement to the proceedings of the symposium.

Further information on the symposium and on the concerted action can be obtained from:

P. L'Hermite, DG XII/E1, CEC, 200 rue de la Loi, B-1049, Brussels.
Tel. +32 2 2355163.

1.3. Chemical Waste Research at the Environment Institute of the JRC Ispra

Migration and transformation of pollutants in soils

Results of research on the migration of trace metals and organic com-

pounds using micromorphological techniques will be reported in the next issue.

Construction of a mobile analytical laboratory for in-field measurements of toxic wastes

A project for the construction of a mobile analytical laboratory, prepared in collaboration with the Danish Technological Institute in Copenhagen, will be submitted for approval by the management committee of the EUREKA/EUROENVIRON project.

This mobile analytical laboratory should monitor and control waste and contaminated water or soils in field conditions. The installation could also handle air pollution. It can be used to confirm measurements made by private or public environmental bodies at national and international levels. Potential work areas in terms of management of accidents, spills and contaminated soil sites include preventive pollution monitoring, immediate emergency response related to existing contingency planning as well as long-term rehabilitation of contaminated sites. The final goal of the project is to build up a prototype in a delay of 2 to 2 1/2 year. Protocols for sampling, sample treatment and analytical methods will also be prepared.

Chemical Emergencies Management - Oil-PCB Manager (OPM): a Risk Evaluation and Management System for Electrical Containers

The OPM project is part of the programme on chemical waste related to the management of prevention and emergency situations where highly toxic compounds are involved (see also Environmental Research Newsletter N° 3).

The OPM is a computer based system which permits the acquisition, management, and retrieval of information concerning sites and containers involving PCB and mineral oil contaminated by PCB.

The information model used describes the containers as part of a more complex set which includes the particulars on installation, site and container. At each of these levels, data are provided to represent the relevant information features, i.e.:

- At installation level: (i) address, map, general information; (ii) synopsis of hazardous load: site number, container number; (iii) maintenance, safety procedures.
- At site level: (i) site type (cabin, room, area, stations, etc.), location; (ii) synopsis of hazardous load: container number; (iii) preventing actions, mitigation; (iv) potential targets in the environment close to the site.
- At container level: (i) maker, container type (transformer, rectifier, commutator, tank, etc.); (ii) capacity, voltage; (iii) accessibility; (iv) fluid characteristic (type, function, amount); (v) label, fluid analyses; (vi) degradation level, release, migration; (vii) containment/barriers; (viii) out of order.

The system is a powerful data base and an hypertext system with retrieval capabilities integration of different knowledge bases. It provides a standardisation scheme for data acquisition and knowledge-base. Extensive help menus allow rational interpretations even in case of complex situation. The resident expert component of the system provides risk analysis and possible mitigation strategies to the decision making authorities.

The OPM system has been successfully tested with data of JRC. Other validation tests are foreseen.

OPM is currently implemented on MacOS and a porting of the system under OS/2 PM and MS-Windows is in progress.

Further information can be obtained from:

S. Facchetti, Environment Institute, CEC-JRC Ispra, I-21020 Ispra.
Tel. +39 332 789970.

1.4. Support Activities

An analytical method for the fast screening of PCBs at ppm level in

EC Regulatory Action

1. Industrial Risks

The EEC Fourth Environmental Action programme (1987-1992) pays particular attention to the prevention of industrial accidents (OJ No C 328, 7.12.1987) through the implementation of the **Council Directive 82/501/EEC on the major-accident hazards of certain industrial activities** (see also Environmental Research Newsletter N° 3). The following information update the most recent actions towards a more effective implementation of this Directive.

The **Council Resolution of 16 October 1989 on guidelines to reduce technological and natural hazards** (OJ No C 273, 26.10.1989) invites the Commission to focus on certain issues in respect of Directive 82/501/EEC. These issues were: safety reports, land-use planning controls, information of the public and use of the Accident Gravity Scale.

The Commission together with Member States aims at the harmonization of national principles and practises regarding the safety reports submitted to the Authorities by June 1989. The Commission will investigate

as soon as possible ways of including specific requirements on the control of land-use planning in the Directive, when new installations are authorized and, when there is urban development around existing installations. Public information will be emphasized and the Commission will draft a practical guide to facilitate the implementation of those provisions. Attention will be paid to experience gained from industrial accidents, including monitoring the trial period of the Accident Gravity Scale.

A major task now undertaken by the Commission, together with the Committee of Competent Authorities, is a fundamental revision of the annexes. The aim is to simplify the criteria used for defining the substances considered and to optimize the scope of the Directive taking into consideration the real industrial background and the experience gained after 6 years of active implementation.

Further information can be obtained from:

P. Testori-Coggi, DG XI/A2, CEC, 200 rue de la Loi, B-1049 Brussels.
Tel. +32 2 2353430.

2. Biotechnology

The Council has recently adopted two Biotechnology Directives:

Council Directive 90/219/EEC on the contained use of genetically modified micro-organisms
(OJ No L 117, 08.05.1990)

Council Directive 90/220/EEC on the deliberate release into environment of genetically modified organisms
(OJ No L 117, 08.05.1990)

The Directives provide a comprehensive EC regulatory framework for the applications of genetic engineering and similar gene modification methods in biotechnology. This legislation covers the whole area ranging from the use of Genetically Modified Micro-Organisms (GMMs) –including genetically modified cells in culture– for research, development and large scale industrial production to the release of the developed Genetically Modified Organisms (GMOs). This applies to either experimental research in open field trials or to commercial operations aiming at placing products containing live GMOs on the market.

The final texts of both Directives follow the original proposals of July 1988 (OJ No C 198/9 and /19, 29.07.1988) and do not contain major changes

from the first drafts summarized in Environmental Research Newsletter N° 3, February 1989. However, the following remarks should be made:

- To strengthen the scope of the Community legislation in the area of interest, the preamble to the contained used Directive refers to Article 130s of the Treaty establishing the EEC and not to Article 100a as in the published proposal.
- A technical annex (now Annex I) has been added to or greatly expanded from the text in the proposals for each Directive. It defines the methods of genetic modification that render the newly developed micro-organisms or organisms liable to the specific EC regulations.
- The Directive on the deliberate release of GMOs does not apply to the placing on the market of products covered by Community legislation which requires a specific environmental risk assessment similar to that laid down in Annex II of the Directive.

Further information can be obtained from:

J. Tachmintzis, DG XI/A2, CEC, 200 rue de la Loi, B-1049 Brussels.
Tel. +32 2 2354525.

Waste Management and Technologies for Environmental Protection

EC Research Programme and Support Activities to the Commission

Detailed information on activities managed by DG XII/E in the framework of the 4th Environmental R&D Programme (1986-1990) and by DG XII/JRC Ispra was given in Environmental Research Newsletter N° 3, February 1989. These activities in progress consider "Waste Research" (1) and processes for the reduction of pollution: "Emission Abatement"

(2) and "Clean Technologies" (3). They are implemented by shared-cost, concerted and direct actions. Besides its research contribution, the JRC Ispra carries out support activities necessary for the implementation of the regulatory actions of DG XI. Demonstration projects managed by DG XI aim at developing new clean technologies and techniques for recycling

assumptions on major failure modes of principal components, the assumptions concerning the physical behaviour of ammonia after its release and the toxicity criteria adopted.

In the final working phase of the project, a set of topical exercises based on well defined boundary conditions was carried out to separate the effects and to identify the most significant contributors to the uncertainties of a risk analysis.

A final report will be available and a follow up has been proposed for the next STEP Programme (see also 1).

Further information and reports can be obtained from:

A. Amendola, Institute for Systems Engineering and Informatics, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789208.

3.2. Risk Assessment and Management

The objective is to develop models and tools necessary for the implementation of decisions relating to the different steps of a risk identification and management process. This calls also for connected actions for the gathering and analysis of relevant data.

This research area benefits from the experience gained and the tools developed in the risk & reliability project for NPP safety as well.

An expert system (STARS) is at an advanced state of development through a collaboration effort which involves various institutes in Den-

mark, Italy and Finland. This system design and plant risk level study is supported by a user group which includes interested industries and laboratories.

Emergency decision support systems are being developed at a system operation level. The FORMENTOR project which aims at advising operators of complex man-made systems in emergency situations in avionics and chemical plant emergencies will be carried out by the JRC Ispra and by French and Norwegian organizations associated in an EUREKA Programme.

Together with such tools, cognitive engineering and applied psychology are used to establish a taxonomy of human errors for the development of a data base on human behaviour.

Further information can be obtained from:

G. Mancini, Institute for Systems Engineering and Informatics, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789714.

For risk management, the implementation of the IRIMS decision support system developed in collaboration with IASA is being followed by the specialization of tools to specific problem areas (HELP for transport of dangerous goods, PURPLE for urban wastes now being extended to toxic wastes).

Further information can be obtained from:

H.J. Otway, Institute for Systems Engineering and Informatics, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789951.

4. Support activities

The Institute for Systems Engineering and Informatics of the JRC Ispra provides the Commission with the technical support for the implementation of the Directives relating to industrial risks particularly in chemical and biotechnological fields.

4.1. Support to the implementation of the Seveso Directive (82/501/EEC)

Major Accident Reporting System (M.A.R.S.) data base

This data base includes accident notifications and their characterization by various parameters (type of accident, activity, substances involved, etc.) or indices specifically developed for this purpose (gravity index, causative factors).

A report for an exchange of experience among competent authorities of Member Countries is issued periodically. It contains a summary of major accidents indicating causes, consequences and measures that could prevent their recurrence as well as a report of experience gained following accidents notified to improve prevention. M.A.R.S. content and the reports mentioned above are available only to national competent authorities.

Community Documentation Centre on Industrial Risk (C.D.C.I.R.)

The role of the Documentation Centre located at Ispra is to collect, classify and diffuse information on published accident investigations, regulations, safety codes of practice, risk studies, etc. The Centre is accessible and the information is distributed by bulletins available to the public. This activity contributes to better information on matters concerning the risk besides providing policy makers and safety analysts with knowledge on national practices.

Information bulletins vol.1 (SP/1.89.12) and vol 2 (SP/1.89.25) are available (see below).

Conferences related to the directive

Emergency Planning for Industrial Hazards, Varese, Italy, 4-6 November 1987.

This conference was organised by the CEC-DG XI in collaboration with the JRC Ispra. The objective was to analyse the state-of-the-art and national practices in emergency preparedness and response, as a basis

for the implementation of the directive requirements concerning on-site and off-site emergency planning.

Proceedings edited by H.B.F. Gow and R.W. Kay were published by Elsevier Science Publisher Ltd, Crown House, Linton Road, Barking, Essex 1G11 8JU, UK, EUR 11591 EN, ISBN 1-85166-260-X, 1988.

Communicating with the Public about Major Accident Hazards, Varese, Italy, 30 May-1 June 1989.

This conference was organised by the CEC-DG XI in collaboration with the JRC Ispra. The objective was to integrate and analyse the uneven and fragmented experience of major hazard communication to date and to draw conclusions specific to European cultural tradition and legislative structures.

Proceedings edited by H.B.F.Gow and H. Otway were published by Elsevier Science Publisher Ltd, Crown House, Linton Road, Barking, Essex 1G11 8JU, UK, EUR 12255 EN, ISBN 1-85166-457-2, 1990.

Further information can be obtained from:

A. Amendola, Institute for Systems Engineering and Informatics, CEC-JRC Ispra, I-21020 Ispra. tel. +39 332 789208.

4.2. Support for the finalization and the implementation of the Biotechnology Directives (90/219/EEC and 90/220/EEC)

Technico-scientific assistance, either in general or on ad-hoc basis, has been given to DG XI for the final issuing of the Directives on the contained use of Genetically Modified Micro-organisms (GMMs) and on the deliberate release of Genetically Modified Organisms (GMOs).

Activities are now directed to support the DG XI for the application of the two Biotechnology Directives. In this respect, three major areas of involvement should be mentioned: (i) studies to prepare selected guidelines for the provisions contained in the technical annexes of the directives, in particular development of technical specifications, criteria for classifications and principles of good practices; (ii) general technical assistance to the competent services of DG XI including participation in meetings, as required; and (iii) technical support for discussion on biotechnology regulation at international level (see also below).

Further information can be obtained from:

F. Campagnari, Institute for Systems Engineering and Informatics, CEC-JRC Ispra, I-21020 Ispra. tel. +39 332 789350.

of operating conditions and simulate the system behaviour when anomalies arise.

The aim of this simulator is to guide the experimental programme, to ensure optimal exploitation of the experimental facilities and facilitate analysis of the experiments.

Investigations of multiphase flow phenomena in reactor relief systems during venting aim at studying the flow behaviour of multicomponent fluids during emergency venting. The research concentrates on in-vessel phenomena, vent line phenomena and dump tank behaviour.

The development and assessment of computer programmes for emergency release of multicomponent fluid mixtures from chemical reactors and storage vessels aim at providing validated prediction methods for adequate and safe design of emergency relief systems for chemical reactors with runaway potential. The activity includes: (i) development of mathematical models and their implementation in computer codes; (ii) code assessment using available experimental data; (iii) confrontations of computer codes; and (iv) code application to equipment of industrial interest.

Utilising the experience attained at the JRC Ispra in modelling two-phase flow phenomena relevant to postulated accidents in nuclear reactors, the development of the computer programme RELIEF has been pursued. It provides a one-dimensional transient analysis of multicomponent two-phase flow in discharging vessels, including the occurrence of liquid phase chemical reactions.

Another code available at the JRC Ispra is RELAP5-MF, a multifluid version of the US light water reactor safety code RELAP5-MOD1 from which it differs by a much higher computational efficiency and ability to handle different fluids. Two-phase flow conditions are treated in terms of a five-equation model and the code can describe fluid behaviour in complex circuit. The code was used to predict the behaviour of a petrochemical system under abnormal conditions.

Two US vent sizing codes (SAFIRE and DEERS) were purchased by JRC to acquire the present state of computer modelling for relief purposes. SAFIRE is based on the representation of the reactor vessel by a single computational cell for which global balances of mass and energy are formulated. Two-phase flow phenomena in the vent line are treated one-dimensionally. DEERS provides a one-dimensional two-phase fluid dynamic treatment both for vessel, vent line and dump tank. The conservation equations of mass, momentum and energy are formulated in terms of two-phase mixture variables (density, velocity, enthalpy) and additional equations are formulated in terms of variables describing deviations from equilibrium (in particular phase slip).

An exploratory research activity is directed to the development of an advanced computer code for a subsonic/supersonic chemically reactive fluid flow in complex geometry.

Further information can be obtained from:

R. Nijssing, Institute for Safety Technology, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789306.

2.2. Dispersion of Dense Vapour Clouds

The aim is to provide enhanced numerical methods to predict the behaviour of denser than air vapour accidentally released to the atmosphere. Both the quasi-instantaneous release resulting from the complete failure of a containment structure and the more frequent small-scale continuous release are considered.

3. Industrial Hazards Research at the Institute for Systems Engineering and Informatics of the JRC Ispra

3.1. Coordination of the Benchmark Exercise on Major Hazards Analysis

The project started in January 1988 has been completed by end 1989. It aimed at evaluating the state of the art in risk analysis obtaining estimates of the degree of connected uncertainty and assessing available models and procedures.

The reference object was an ammonia storage facility including: (i) a sea terminal; (ii) an isolated refrigerated storage; (iii) a pressurized stockage; and (iv) the pipelines connecting these installations.

The work, started in 1989, was initiated by the implementation and intercomparison of a number of simple box models, where all the properties of the cloud were assumed constant. Then, a series of numerical experiments with a finite element programme for laminar flow conditions were performed to elucidate typical dispersion phenomena in a 2-D domain containing obstacles.

Research now concentrates on the application and further development on a 3-D finite volume code ADREA-HF and a simpler intermediate computation tool (based on the shallow layer approach). The work is performed in the frame of a collaboration with the Centre Demokritos of Greece and in association with the ongoing and future Shared-Cost Action programmes on Major Technological Hazards.

A key feature of the ADREA-HF code is the capability to treat in an efficient and userfriendly manner the domain boundaries of highly complex terrain and to model directional time-dependent sources of dense fluid (gas, liquid or two-phase mixture) at arbitrary locations of the computational domain.

The main objective of the shallow layer computer model, which at present exists in a 1-D version, is to substitute the simple box models and provide a link with the 3-D computer codes.

Present activities regard the application of the models to different experiments (Thorney Island field test and different wind tunnel tests).

Planned activities concern the development of the shallow layer model to two dimensions and an introduction of 2-phase flow capabilities in the ADREA-HF code.

Further information can be obtained from:

R. Nijssing, Institute for Safety Technology, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789306.

Eurocourse on "Safety of Chemical Batch Reactors and Storage Tanks", Ispra, Italy, 17-21 September 1990.

This course organized by the Institute for Safety Technology will review the safety issues relating to batch reactors and storage tanks with emphasis on the prevention and mitigation of dangerous situations which could produce thermal and pressure excursions.

The course will analyse the relevant case histories and will illustrate the current safety criteria and guidelines. The emphasis will be on the prevention and protection/mitigation measures against runaway reactions. Methods for chemical system characterization which include chemical kinetics and material physical properties will be examined. An exhaustive review of experimental techniques to investigate the runaway reaction initiation will be presented. Attention will be focused on instrumentation and control techniques. The problem of pressure relief under runaway reaction or external fire and the most recently developed methodologies in this area will be illustrated and discussed. In addition, analytical methods to simulate chemical system behaviour under normal and off-normal operation conditions including two-phase fluid dynamic effects will be considered. The course will conclude with a presentation of the Ispra JRC's experimental facilities (FIRES, MPMC and Calorimetry Lab.) for investigations related to process safety and process optimisation.

Further information and documentation on the course can be obtained from:

Secrétariat EURO COURSES, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789819/789308. Telefax +39 332 789839. Telex 380042-380058 EUR I.

The documentation and the interaction with the operator was made available to eleven teams to perform a complete risk assessment exercise in Working Phase 1 (see also 1.5.). Participating teams included experts from public authorities, industries, research and consultant organizations (from EC countries and Finland) responsible for the safety assessment and decision making concerning major hazard installations.

A first comparison of results was performed in a project meeting at Ispra on February 1989. This revealed a significant spread of the risk figures, which was due not only to different failure data or computer codes used, but also to the extent of the hazard identification process, the retained

Participating institutes:

- Danish Maritime Institute, Lyngby, Denmark (S. Hansen);
- Risø National Laboratory, Roskilde, Denmark (P. Becher);
- TNO, Apeldoorn, The Netherlands (P. Bultjes);
- Universidad Politecnica de Madrid, Spain (A. Crespo-Martinez);
- ARS SpA, Milano, Italy (G. Biardi).

1.5. Risk assessment

The ongoing project, started in 1987, considers:

Benchmark exercise on major hazards analysis

This project has been partially funded jointly by DG XII/ E and JRC, and DG XI.

The objective is to compare methodologies of risk assessment and obtain estimates of the degree of uncertainty in risk analysis.

The first phase aimed at a comparison of the overall approaches to risk analysis, from hazard identification up to the calculations of the risk contours; the second one is to identify the most significant contributors to the uncertainties of a risk analysis.

Participating institutes:

- Vincotte Department Sûreté Nucléaire and Solvay, Brussels (Belgium);
- Technica Ltd, London (UK) and ANSALDO SpA (Italy);
- Gesellschaft für Reaktorsicherheit, Köln, and Batelle, Frankfurt (FRG);
- NIER Coop., Bologna; FIAT Engineering, Torino; ENEA-DISP, Roma; SNAM-Progetti, S. Donato Milanese (Italy);
- HSE, Bootle (UK);
- Technical Research Centre of Finland (VTT);
- CEP (France); EDRA (Italy); IGC (Spain); TECHNIMONT (Italy);
- Risø National Laboratory, Roskilde (Denmark);
- TNO (The Netherlands);
- Greek Atomic Energy Commission; University of Athens; Ministry of the Environment (Greece);
- NL Ministry for Environment (The Netherlands).

(see details under 3)

1.6. Risk perception

The ongoing project, started in 1987, considers:

Unconscious disinformation processes in major technological hazards: are there any remedies?

The objective is to create a permanent observatory of social response to major risks.

The project was based on two accidents in 1986 (a toxic cloud release over Le Havre in France and the water pollution incident following the Sandoz fire at Bale). The study undertook to compile information on the accidents, analyse the public's perception and behaviour to these accidents, examine the difficulties of medical diagnosis and the processes of decision-making by officials in charge.

Participating institute:

- Centre des Recherches des Dysfonctions de l'Adaptation, Paris, France (B. de Vanssay).

The Major Technological Hazards activities will be enlarged in the new environmental protection programme, i.e. **STEP Programme (1989-1992)**, with a more sizeable budget.

The objective now is to develop a scientific basis for the assessment of risk to the general population and the environment from major industrial accidents and to investigate possibilities for preventing and mitigating such accidents, in support of regulatory activities derived from Council Directive 82/501/EEC.

Research will be complementary to work presently carried out at the JRC Ispra (see below). In certain areas, it will continue work funded in the ongoing 4th Environment Research Programme.

The content of the programme is as follows:

- Chemical and physical phenomena** include source term, dispersion, combustion and related effects
- Technologies of accident prevention** deals with measures to prevent, stop or mitigate accidents and improve the intrinsic safety of plants and transport devices for dangerous bulk substances
- Evaluation and management of risk** covers hazard analysis, management of risk and human factors.

A call for proposals was published in OJ No C 326, 30.12.1989 with a deadline of 30 March 1990. Of 60 proposals received, 25 concerned topic A (chemical and physical phenomena), 5 topic B (technologies of accident prevention) and 30 topic C (evaluation and management of risk). Proposals originated from EC Member States as well as Finland, Norway and Sweden. Evaluation of proposals has been completed by end May and final selection by mid July.

Further information can be obtained from:

P.D. Storey, DG XII/E, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2350347.

2. Industrial Hazards Research at the Institute for Safety Technology of the JRC Ispra

2.1. Runaway Reactions

Research on chemical and fluid dynamic phenomena associated with runaway reactions was started at the JRC Ispra in the previous multiannual programme. This programme has been formulated and is carried out in close association with the "European Contact Group on Runaway Reaction" (ECG-RR). It provides scientific support to Commission actions on environment and is part of the JRC's much larger "Industrial Hazards" research programme.

The general objective is:

- prevention of runaway by development and testing of early-warning techniques and improved control systems;
- assessment of techniques to stop an ongoing runaway event;
- assessment and improvement of methods for the design of emergency pressure relief and fluid discharge systems.

The programme includes studies on:

- process dynamics close to runaway (investigation in batch chemical reactor and computer simulation of batch-type chemical processes).
- multiphase flow of chemically reacting multicomponent fluid mixtures (investigation of multiphase flow phenomena in reactor relief systems during venting as well as development and assessment of computer

programmes for emergency release of multicomponent fluid mixtures from chemical reactors and storage vessels).

The main research activity of **investigations of process dynamics close to runaway in batch reactors** is to be performed in FIRES (Facility for Investigating Runaway Events Safely). It consists of a cylindrical chemical reactor vessel of 0.1 m³ volume placed in a bunker for safety reason, equipped with sensitive measuring devices and provided with systems for control, early-warning and shutdown. Basic knowledge of the chemical processes prior to their investigation in FIRES are carried out in a small scale 2 liter reactor (Mettler RC 1 reaction calorimeter). A second experimental apparatus (adiabatic calorimeter PHI-TEC) has been acquired and can detect the onset of exotherms of unstable materials and predict vent sizing using the DIERS methodology. The chemical processes now investigated are toluene mononitration by mixed acid and suspension polymerisation of methyl methacrylate.

For **computer simulation of batch-type chemical processes**, a mathematical simulator named FISIM (**FIRES SIMulator**) has been developed. It solves mass and energy conservation equations for batch-type chemical reactors containing either homogeneous liquid reaction systems or heterogeneous liquid-liquid reaction systems. It can perform sensitivity analysis for all parameters of engineering interest, determine safe ranges

EC Research Programme and Support Activities to the Commission

Research on "Major Technological Hazards", managed by DG XII/E, is implemented by shared cost contracts presently incorporated in the STEP Programme (1.). Research on "Industrial Hazards" at the JRC Ispra is carried out in two institutes. The activities in the Institute for Safety Technology concentrate on investigations of chemical and fluid dynamics phenomena related to process and equipment failures in the chemical industry (2). The activities in the Institute for Systems Engineering and

Informatics regard risk analysis and risk management (3). Lead Institute for the JRC programme is the Institute for Safety Technology. Actions linked with a harmonised implementation of the EEC Directives on major accident hazards (82/501/EEC) and on biotechnology (90/219/EEC and 90/220/EEC) are sponsored by DG XI and carried out mostly by the JRC (4). Activities in these various actions are coordinated towards a positive interaction.

1. Shared-cost contracts on major technological hazards

A first pilot programme on Major Technological Hazards was launched in the framework of the **4th Environmental R&D Programme (1986-1990)**. It is implemented by shared-cost contracts managed by DG XII/E with the direct participation of the JRC Ispra in some projects.

Pilot projects and studies concern two areas: (i) physical and chemical phenomena and mitigation of consequences of accidents; and (ii) assessment and management of risk.

The cost-shared projects in progress are related to the following topics: source term (1.1.), dispersion (1.2.), flame propagation (1.3.), catastrophic fires (1.4.), risk assessment (1.5.) and risk perception (1.6). They are listed below together with the participating institutes.

1.1. Source term

The ongoing project, started in 1987-1988, considers:

Two-Phase releases for toxic and flammable substances – Thermal initiation, source term and fire effects

The objective is to assess and quantify the hazard from the release of pressurised liquified gases.

Research concentrates particularly on the mode by which fire can lead to containment failure and two-phase release. Experimental investigations are aimed at examining the characteristics of the release from both inside and outside the vessel. Complementary work aims at developing predictive mathematical models of cloud growth and propagation.

The project sub-divides naturally into four areas dependent on the stage and type of failure: conditions of a vessel up to failure of containment, conditions within the vessel following partial failure, characteristics of discharge following partial and complete failure.

Participating institutes:

- Commissariat à l'Énergie Atomique, Grenoble, France (M. Grand);
- Commissariat à l'Énergie Atomique, Grenoble, France (J. Delhaye);
- Université Catholique de Louvain, Belgium (M. Giot);
- Shell Research Ltd, Chester, UK (L. Cowley);
- UK Atomic Energy Authority, Culcheth, UK (D. Webber);
- Batelle Inst. E.V., Frankfurt, FRG (M. Stock);
- British Gas, Solihull, UK (M. Wickens);
- Health and Safety Executive, Buxton, UK (J. Barton);
- Institut von Karman, Rhode-Saint-Genèse, Belgium (M. Reithmuller).

1.2. Dispersion

The ongoing project, started in 1987-1988, considers:

Research on continuous and instantaneous heavy gas clouds

The objective is to provide enhanced numerical and physical methods to predict the behaviour of heavy gas accidentally released to the atmosphere.

Research considers both the quasi-instantaneous release resulting from the complete failure of a containment structure and the more frequent small-scale releases often described as of constant release rate. Work concentrates on the influence of obstacles, such as buildings, on the dispersion process and on the distributional properties of concentration fluctuations as a function of time and place.

The project consists of 3 basic components: both field and wind-tunnel experimentation to provide data on heavy gas behaviour in obstructed terrains including the fluctuations in concentration; analysis of experimental results; and model development and validation using appropriate experimental data.

Participating institutes:

- UK Atomic Energy Authority, Culcheth, UK (D. Webber);
- Universität Hamburg, FRG (M. Schatzmann);
- TNO, Apeldoorn, The Netherlands (P. Bultjes);
- Health and Safety Executive, Sheffield, UK (C. Nussey, J. Davies);
- Risø National Laboratory, Roskilde, Denmark (N. Jensen);
- Warren Spring Laboratory, Stevenage, UK (D. Hall);
- Brunel University, Uxbridge, UK (P. Chatwin);
- Solvay et Cie S.A., Brussels, Belgium (E. Vergison);
- Technischer Überwachungs-Verein, Hamburg, FRG (M. Heinrich).

1.3. Combustion

The ongoing project, started in 1988, considers:

Investigation of flame propagation: influence of turbulence

The objective is to determine the influence of turbulence, repeated obstacles and partial confinement on flame propagation.

The project sub-divides in two parts: relationship between characteristics of turbulence such as fluctuation, velocity and eddy size in an unburned gaseous mixture and resulting turbulent flame velocity after ignition as well as the study of flame propagation in complex geometries and among different types of obstacles.

Participating institutes:

- Physikalisch Technische Bundesanstalt, Braunschweig, FRG (H. Forster);
- TNO, Den Haag, The Netherlands (K. Van Wingsden).

1.4. Catastrophic fires

The ongoing project, started in 1987, considers:

Physical modelling of torch fires

The objective is to develop a series of reliable methods and models to predict the effect of large flames or fires on the environment.

The project includes field experiments, extensive wind-tunnel experiments using horizontal and vertical blown jets, and wind tunnel small-scale experiments simulating full-scale methane flames by using cold buoyant gases.

overall reduction of approximately 4000kt NO_x towards the year 2000, i.e. 25% of the Community anthropogenic emissions.

The adopted Directives concerning motor vehicles will also reduce VOC emissions. Towards the year 2000, this reduction would be only 1700 kt, i.e. 17% of EC anthropogenic emissions.

While recognizing the importance of these measures, the Commission is conscious that they are not sufficient to reduce, within a reasonable time scale, the formation of photochemical oxidants at regional level and to reduce ozone concentration to a level close to/or below the standards recommended by different bodies to avoid damages to ecosystems or human health.

For these reasons, the Commission has already initiated a certain number of activities:

Measures making the emission standards for vehicles more stringent:

In February 1990, the Commission made proposals aiming at strengthening the emission standards. The same standards apply in the same way for diesel engines and are based on the best available technology. In May 1990, the Commission made a proposal for reducing exhaust emissions from heavy duty vehicles. (see also above)

Measures limiting the evaporative emissions from vehicles and from the fuel distribution chain:

VOC evaporation emissions from engines will be limited taking into account the potential effectiveness of on-board canisters. Furthermore, the Commission considers the possibility to limit VOC evaporation emissions from the storage and distribution chain of fuel in two steps: vapour recovery at the different stages of fuel distribution to

the service stations (stage I) and vapour recovery during car refueling (stage II).

Measures controlling VOCs emissions from solvent use activities:

VOC emissions from solvent use will be regulated at Community level as from 1991.

The most important activities are closely examined as a priority by the Commission to identify the best strategies to reduce VOC emissions. These activities are: car painting, metal degreasing, printing, private use of paints.

In a second step, other activities will be considered: dry cleaning, coating of metallic surfaces, coating and impregnating of wooden surfaces.

Moreover, the Commission is preparing a *proposal for a Council Directive on air quality objectives for ozone.*

These objectives will be based essentially on guidelines recommended by WHO.

Member States will be compelled to elaborate air quality improvement programmes to reduce the photochemical pollution if the latter exceeds the established norms.

Finally the Community is actively participating in internal discussions at UN-ECE in the working group established to draft **a protocol, in the frame of the Convention on long-range transboundary air pollution, concerning the control of emissions of VOC or their transboundary fluxes.**

Further information can be obtained from:

P. Stief-Tauch, M. Wolf, DG XI/A3, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2351050.

Other Activities Relevant to EC Environmental Programmes

Joule Sub-programme on Models for Energy and the Environment (DG XII/E)

Development of Methodologies for the Assessment of Strategies for Acid Pollution reduction in the EC.

Acidification is an issue of great concern to the European Commission. SO_x, NO_x and NH₃ emissions are considered to be the major acidification sources and need to be limited particularly in the largest contributor: the energy sector. Since 1980 the EC and some European countries attempted to limit SO₂, NO_x and NH₃ emissions by a variety of regulations and emission control standards at national and European levels (Convention on Long-Range Transboundary Air Pollution and the Helsinki Protocol).

In view of the expected establishment of the European Single Market in 1992 and because of the Commission's concern for the environment, the DG XII through its JOULE Programme commissioned a study on methodology to assess strategies so as to reduce acid air pollution in the EC. This study was performed by national research institutes in all Member Countries in the framework of the JOULE sub-programme.

The objectives of the study were:

- Analysis and estimation of SO₂ and NO_x emissions in the EC up to 2010;
- Identification of cost-efficient SO₂ and NO_x control measures and reduction strategies allowing to meet global reduction targets in the Member Countries;
- Assessment of the impacts of different emission reduction strategies on emission levels, control costs, energy supply (e.g. fuel switch), etc.

Answering these questions is a difficult task for the EC due to the variety in national characteristics of the energy supply and consumption pat-

terns, of the possible control policies, of the level of emissions and the development of the economy. To foster a consistent approach all national institutes applied a similar energy/environment model, called EFOM-ENV. The model is country specific to closely reflect the situation in each Member Country. EFOM-ENV model was developed by DG XII (JOULE Programme) and contains detailed descriptions of the energy system and its related technologies, of its associated emissions and of the control measures for each EC-country. This common methodology allows the suitable comparison of results and policies.

An energy scenario developed by DG XVII (Energy) provided the economic framework for this study as well as inputs such as energy demand and energy prices. The following SO₂ and NO_x control strategies were assessed:

- A "doing nothing" case, where no abatement measures were assumed for sake of comparison;
- A "legal" case, which included all national control measures and regulations presently prevailing;
- A "CEC" case, following EC regulations and directives, mainly applicable to combustion capacities with a production exceeding 50 MWth;
- "Cost-efficient" cases with scenarios of cost-efficient combinations of control measures to reduce SO₂ and NO_x emissions. These were ran up to 2000 and 2010 using 1980 as the reference year.

More information on the results of this study can be found in the publication: "**Energy and Environment: Methodology for the Assessment of Acid Pollution in Europe**", in press.

Further information on the JOULE sub-programme: "Models for Energy and the Environment" can be obtained from:

P. Valette, DG XII/E5, CEC, 200 rue de la Loi, B-1049. Tel. +32 2 2356356.

Air Pollution from Motor Vehicles

Work undertaken by the Commission to develop rules in the motor vehicle sector increased during the last two years.

Passenger cars (with gasoline or diesel engines) – Gaseous emissions

The "mother" **Directive 70/220/EEC on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from engines of motor vehicles** (see Environmental Research Newsletter N° 2) was amended/extended several times since 1987:

Council Directive 88/76/EEC amending Council Directive 70/220/EEC

(OJ No L 36, 09.02.1988)

This Directive establishes more stringent standards for cars below a total mass of 2500 kg divided into three engine size classes. Different values (CO, HC + NO_x) are set to be enforced within established dates.

Council Directive 89/458/EEC amending Council Directive 70/220/EEC

(OJ No L 226, 03.08.1989)

This Directive introduces more stringent European standards for cars with an engine capacity below 1400 cm³. These standards are based on the performance of the best available technology, i.e. the three way catalytic convertor with closed-loop control.

Proposal for a Council Directive amending Council Directive 70/220/EEC

(OJ No C 81, 30.03.1990)

This proposal commits the Community to align the emission standards for cars having an engine capacity equal to or more than 1400 cm³ to those for cars below that capacity. These standards shall apply at the same dates, i.e. from 1 July 1992 for new types and from 31 December 1992 to the first registration of all new cars. Furthermore, these standards shall be adapted, for all car categories, to the improved test procedure including an extra-urban driving sequence.

Passenger cars – Emissions of diesel particulates

Council Directive 88/436/EEC amending Council Directive 70/220/EEC

(OJ No L 214, 06.08.1988)

This Directive establishes the first European standards for particulate emissions from diesel powered passenger cars. It requires the introduction of a second stage for these standards by the end of 1989. It is

proposed to introduce more stringent ones for the emission of particulates together with those for gaseous emissions.

Commercial vehicles (diesel engines)

Council Directive 88/77/EEC on the approximation of the laws of the Member States relating to the measures to be taken against the emission of gaseous pollutants from diesel engines for use in vehicles

(OJ No L 36, 09.02.1988)

This Directive is related to measures to be taken against the emission of gaseous pollutants from diesel engines used in vehicles. It introduces the control of CO, HC and NO_x emitted.

Article 6 of this Directive commits the Community to consider a further reduction of the limit values of the three gaseous pollutants and the introduction of the control of particulate emissions. To this end the Commission prepared the following:

Proposal for a Council Directive amending Council Directive 88/77/EEC

COM(90) 174 final

The main points of this proposal concern: the test procedure agreed upon, the introduction of more severe European standards in two stages and the fuel properties.

Further information can be obtained from:

P. Perera, P. Hecq, DG XI/B3, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2361670.

New Orientations of the Urban Environment Policy

On his appointment as Commissioner for the Environment, Mr. C. Ripa di Meana gave priority consideration to the Commission policies and actions aimed at solving the major environmental problems faced by towns and cities in the EC.

Since 1989 an interservice group led by DG XI has been working on the preparation of a Commission discussion document entitled "**Green Book on the Urban Environment**" which reviews the problems, analyses the causes and from that analysis proposes potential lines of action. It has been discussed by the Commission at the end of May pending its publication in all official languages to be submitted to the Council and Parliament. A more detailed analysis of the final document will appear in a future issue of Environmental Research Newsletter.

Further information can be obtained from:

P. Perera, N. Hanley, DG XI/B3, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2361670.

EEC Policy to Reduce Photochemical Pollution

Conclusions of studies and programmes undertaken by the Commission indicate that a significant reduction in photochemical pollution is both possible and necessary at Community and international levels.

Various ozone formation and transport models developed and tested to determine the required reduction of precursors' emissions to bring ozone concentration down to a lower level than that at which health or ecosystems are affected indicate that, for central and northern European countries:

- reduction in VOC and NO_x emissions lower ozone concentrations;
- reduction in VOC emissions appear always to have a positive effect while NO_x reductions sometimes induce counter productive effects in the low troposphere (especially in the regions with low ozone concentrations) but apart from that it always seem to have a positive effect on the reduction of tropospheric ozone formation. NO_x reduction must nonetheless be part of efforts to control acidification of the environment;
- ozone behaviour varies according to region and is mainly influenced by the NO_x/VOC ratio;
- reduction of ozone as a function of NO_x and VOC reduction is less than proportional. Substantial VOC and NO_x emission reduction (of the order of 50%) is needed to cause a significant decline of the ozone formed during episodes of photochemical pollution.

Main anthropogenic sources of precursors in the Community (in % of total man-made) are :

- for VOC: road traffic (47%); industrial use of solvents (19%); non-industrial use of solvents (16%)
- for NO_x: road traffic (42%); power stations (22%); other combustion installations (17%).

The complexity of the phenomena (emission, chemical reactions, transport) leading to the formation of photochemical oxidants, their variability in terms of time and scale and the non-negligible levels of ozone naturally produced are factors which have to be taken into account. Consequently an approach combining air quality objectives and concrete measures to reduce precursor emissions from various sectors seems to be more suited.

The Community has already adopted **legal measures to reduce NO_x emissions by large combustion installations and motor vehicles:**

Council Directive on the limitation of emissions of certain pollutants into the air from large combustion plants

(OJ No L 336, 07.12.1988)

Council Directives on motor vehicle pollution

(see above)

Full implementation of these measures should result optimistically in an

(VOCs) because of their key role as precursors of photochemical oxidants. VOC measurements should provide input data to models predicting photochemical air pollution while monitoring trends in the atmosphere. An attempt will be made to check the effects of emission reduction programmes, and other legislation on VOC emissions (e.g. regarding the use of unleaded fuel).

The working group, which was established in spring 1989 has the following tasks:

- to define a list of VOCs to be measured with priority as function of their importance for photochemical oxidant formation;
- to recommend sampling and analysis methods;
- to give guidelines for the selection of measurement sites and for the subsequent treatment of the data obtained.

The working group has so far established the list of VOCs to be measured with priority together with the analytical techniques to be used. An intercalibration campaign that will allow the involved laboratories to check the accuracy of their VOC measurements is in preparation. The working group is expected to elaborate the subsequent points by the end of 1990.

To fulfill the various tasks requested by the Commission and Member States, establishment of a reference laboratory as well as a new mobile laboratory for the measurement and the calibration of air pollution is underway.

Further information can be obtained from:

- M. Payrissat, Tel. +39 332 789118
- E. Desaegeer, Tel. +39 332 785841
Environment Institute, CEC-JRC Ispra, I-21020 Ispra.

3.2. EMEP Station at the Environment Institute of the JRC Ispra

The Evaluation and Monitoring European Pollution (EMEP) programme is a Cooperative Programme for Monitoring and Evaluation of the Long Range Transmission of Air Pollutants in Europe. It is carried out under the auspices of the Economic Commission of Europe (ECE) and the United Nations Environment Programme (UNEP). Its main objective is to provide governments with information on the concentration and deposition of air pollutants and on the quantity and significance of pollutant fluxes across national boundaries.

By the end of 1980 EMEP data were collected at 90 measurement sites in 25 European countries.

The EMEP monitoring station was set up at the JRC Ispra following Council Resolution No 81/462/EEC article 9 which led to the active participation of the Commission's services (DG XI and JRC Ispra). Since November 1985 (see also Environmental Research Newsletter N° 2) this station is working on a regular and continuous basis and data are transmitted monthly to the Norwegian Institute for Air Research (NILU) for analysis and evaluation together with the data from other participating countries within the programme.

Sulfur dioxide, nitrogen oxides (NO, NO₂) and ozone in air are monitored continuously for hourly and daily average concentrations.

Other acidic species as hydrochloric, nitric acids, etc. or basic species as ammonia, (by annular denuder technique) as well as carbon monoxide, PAN, methane and non-methane hydrocarbons (by FID technique) are occasionally measured.

Sulfate, nitrate, ammonium, total suspended particulate and acidity in atmospheric particulate are measured on daily average samples. Heavy metals are sampled with 3 to 7 day sampling periods.

Daily average precipitation samples are analysed for sulphate, nitrate, chloride, ammonium, sodium, potassium, calcium, magnesium, pH, electrical conductivity and acidity.

Heavy metals are determined occasionally in 24 hours and monthly average samples.

Wind direction, wind speed, temperature, relative humidity, atmospheric pressure, solar radiation and precipitation are monitored continuously.

Detailed results obtained at the JRC EMEP Station are reported in annual reports.

A comparison between point chemical monitors at EMEP Station and long open path DOAS system set up in the JRC for monitoring some atmospheric pollutants (ozone, sulphur dioxide, nitrogen dioxide, formaldehyde etc.) has been recently undertaken.

Further information can be obtained from:

- G. Serrini, tel. +39 332 789977
- W. Leyendecker, tel. +39 332 789419
Environment Institute, CEC-JRC Ispra, I-21020 Ispra.

EC Regulatory Action

Most of the EC regulatory actions on air quality (product norms, air quality standards, limit values for pollutant emissions from specific sources, transboundary air pollution, monitoring and information exchange systems) managed by DG XI have been reviewed in Environmental Research Newsletter N° 2.

The information given here update the most recent actions concerning the quality of urban environment including air quality standards and emissions from motor vehicles. It also presents new orientations of the urban environment policy. Measures to reduce photochemical pollution are also reported.

Quality of the Urban Environment

Air Quality

Development of a Data Bank on the Quality of Air in the Member States of the EC

A comprehensive information on the quality of air has become essential to: (i) identify potential problem areas and define priorities on environmental policy, (ii) report on air quality in a harmonized form to institutions, organisations and the public at large in all EC Member States, (iii) check to which extent the EC air quality limits and guide values for SO₂, particulates, NO₂ and Pb are approached.

A pilot study over Benelux has been completed to investigate how a data bank could meet the targets outlined above. Encouraging results have led to an extension of the study to all Member States. Initiated in 1985, results are foreseen by end 1990.

Air Quality Directives

Council Directive 89/427/CEE amending Council Directive 80/779/EEC (SO₂-particles) (OJ No L 201, 14.07.1989)

In accordance with the requirements of the Directive 80/779/EEC (see Environmental Research Newsletter N° 2), the Commission made a proposal relating to article 10(2) and Annex IV taking into account the results of parallel measurements carried out under Article 10(3) and the need to avoid discriminatory provisions.

The present revision is limited and a further review in general and in particular of the limit values will be needed considering ongoing research on suspended particulates. The Commission plans to submit proposals along these lines to the Council in 1992 or 1993.

Halogen oxide reactions of importance for the lower stratosphere – Halox

The objective is to provide the necessary kinetic and mechanistic data to make a critical assessment of the role of the important species and reactions regarding stratospheric ozone depletions. The project includes the study of formation and reactions of dimers of ClO, reactions between halogen oxide radicals and peroxy radicals and reactions in the coupled BrO-ClO system.

Participating institutes:

- CNRS Chimie de la Combustion et des Hautes Températures, Orléans, France (G. Poulet, project leader);
- United Kingdom Atomic Energy Authority Harwell Laboratory, UK (G.D. Hayman);
- Max Planck Institut für Chemie, Mainz, FRG (J.P. Burrows);
- Dept. of Physical Chemistry, University of Oxford, UK (R.P. Wayne).

Interpretation of stratosphere monitoring by ground based ultraviolet and visible spectrometers

The objective is to increase the accuracy of stratospheric measurements by appropriate model simulations of the atmospheric radiative transfer and large scale transport.

Participating institutes:

- Service d'Aéronomie du CNRS, Verrières-le-Buisson, France (J.P. Pommereau, project leader);
- British Antarctic Survey, Cambridge, UK (H.K. Roscoe);
- University of Cambridge, UK (J.A. Pyle);
- Norwegian Institute for Air Research, Lillestrøm, Norway (G.O. Brathen);
- Danish Meteorological Institute, Copenhagen, Denmark (T.S. Jorgensen);
- Institut d'Aéronomie spatiale, Brussels, Belgium (P.C. Simon);
- Instituto Nacional de Técnica Aeroespacial, Torrejón de Ardoz, Spain (M. Gil);
- Université de Lille, France (J. Lenoble);
- FISBAT-CNR, Bologna, Italy (G. Giovanelli);
- Finnish Meteorological Institute, Finland (S. Joffre);
- Max Planck Institut für Luftchemie, Mainz, FRG (D. Perner).

Modelling the dynamics, transport and chemistry of the lower stratosphere at mid and high latitudes in the northern hemisphere

The objective is to improve the chemistry, radiation, dynamics and transport by developing models which couple 3D dynamical with photochemical models.

Participating institutes:

- Service d'Aéronomie du CNRS, Toulouse, France (D. Cariolle, project leader);

- Laboratoire de Physique et Chimie de l'Environnement, Orléans, France (M. Pirre);
- Service d'Aéronomie du CNRS, Verrières le Buisson, France (H. Le Texier);
- Rutherford Appleton Laboratory, Oxon, UK (L. Gray);
- University of Cambridge, UK (J. Pyle);
- Meteorological Office, Bracknell, UK (A. O'Neill);
- Max Planck Institut Mainz, FRG (P. Crutzen);
- FU Berlin, FRG (K. Rose);
- Universität Köln, FRG (A. Ebel).

Following the call for proposals published in OJ C 248, 29.09.1989, 6 projects were proposed for funding. The selected projects will lay the groundwork for the organization of a European Arctic campaign in the winter 1991/92 (see below).

Arctic Ozone Campaign (1991-1992)

The overall aim of this campaign will be to determine the extent of ozone depletion occurring in the north polar stratosphere during the winter season, and to investigate the extent to which processes in the arctic influence the lower stratosphere at mid latitudes.

It is planned to make an extensive use of ground based instrumentation, balloons, probes as well as aircraft and satellite data to map the temporal and spatial development of the concentration of ozone and related trace species including PSCs in the lower stratosphere over the winter and spring months.

During a preliminary planning meeting for the campaign on 14 December 1989 in Bracknell, four specific topics were agreed: (i) vortex structure and evolution; (ii) fast response chemistry of catalysts and reservoirs; (iii) ozone structure and trends; and (iv) denitrification and the role of PSCs. A second planning meeting grouping experts in these topics was held in Cambridge on 8-9 March 1990.

A first assessment of the overall cost of the campaign and of the necessary follow-up activities including post mission data analysis resulted in an amount of some 11.5 MECUs for a 3 years' period.

First European Workshop on Stratospheric Ozone Depletion

The workshop jointly organised by the CEC and the BMFT of FRG is scheduled for 3-5 October 1990 in Schliersee, Bavaria, FRG. It will cover the following topics: (i) dynamics; (ii) ozone structure and trends; and (iii) PSCs and chemistry.

Further information on this activity and on the workshop can be obtained from:

J.H. Büsing, DG XII/E1, CEC, 200 rue de la Loi, B-1049 Brussels.
Tel. +32 2 2355625.

3. Support activities

3.1. Central Laboratory for Air Pollution at the Environment Institute of the JRC Ispra

The JRC Central Laboratory for Air Pollution (CLAP) provides to the Commission the technical support for implementing EC Directives on air quality standards (see also ERN N° 2).

A large part of its tasks consist in the harmonization of the measuring and calibration methods used in Member States.

As a follow-up of the activities performed in the previous years, the CLAP has been involved in the following actions:

- Completion of a second quality assurance programme (QAP/2) directed to SO₂ routine measurements in the European air quality networks, in the frame of a First Common Measurement Programme. The intercomparison which involves calibration tests and parallel measurements during 24-hour periods was performed in 35 measuring stations using a specially equipped mobile laboratory. A programme for the harmonisation of the NO₂ directive will be launched under request of the Member States.
- Design and construction of a test atmosphere generator, capable of generating variable gas mixtures at a high flowrate, to control the

efficiency of the sampling lines in the measuring station. This device will be implemented in the course of the next QAP for the NO₂ directive.

- Preparation of an instruction manual for the measurement of SO₂ and Black Smoke in the air quality networks with the support of national institutes in the Member States. This manual will contain recommendations for a good measuring practice and is intended for technicians at measuring network level.
- Six months-measuring campaign in the Paris area using the diffusion tube technique for mapping the NO₂ pollution, as a support to the improvement of the network design. This pilot study allowed to obtain scientific criteria for the selection of measuring sites to redesign the Paris network. Similar action has been launched recently for the Rouen-Le Havre area and another one is foreseen for the Madrid area later this year.

Another part of the Central Laboratory activities concerned preparatory studies necessary to establish a basis for a future directive concerning photochemical oxydants.

In this framework the JRC-Ispra was asked to establish and coordinate a working group on measurements of volatile organic compounds

2. Stratospheric Chemistry and Ozone Depletion

EC/EFTA Programme on Stratospheric Ozone Depletion

The **general objective** of the programme managed by DG XII/E is to develop an understanding and a data base permitting assessment of the impact of anthropogenic emissions on stratospheric processes leading to ozone depletion.

The following six priority research areas have been identified: (i) climatology of ozone and related atmospheric species in the northern mid- and high latitudes; (ii) distribution and trends of solar UV flux at ground level in Europe; (iii) dynamics and composition of air in the lower stratosphere; (iv) polar stratospheric clouds in the north polar stratosphere; (v) chemistry of ClO_x and NO_x molecules in the polar stratosphere; and (vi) consequences for climate of variations in the circulation and stratosphere-troposphere exchange, which may be induced by changes in stratospheric composition.

Participating countries include EC countries, Norway, Finland, Sweden and Switzerland.

Implementation of the programme is through research projects funded at national and Community level in the framework of the EC research programmes STEP and EPOCH (see list below).

Co-ordination is promoted by the **Task Group "EC/EFTA European Stratospheric Ozone Research"** established in 1989 in the framework of the COST Project 611 and consisting of a **Coordination Unit** hosted by the British Antarctic Survey, Cambridge and a **Science Panel** composed of 14 senior scientists from EC and EFTA countries (see also Environmental Research Newsletter N° 4, p. 30).

Shared-cost projects

Two Calls for Proposals have been launched in the field of Stratospheric Chemistry and Ozone Depletion (OJ No C 162, 29.06.1989; OJ No C 248, 29.09.1989). These calls referred to the following topics: (i) laboratory experiments on: low temperature homogeneous gas-phase chemistry, low temperature heterogeneous reactions, low temperature photochemistry, micro-physics of phase changes, spectroscopy; (ii) field measurements, eventually including both episodic campaigns and long-term trend studies, on: ozone and related parameters, long-lived trace gases and aerosols, UV-B intensity, trace species which may be critical factors in ozone changes; and (iii) modelling of polar ozone phenomena, of atmospheric response to changes in emissions and in support of field campaigns.

Nine projects were selected from the proposals received in response to the first call published in OJ No C 162, 29.06.1989. The starting date was March 1990.

Data analysis to detect trends in stratospheric temperature

The objective is to better determine climatic change from the analysis and comparison of the best available stratospheric temperature data.

Participating institutes:

- Service d'Aéronomie du CNRS, Verrières-le-Buisson, France (M.L. Chanin, project leader);
- Meteorological Office, Bracknell, UK (A.O. Neill);
- FU Berlin, FRG (K. Labitske);
- CNRS, Palaiseau, France (A. Ghedin);
- Istituto di Fisica dell'Atmosfera, CNR, Frascati, Italy (G.P. Gobbi).

Modelling of changes in stratospheric ozone and other trace gases due to emission changes

The objective is to further develop existing 2-D models to: (i) understand the interaction between dynamics, chemistry and radiation in the stratosphere with emphasis on the Arctic region, (ii) improve modelling capacity within the European research community for the prediction of future changes in ozone as a result of changes in emissions and (iii) develop dynamical/chemical models which can support observations aimed at detecting long-term changes in the ozone distribution.

Participating institutes:

- University of Oslo, Norway (I. Isaksen, project leader);
- Service d'Aéronomie du CNRS, Paris, France (C. Granier);
- Università degli Studi, L'Aquila, Italy (G. Visconti);
- Institut d'Aéronomie Spatiale de Belgique, Brussels, Belgium (A. de Rudder);

- Danmarks Meteorologiske Institut, Copenhagen, Denmark (N. Larsen).

European stratospheric monitoring station - ESMOS

The objective is to establish coordinated measurements at European research stations for stratospheric studies located at mid- and high latitudes (Jungfraujoch, Switzerland; Observatoire de Haute Provence, France; Observatoire de Bordeaux, France; Hohenpeissenberg, FRG; various stations in Switzerland; Spitsbergen, Norway) to (i) provide the earliest detection of possible changes in stratospheric composition and structure, (ii) understand the aeronomic processes involved in short-term variations of ozone and related species, (iii) provide comprehensive measurements of stratospheric constituents. This information will supply "ground truth" for current and planned satellite observations.

Participating institutes:

- Institut d'Aéronomie Spatiale de Belgique, Brussels, Belgium (P. Simon, project leader);
- Université de Liège, Belgium (L. Delbouille);
- Université P. & M. Curie ADFAC, Paris, France (S. Godin);
- Université de Bordeaux, France (J. De La Noe);
- Universität Bremen, FRG (K. Künzi);
- National Physical Laboratory Teddington, UK (P. Woods) and Institute of Applied Physics, University of Bern, Switzerland.

SIDAMS - Atmospheric trace gas mass spectrometry with simultaneous ion detection: a new approach

The objective is to determine in situ the concentration of various stratospheric trace gases by measuring positive and negative ion composition simultaneously with a new second generation balloon-borne mass spectrometer offering a higher mass and spatial resolution, an increase in absolute sensitivity and a reduced fragmentation of complex ions by using either passive or active chemical ionization methods (e.g. H_2O , CH_3CN , HNO_3 , H_2SO_4 , N_2O_5).

Participating institutes:

- Institut d'Aéronomie Spatiale de Belgique, Brussels, Belgium (E. Arijs, project leader);
- Laboratoire de Physique et Chimie de l'Environnement, CNRS Orléans, France (A. Barassin);
- Physikalisches Institut der Universität Bern, Switzerland (E. Kopp).

Interactions of stratospheric aerosols and trace gases in relation to ozone depletion

The objectives are to: (i) investigate physical and chemical processes involving particles of PSCs and the potential role of these processes in the chemistry of the stratosphere, (ii) to develop models of aerosol catalysed reactions relevant to the depletion of ozone and (iii) to compare laboratory results with those from balloon- and rocket-borne field experiments.

Participating institutes:

- CNRS, Saint Martin D'Hères, France (J. Klinger, project leader);
- Max Planck Institut für Kernphysik, Heidelberg, FRG (F. Arnold);
- CNRS, Orléans, France (J.C. Petit);
- University of Cambridge, UK (D.C. Clary).

Transport of ozone and stratosphere/troposphere exchange

The objective is to study: (i) stratosphere/troposphere exchange, (ii) transport processes in the lower stratosphere, (iii) radiative effects in the lower stratosphere, (iv) small scale processes as well as the nature of mixing the lower stratosphere. The project combines observations (ground-based and air-borne) with modelling and data interpretation.

Participating institutes:

- Science and Engineering Research Council, Swindon, UK (L. Gray, project leader);
- Service d'Aéronomie du CNRS, Paris, France (G. Mégie);
- Centre de Recherche en Physique de l'Environnement, Saint Maur des Fosses, France (F. Bertin);
- Max Planck Institut für Aeronomie, Lindau, FRG (R. Ruster);
- University College of Wales Aberystwyth, UK (G. Vaughan);
- University of Athens, Greece (C. Varotsos);
- FU Berlin, FRG (K. Labitzke);
- The Meteorological Office, Bracknell, UK (R. Jones);
- University of Reading, UK (B.J. Hoskins).

A call for proposals was published in OJ No C 326, 30.12.1989 with a deadline of 30 March 1990. Fifteen proposals originated from EC Member States as well as EFTA countries. Evaluation of proposals will be completed by end of June 1990 and final selection by 16 July 1990.

Further information can be obtained from:

J.H. Büsing, DG XII/E1, CEC, 200 rue de la Loi, B-1049, Brussels.
Tel. +32 2 2355625.

EC Regulatory Action

Most of the EC regulatory actions on waste managed by DG XI have already been reviewed in Environmental Research Newsletter N° 3.

Community Strategy for Waste Management

The informations given here update the most recent actions in the framework of the Community Strategy for Waste Management adopted by the Commission on 13 September 1989 (SEC (89) 934 final, 18.09.1989). The strategic guidelines of the Community action are:

- **Prevention:** promotion of clean technologies and development of a "green" label for "ecoproducts".
- **Recycling and re-use:** actions to promote re-use, regeneration and recycling by legal measures concerning specific waste streams (plastic, metal cans) and complementary instruments such as recyclable-waste exchange systems.
- **Optimization of final disposal:** treatment of waste to reduce its volume or potential harm prior to dumping, establishment of standards ensuring a high level of environmental protection and concerning site selection, site development, site operation, pre-treatment of the waste dumped, type of waste accepted, post-closure supervision; standards for industrial waste incinerators and phasing out of dumping and incineration at sea.
- **Transport:** continuation of ongoing actions.
- **Remedial action:** support of identification and rehabilitation techniques for contaminated land from former waste dumping and industrial sites.

The Strategy document takes position on waste movements in view of 1993. Actions include:

- Proposals for adapting the notification and control systems for trans-frontier shipments of waste and coordination by the Commission of the implementation and backup for waste disposal plans.
- Development of criteria for limiting waste movements based upon the principle that waste should be disposed of in one of the nearest suitable plants respecting high standards.

On 22 March 1990 the Environment Council adopted a **Resolution supporting the Commission's strategy** (OJ C 122, 18.05.1990)

The Council largely endorsed the actions announced by the Commission and states the necessity for the Community as a whole and for Member States to become self-sufficient in waste disposal. The Council also underlines the need for a Community-wide network of adequate waste disposal facilities based upon harmonized standards and recalls the Member States' obligation to create such an infrastructure.

New proposals for Council Directives

Proposal for a Council Directive attributing civil liability to the producer for damage caused by waste (OJ No C 251, 04.10.1989)

This proposal aims at facilitating the position of the victim of such damages, at inciting the producers to use clean technologies and at approximating Member States' legislations. At the same time, it contributes to the precision of the polluter-pays principle.

The proposal's scope is restricted to waste generated in the course of an occupational activity from the moment it arises; it therefore excludes used products thrown away by the consumer.

The strict liability, whilst in general resting on the producer, is transferred to:

- *the importer*, in case of import into the Community;
- *the holder*, in case the producer is not identified or in case the waste is transiting through the Community;
- *the authorized person* responsible for the disposal facility, once the waste has been *lawfully* transferred to such facility.

In case of multiple producers, they will be liable jointly and severally. The proposal is not limited to the "classical" damages: it equally includes actions resulting from injuries to the environment, provided these are significant and persistent.

Proposal for a Council Directive modifying Council Directive 75/442/EEC on waste

(original proposal: OJ No C 295, 19.11.1988; modified proposal: OJ No C 326, 30.12.1989)

This proposal for a Framework Directive made in August 1988 is now under discussion in the Council of Ministers. The European Parliament gave an opinion in May 1989 and basically endorsed the Commission's proposal. It also proposed a number of amendments aiming at amongst others excluding secondary raw materials or giving them a special status in EEC waste legislation. The Environment Ministers have reached an agreement on this text at their meeting on 7 June 1990 and will send it to the European Parliament for second reading.

Proposal for a Council Directive on hazardous waste

(original proposal: OJ No C 295, 19.11.1988; modified proposal: OJ No C 42, 22.02.1990)

The proposal which is a daughter Directive of the above Framework Directive, has not yet been discussed by the Council since it obviously depends upon the first one.

The Parliament's opinion, given in May 1989, showed some concern that the proposal was not stricter than the existing Directive 78/319/EEC which is to replace.

The main objective of the Commission was to introduce a new definition of hazardous waste based on the definition agreed in OECD. These definitions broaden the field of application considerably, since they define more types of waste as hazardous compared to the Directive 78/319/EEC.

Action programmes on priority waste streams

The Commission has initiated a new activity aiming at identifying together with Member States priority waste streams requiring special attention, analyzing the problems of these individually and developing action programmes for each of them. These programmes should reflect a comprehensive approach and envisage measures at the level of prevention, recycling and final disposal.

The approach is based upon the Dutch PRIAF project and features early involvement of all parties concerned by the problem and the measures in order to reach a maximum of consensus prior to actions. At present the Commission is identifying the waste streams to be covered in a first phase, and has already embarked, in the meantime, on the themes: packaging, plastics, tires and halogenated hydrocarbons.

News on other proposals for Council Directives

Proposal for a Council Directive on used batteries and accumulators containing heavy metals

(OJ No C 6, 07.01.1989)

The Commission presented a modified proposal which takes into account the opinion of the European Parliament (OJ No C 11, 17.1990). The Council of Ministers has adopted a common position on this proposal on 7 June 1990.

The Directive introduces a compulsory labelling scheme for certain types of batteries containing mercury. It also prohibits the marketing of certain batteries containing more than 0.025% cadmium from 1.1.1993.

It requires Member States to take appropriate measures to ensure that labelled batteries are collected and disposed or recycled separately. To this end deposit schemes can be introduced provided they do not create trade barriers. The producer or importer into the Community should bear the disposal cost.

Proposal for a Council Directive on the disposal of polychlorinated biphenyls and terphenyls

in replacement of Directive 76/403/EEC (OJ No C 319, 12.12.1988)

The Environment Committee of the European Parliament is discussing a report on this proposal which aims at reinforcing the controls and at extending them to all PCBs/PCTs (not only used ones) as regards certain provisions.

Council Directive 86/278/EEC on the use of sewage sludge in agriculture: inclusion of limit values for chromium

(OJ No L 181, 04.07.1986)

The Commission has just presented a modified proposal which takes

into account the request by the European Parliament to fix stricter values for chromium than those proposed by the Commission originally. With this proposal the Commission has fulfilled a commitment contained in the Directive from 1986 to propose limit values for chromium at a later stage, since the scientific base was considered insufficient at the time of adoption of the Directive.

Further information can be obtained from:

J.-M. Junger, K. Rudischhauser, DG XI/A4, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2355442.

Other Activities Relevant to EC Environmental Programmes

Actions by the Community relating to the Environment: ACE Programme (DG XI)

On 23 July 1987, the Council adopted **Regulation (EEC) N° 2242/87** (OJ No L 207, 29/07/87) on action by the Community relating to the environment, which replaced Council Regulation 1872/84 (OJ No L 176, 03/07/84), extending its scope (see also Environmental Research Newsletter N° 3, February 1989).

Under this Regulation, three calls for tenders for demonstration projects were published:

1. OJ No C 82, 30/03/88 (closing date: 30/06/88)

This action dealt with the development of new clean technologies (a) and the development of techniques for recycling and reusing waste (b).

Out of 101 proposals (total cost: 328 MECU), 24 were initially selected for financial support (5,4 MECU) and 21 contracts were signed. All of the 21 projects started between November 1988 and January 1990.

The title of the projects and the responsible organisation are:

- Progetto ERA-Reduction of the pollution load of olive mill waste waters.
Unieco, S.c.r.l., Reggio Emilia, Italy.
- Recovery of nickel from diluted industrial waste waters through the pellet reactor technology.
DHV Consulting Engineers International, B.V. Amersfoort, The Netherlands.
- Aluminium and salt recovery from slags from aluminium smelters.
Andaluz de recuperacion de sales, S.A., Almeria, Spain.
- Development of a recovery system for polluting metals (cadmium) from industrial effluents.
Ecole Nationale Supérieure d'Ingénieurs de Génie Chimique, Toulouse, France.
- Development of a new, dry paint-stripping system to replace the use of solvents.
Schlick roto-jet maschinenbau, GmbH, Metelen, FRG.
- Recycling of chromium as tanning agent.
Ministry of Environment, Greece.
- Recuperation of solvents by means of adsorption on active carbon tissue.
AMEG France, Paris, France.
- Recovery of phenols in the production of phenol-formaldehyde resins.
Sonae, Industria e Investimentos, S.A., Maia, Portugal.
- Removal of zinc, cadmium and lead from dust arising at electric furnace steel works.
IMS Lycrete, Ltd, London, UK.
- Recovery of zinc, copper and nickel from dilute solutions, applying the E.P.P.P. technology.
INASMET, San Sebastian, Spain.

- Processing of waste gases from the drying of olive press cake.
PROTECHNA, Ltd, Athens, Greece.
- Recovery of lead from scrap batteries.
GINATTA, S.p.a., Torino, Italy.
- Recuperation of heavy metals (zinc, lead) contained in dust arising from steel works.
Torchiano Renzo, S.r.l., Brescia, Italy.
- Tangential microfiltration to reduce cadmium emission.
Société Languedocienne de Micron Couleurs, Narbonne, France.
- Wetblue project-Purification process reducing salt, chromium and organic residues in waste waters from tanneries and slaughterhouses.
Coöperative Vereniging "Amsterdamse Huidenclub" B.A., Nijmegen, The Netherlands.
- Bleaching of wood-containing waste paper.
Papierfabriek Gennepe, Gennepe, The Netherlands.
- Reduction of chromium consumption in the tanning industry.
The British Leather Company, Ltd, Birkenhead, UK.
- Processing of sludge from paper mills.
Recymat, v.z.w., Brugge, Belgium.
- Recovery of pigments, binding agents and solvents in paintshops.
Chemische Werke Kluthe GmbH & Co, Heidelberg, FRG.
- Reduction of the fluorine concentration in waste waters from chemical treatment operations.
Cristalleries et Verreries d'Art de Vianne, Lavardac, France.
- Utilization of waste organic solvents in lime production.
Fortom Chimica, S.r.l., Vicenza, Italy.

2. OJ No C 178, 14.07.1989 (closing date: 14.11.1989)

This action dealt with the development of techniques for locating and restoring contaminated sites (c) and the development of techniques and methods for measuring and monitoring the quality of the natural environment (d).

Out of 116 proposals, 34 dealing with item (c) and 61 with item (d), 21 were rejected for non-conformity with the prescriptions of the call for tenders.

Ninety five proposals have been evaluated out of which 21 projects for a global amount of 5.422.000 ECU are being proposed to the Commission for financial support.

3. OJ No C 134, 01.06.1990 (closing date: 30.06.1991)

Invitation to submit proposals for demonstration projects on the following subjects:

- a. Separation, treatment and valorisation of plastic refuse arising from:

(i) commerce and industry; (ii) agriculture waste; and (iii) urban waste (including separation of plastics from other constituents at the collection phase).

b. Valorisation and recycling of used non retreadable tyres.

Application form (compulsory) and questionnaire for this call for tenders as well as further information on the above can be obtained writing to:
CEC, DG XI/C2, Environmental Programme A.C.E., 200 rue de la Loi, B-1049 Brussels.

Protection and Conservation of European Cultural Heritage

EC Research Programme and Support Activities to the Commission

Information on activities managed by DG XII/E in the framework of the **4th Environmental R&D Programme (1986-1990)** was given in Environmental Research Newsletter N° 2 in research area "Air Quality", topic "Effects of air pollution on historic buildings and monuments".

The aim of the EC programme is to improve understanding of the mechanisms of pollution damage to historic buildings and monuments, to quantitative damage functions and to help provide a scientific basis for conservation and restoration. Cooperation was established with the EUREKA Project EUROKARE concerned with the development of conservation materials and techniques based on the best multidisciplinary expertise available (see also Environmental Research Newsletter N° 4).

A coordinated project on "Effects of air pollution on historic buildings and monuments" grouping ten shared contracts was started in 1987. Progress reports are available on request.

A European Symposium on "Science, Technology and European Cultural Heritage" was organised jointly by the CEC, the National Research Council of Italy (CNR) and the University of Bologna, Bologna (Italy), 13-16 June 1989.

Presentations and discussions concerned environmental risks, impacts, causes, mechanisms and measurement of damage as well as conservation, restoration and maintenance. Case studies included: Trajan's Column, Sistine Chapel, statue of Marco Aurelio in Rome(I), Pantheon in Paris (F), Wells Cathedral (UK), portal of Lausanne Cathedral (CH), Book of Kells (IRL), Acropolis restoration programme (Gr) and in situ conservation at archaeological sites.

Proceedings are in press.

European Cultural Heritage Newsletter on Research is published and distributed free of charge by the CEC. It is addressed to individuals and

institutions concerned with research, conservation, administration, etc. in the field of preservation of cultural heritage. It contains interdisciplinary notes, reports on research projects supported by the CEC and on research activities at national level, information on the EUREKA Project EUROKARE involved in the development of conservation materials and techniques, abstracts, book reviews, meeting reports, forthcoming events, essays, etc. The newsletter is edited by Michel Benarie, 12 rue de l'Yveline, F-91220 Brétigny.

Programme STEP (1989-1992) includes a specific research area devoted to Protection and Conservation of European cultural heritage. It covers three topics :

- Materials, environmental factors and damage: identification and assessment of the role of the main environmental factors causing damage to cultural property and materials.
- Measuring environmental damage: development, transfer and application of suitable techniques to identify and quantify damage due to environmental factors.
- Scientific and technical support for conservation, restoration and maintenance: improvement and application of scientific understanding and technical capability in support of basic strategies, standards, materials and technologies used in conservation practice.

Fifty five proposals were submitted in response to the call for shared-cost proposals (OJ No C 326, 30.12.1989). They are being processed for a final evaluation.

Further information can be obtained from:

A. Sors, DG XII/E1, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2357659.

Other Activities Relevant to EC Environmental Programmes

Support for pilot projects to conserve and promote the Community's architectural heritage

An action of financial support to conserve and promote the Community's architectural heritage is managed by the "Cultural Action" Division of DG X (Information, Communication and Culture), since 1984, in the framework of its annual pilot-projects scheme. This action is based on the awareness of the manifold importance attached to the preservation of the European architectural heritage in cultural, social and economic terms.

The 1989 to 1992 support programme has accordingly been designed to reinforce the interdependence between these three sectors by focusing on the effect that investment in Europe's past can have on its future cultural, social and economic development.

The limited financial resources available do, however, render this action very selective by concentrating each year on a priority theme.

The 1989 scheme for civil and religious monuments or sites of exceptional interest met with great success. A total of 2.4MECUS was granted to 24 of the 822 projects submitted.

The themes for the next three years are as follows: historic buildings and groups of buildings which define and characterise an urban or rural pattern (1990); testimonies to human activities in industry and agriculture and crafts (1991); integrated upgrading of public spaces in historic centres (1992).

The deadline for submission of proposals corresponding to theme for 1990 was 20 February 1990 (see OJ No C 303, 02.12.89). There have

been 1130 submissions for 1990, a large increase in comparison with the 822 projects submitted in 1989. The final decision will be taken by the Commission on the advice of a European panel of experts by mid-July 1990. Information for the submission of applications to themes for 1991 and 1992 will be published in due time in the Official Journal of the European Communities.

Further information can be obtained from:

- T. Mastrominas, Tel. +32 2 2359946, or
- C. Dupont, Tel. +32 2 2359095,
DG X/2 Cultural Action CEC, 200 rue de la Loi, B-1049 Brussels.

Protection of European cultural heritage against natural hazards

The architectural heritage being a fundamental aspect of European culture and identity, the EEC contributes to its protection through a number of actions. These cover corrosion from chemical pollution and damage from natural or man made catastrophes such as fire, floods, earthquakes, etc.

DG XI in collaboration with the Italian region of Umbria and the National council of architects organized a seminar in Perugia, Italy, on 6-7 April 1990 dealing with prevention and restoration of monuments.

Although a certain amount of agreement exist in the field of prevention, this is not the case for interventions following catastrophes. It is obvious

that pending immediate action further irreversible damage could occur. The seminar discussed these points under a scientific and practical aspect, "therapeutic" interventions of both traditional and new methods taking into consideration political and cultural aspects.

Conclusions reached at this meeting will be submitted for information and eventual initiatives by the Commission to the Council on Civil Protection in October 1990.

Further information can be obtained from:

- F. Paolini, Civil Protection, DG XI, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2351692/2359014.

Information

European Environment Agency – European Environment Information and Observation Network

The establishment of the above (see also Environmental Research Newsletter N° 4, December 1989) has been formalized in **Council Regulation (EEC) No 1210/90** of 07.05.1990 (OJ No L 120, 11.05.1990).

The Agency and the network aim at achieving the environmental protection and improvement laid down by the Treaty and by successive Community action programmes on the environment so as to provide the Community and the Member States with: (i) objective, reliable and comparable information at European level enabling them to take required measures to protect the environment, assess the results of such measures and ensure that the public is properly informed about the state of the environment; (ii) the necessary technical and scientific support; (iii) the forecasting necessary to take adequate preventive measures; and (iv) the stimulation of methods to assess the costs of damage, prevention, protection and restoration.

Principal areas of activity of the Agency will include all elements enabling it to gather the information making it possible to describe the present and foreseeable state of the environment from the points of view of: (i) quality of the environment; (ii) pressures on the environment; and (iii) sensitivity of the environment.

Priority will be given to the following areas: (i) air quality and atmospheric emissions; (ii) water quality, pollutants and water resources; (iii) state of soil, fauna, flora and biotopes; (iv) land use and natural resources; (v) waste management; (vi) noise emissions; (vii) chemical substances hazardous for the environment; and (viii) coastal protection. Particular emphasis will be put on transfrontier, plurinational and global phenomena as well as socio-economic aspects.

Besides the cooperation of the CEC Joint Research Centre, the Statistical Office (Eurostat) and the EC Environmental R&D programme activity, the Agency will also cooperate actively with other bodies such as the European Space Agency, the OECD, the Council of Europe and the International Energy Agency as well as the United Nations and its specialized agencies particularly the UNEP, WMO and IAEA.

Further information can be obtained from:

- Agency Task Force, DG XI, CEC, 200 rue de la Loi, B-1049 Brussels. Telefax +32 2 2350144.

The New Lomé IV Convention and the Environment

The Lomé IV Convention of December 1989 between the ACP and EEC countries includes a specific chapter on environment. This ten year convention underlines that both parties consider the environmental aspect to be of primary importance also in ACP countries. The parties undertake to prevent damage to the environment maintaining as far as possible the ecological balance and conserving natural resources. These considerations will be integrated into short and long term policies at national, regional and international level.

Other important points concern the export of hazardous and radioactive waste from EEC to ACP countries. The provision by the Community of technical information and assistance on the proper use of pesticides and other chemicals is mentioned. The parties have agreed to hold consultations on major ecological hazards and cooperation on environmental problems is expected in agriculture and energy production.

Further information can be obtained from:

- DGXI/C1, CEC, 200 rue de la Loi, B-1049 Brussels. Telefax. +32 2 2350144.

CEC Cooperation with Countries in Central and Eastern Europe

The Commission of the European Community has initiated actions in favour of countries in Eastern and central Europe.

These include the so-called **PHARE Programme** (OJ No C 375, 23.12.1989) which consists in economic assistance to Poland and Hungary. The aid will help the process of reform in these countries and will be in close cooperation with that of the OECD. Projects cover i.a. agriculture, environment and training.

The basic aim of the environment aspect is to include ecology into the

economy which would also consider pollution monitoring systems, new standards for industry and immediate actions on air and water pollution introducing thereby efficient techniques.

A proposal of the Commission to increase **Trans-European Mobility for University Studies** has been made (JO No C 85, 03.04.1990). This programme, so-called **TEMPUS**, aims at coordinating and enhancing exchange and mobility of university students and teachers to improve their training and encourage cooperation with partners in the EC. Students from Eastern European countries will be exchanged with those from the Community to allow also opportunities for teaching and learning foreign languages.

Assistance is foreseen in the form of scholarships, research projects/networks, training courses, conferences, etc. specifically in the above Phare Programme.

Further information can be obtained from:

D. O'Sullivan, CEC, TFHR, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 237295.

EC/EFTA Scientific and Technological Cooperation in the Field of Environmental Protection

Following the expressed desire by EFTA countries for full participation in the Commission's Framework Programme, a clear convergence between the scientific and technological priorities envisaged by the EFTA countries and those of the EC has been noted. Pending conclusion of a global agreement concerning the more formal partnership desire existing collaboration will be continued and increased.

The Fourth R&D Programme on Environmental Protection (1986-1990) allowed either full participation or participation in concerted action projects.

Finland and Norway signed two agreements for full participation which came into force respectively on 12.01.1990 and 23.11.1989. By these agreements both countries will contribute funds for the programme calculated on the basis of a ratio between the national GDP and that of the EC. In return they will have similar rights and obligations as those of Member States, particularly they will be represented on the management committee overseeing the programme and entitled to receive any information resulting from it.

On the other hand, Austria, Sweden and Switzerland signed the Community-COST Concertation Agreement on seven concerted action projects on 01.06.1989, 02.06.1989 and 25.01.1989 respectively. This consists in concertation between the Community concerted action projects and the corresponding national programmes in these EFTA countries so as to increase efficiency of both.

Austria is participating in three projects, namely "Air Pollution Effects on Terrestrial and Aquatic Ecosystems", "Organic Micropollutants in the Aquatic Environment" and "Treatment and Use of Organic Sludges and Liquid Agricultural Wastes". In addition to these three, Switzerland has signed for the project on "Physico-Chemical Behaviour of Atmospheric Pollutants" and "Indoor Air Quality and its Impact on Man". Sweden has agreed to join all seven concerted action projects with the addition of "Coastal Benthic Ecology" and "Protection of Species".

With regards to participation in the STEP (Science and Technology for Environmental Protection) Programme negotiations for draft agreements are in progress.

Further information can be obtained from:

V. Nieto, DG XII/G1, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2357764.

European Better Environment Awards for Industry 1990

Information on this competition was also given in Environmental Research Newsletter N° 4.

Nine hundred entries were received this year by the national organisers in the twelve Member States, and 48 were selected by national juries to be submitted to the European jury appointed by the Commission.

At a ceremony in Paris on 24 April 1990, the Member of the Commission with responsibility for the Environment, Carlo Ripa di Meana, presented the European Better Environment Awards for Industry 1990. These consisted in specially designed trophies for the winners and certificates for highly recommended entrants.

The award winners (A.W.) and highly recommended (H.R.) in the four categories of Awards were:

- **Good Environmental Management Award** for the integration of environmental considerations into overall corporate or site management policy.

A.W.: Yamanouchi Ireland Co Ltd, IR, for a comprehensive environmental protection system at a bulk pharmaceuticals' manufacturing plant.

H.R.: Associated Chambers of Commerce Gelderland, NL, for arranging a comprehensive package to assist small and medium sized companies to set up their own system of environmental control.

Stocksbridge Engineering Steels, UK, for environmental improvements on an old industrial site, in partnership with the local community.

- **Clean Technology Award** for the development and adoption of clean production processes.

A.W.: BP Chemical SA, F, for a low waste gas-phase process for production of high-density and linear low-density polyethylene.

H.R.: Vald. Henriksen A/S, DK, for a continuous dyeing machine for tubular knitted cotton fabric.

- **Eco-product Award** for products which have incorporated environmental considerations, especially recycling and waste reduction into the earliest stages of product planning and design.

A.W.: Société Claude Blaizat, F, for Zéoroll, a refrigeration system without the use of CFCs.

H.R.: Volkswagen AG, FRG, for a smoothly turbo-charged diesel engine with catalyst

Retiflex SPA, I, for a fibrillar net of polypropylene to replace asbestos reinforcing in cement

- **Environmental Technology Transfer Award** for the development and transfer of environmentally sound technological innovation, specifically adapted to the needs of developing countries

A.W.: none

H.R.: Treco Energy System, NV, B, for a wind turbine system.

Further information as well as a booklet entitled "European Better Environment Awards for Industry 1990" can be obtained from:

- C. Stathopoulos, Tel. +32 2 2352463/2359667

- E. Kaiser, Tel. +32 2 2352210

DG XI/C4, CEC, 200 rue de la Loi, B-1049 Brussels.

ERASMUS: European Community Programme for the Mobility of Students and for Cooperation in Higher Education

The programme of **EuRopean Action Scheme for the Mobility of University Students**, (1990-1994), is now in its second phase as approved by the Council on 14 December 1989. ERASMUS II includes 4 lines of actions: (i) European University Network; (ii) student mobility grants; (iii) activities related to academic recognition of diplomas and periods of study; and (iv) a series of complementary measures (support for university associations, ERASMUS award, conferences, etc.).

Requests for ERASMUS scholarships for studies in 1990-1991 are no longer subject to a deadline. Permanent application is now possible, preferably six months before the planned date of the studies. Guidelines for Applicants including application forms for: (i) grants for visits for higher education staff, and (ii) inter-university cooperation programmes (ICPs) including grants for students are available under request (see address below).

ERASMUS Newsletter is published in the nine official working languages of the EC: danish (DA), dutch (NL), english (EN), french (FR), german (DE), greek (GR), italian (IT), portuguese (PT), spanish (ES). It covers all aspects of the EC ERASMUS Programme: ERASMUS inter-university cooperation programme (ICPs), activities of the ERASMUS national grant-awarding authorities (NGAAs), ERASMUS visits, grants to university associations and publications, the European Community Course Credit Transfer System, and the EC National Academic Recognition Information Centres. The Newsletter also covers important new developments in higher education in the EC Member States. Price for the annual subscription: 9 ECU.

Other publications (in the nine languages as above): The Short Guide for Universities; Guidelines for Applicants (see above); Academic recognition of higher education entrance, intermediate and final qualification in the EC.

Further information can be obtained from:

ERASMUS Bureau, 15 rue d'Arlon, B-1040 Brussels. Tel. +32 2 2330111. Telex 63528 COMEUR B. Telefax +32 2 2330150.

Newsletter Biomedical & Health Research European Community

This Newsletter has been recently launched by the Medical Research Division of DG XII/F of the CEC. It will appear two or three times a year and will be distributed free of charge to interested scientists and organizations.

The first issue, now available, reports on various CEC initiatives concerning AIDS, biomedical engineering, health services, medical biology, cancer and epidemiology.

Further information can be obtained from:

M. Hallen, Medical Research Division, DG XII/F6, CEC, 200 rue de la Loi, B-1049 Brussels. Telefax +32 2 2357407.

Environment & Industry Digest

We are informed that this International Newsletter has started publication and that a free launch copy is kindly made available to readers of the CEC Environmental Research Newsletter upon request to:

J.P. O'Hara, Editor Environment & Industry Digest, Scientific and Technical Information, 4 Kings Meadow, Ferry Hinksey Road, UK-Oxford OX2 0DU.

Databases and Information Systems for Research and Development

BIOREP (free of charge)

Database describing biotechnological projects carried out in the 12 Member States of the Community.

Language: English.

Database producer: Library of the Royal Netherlands Academy of Arts and Sciences on behalf of the CEC.

Coverage: approx. 70% of the publicly funded research projects in the EEC Member States (about 7000 records). Regularly updated.

User help support: information online with the command: INFO BIREP.

DIANEGUIDE (free of charge)

Information on databases and databanks, database producers and host organisations available on DIANE (Direct Information Access Network for Europe). Only online databank that gives the users immediate access, to a wide range of information on online services offered in Europe.

Languages: EN, FR, DE, ES, PT, IT.

Database producer: Information Market Development Group, Luxembourg.

Coverage: more than 850 databases in all subject areas. Updated continuously.

User aids: Database manual in English or French free of charge (the manual is to be used together with the ECHO GRIPS manual). Online guidance.

DOMIS (free of charge)

Directory Of Materials Data Information Sources. Online directory of information sources materials and services in Europe (e.g. databanks and bases, technical centres, scientific and technical laboratories, experts, etc.). Areas: metals, alloys and steel; ceramics and glass; composite materials, coating and joints, plastics and rubber, etc.

Language: English.

Database producer: Commission of the European Communities, DG XIII.

Coverage: More than 250 information sources and services. Updated continuously.

User aids: Detailed information online with the command INFO DOMIS or via DOMIS brochure.

EABS (free of charge)

Online version of the monthly journal Euro-ABSTRACTS. References to the published results of scientific and technical research programmes wholly or partly sponsored by the Commission of the European Communities. Wide range of subject areas (e.g. nuclear research, new sources of energy, environmental research, etc.)

Languages: EN, FR, DE.

Database producer: Commission of the European Communities.

Coverage: More than 50 000 citations since 1966. Updated monthly.

User aids: EABS database manual (English and French) and ECHO GRIPS manual for users free of charge. Online guidance.

ENREP (free of charge)

Online directory of Environmental REsearch Projects in the Member States of the Community.

Language: English.

Database producer: Commission of the European Communities in collaboration with EEC National Focal Points.

Coverage: 50000 research projects from over 5 000 organisations. 1 980 onwards, regularly updated.

User aids: Manuals in English and French. Online guidance.

EUREKA (free of charge)

Detailed information on projects carried out in the framework of the EUREKA programme: Sharing of the financing participants; status of agreement between participants; location of work; application/market; partners sought; status of the project, etc.

Database producer: EUREKA Secretariat in collaboration with national project coordinators.

Coverage: Approx. 250 project records. Regular updating.

User aids: Online guidance with the command INFO EUREKA.

EURISTOTE (free of charge)

Online directory of more than 10 000 theses and studies, both current and completed, which have been conducted since the early 1950's. The theses and studies deal with Community policies (competition law, external relations, European institutions, etc.) Information on over 5 000 professors and university researchers who are studying the construction of Europe.

Languages: English, French.

Database producer: Commission of the European Communities, DG X.

Coverage: Since 1952, updated quarterly.

User aids: Database manual and ECHO GRIPS manual for users, free of charge.

IES-DC (free of charge)

Information Exchange System - Data Collections. Directory and reference service to the European IT (Information Technology) Community. IES-DC currently covers three separate domains:

1. Publicly funded research and development programmes carried out in Europe by institutions active in the field of information technology (ESPRIT, RACE, etc.);
2. Resources and facilities for network services to be used by institutions active in this domain.
3. Addresses in the various electronic mail systems of individuals involved in research and management, mainly within the ESPRIT programme.

In order to provide up-to-date information, IES-DC takes stock of existing data collections, already available on a national or a sectoral basis, complements and extends these data into comprehensive and consistent database information with European-wide coverage and access.

Language: English.

Database producer: Commission of the European Communities.

Coverage: More than 2 000 projects, 1 000 resources and facilities, and 4 200 addresses.

User aids: IES-DC brochure in English, free of charge.

SESAME (charge)

Online source of information on energy projects supported by the EC.

Areas:

1. Demonstration projects: energy saving, renewable sources of energy, liquefaction and gasification, etc.
2. Hydrocarbon technology: geophysics and prospecting; drilling, production systems, etc.

Language: English.

Database producer: Commission of the European Communities, DG XVII.

Coverage: Up-to-date view of current projects financed by the EC, and detailed information on all completed projects carried out under the "Hydrocarbon Technology and Energy Demonstration" programmes since 1975 and 1978. Regular updating.

User aids: Detailed information online with the command INFO SESAME.

Costs: BFR 3 600 per connected hour.

SESAME is only accessible to Videotex users via ECHO.

TED (charge)

Tenders Electronic Daily. Online version of the Supplement (series S) to the Official Journal of the European Communities. Contains public calls for tender offered by more than 80 countries, including calls for proposals for EC research projects. Documents are available on the morning of their publication. Documents dealing with areas of special interest can be directly accessed by means of subject and country codes.

Languages: All official languages of the EC except Greek.

Database producer: Office for Official Publication of the European Communities, Luxembourg.

User aids: Data base manual, free of charge. On-line user guidance.

Costs: 36 ECU per connected hour.

TED-TELEX: Selection of calls for tender can be transmitted by telex through the TED-Telex service. Selection on the basis of key words; will be sent automatically according to instructions.

CORDIS (currently being implemented)

Common Research and Development Information Service. The new CORDIS information service takes all relevant information on Community activities in the fields of research and technological development from a variety of data bases and unites it under one roof. Information on programmes; projects; publications; research results and other relevant questions can be called up. CORDIS is planned to start operating in the first half of 1990. Access through ECHO-HOST.

All the above-listed Databases are accessible through the ECHO-HOST Service of the CEC.

Further information can be obtained from:

ECHO Customer Service, 177 Route d'ESCH, L-1023 Luxembourg.
Tel. +352 488041 (ECHO Help Desk). Fax +352 488040. Telex 2181 eurolu. NUA 270448112.

CELEX, Computerised documentation system for European Community Law

Celex is an EUROBASE offering an on-line information service on EC law. It covers legislation, preparatory documents, Court of Justice case-law, parliamentary questions, and references to national provisions implementing Community directives (in preparation). All documents in the base have an analytical section, giving the title, author, legal form and any relevant dates. It is available through PC in five languages.

Further information can be obtained from:

A. Berger, EUROBASES, DG IX/F4, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2357552. Fax : +32 2 2360624. Telex: 21877 COMEUR B.

Conferences

First European Symposium on Terrestrial Ecosystems: Forests and Woodlands, Florence, Italy, 20-24 May 1991.

This symposium is organized by the CEC together with the European Science Foundation and the National Research Council, Italy. It aims at reviewing available knowledge on patterns and processes in European terrestrial ecosystems with particular emphasis on: (i) natural factors (climate, geology, soils); (ii) man-induced changes (management, pollution, fire, fertilisers, etc.); (iii) methods and approaches; (iv) modelling and

data bases; (v) use of basic knowledge for management and protection; (vi) gaps in knowledge, research priorities. Study cases describing important European ecosystems and reviewing the most significant patterns and processes which characterise these ecosystems will be discussed.

Further information can be obtained from:

- P. Mathy, DG XII/E1, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2358160.
- A. Teller, European Science Foundation, c/o DG XII/E1, CEC, 200 rue de la Loi, B-1049, Brussels. Tel. +32 2 2358446.

Publications

General Interest

EC Research Funding-A Guide for Applicants

This Guide published by the CEC-DG XII contains information on legal, administrative and technical aspects as well as the content of all R&D programmes. It is aimed at everyone who is interested in EC research, especially those from the sciences and industry who want to widen their

field of work internationally, are looking for partners, and wish to cooperate at EC level.

Copies in DE, EN, FR, IT, can be obtained from:

Mrs. K. Toft DG XII, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2356419. Tlx. 21877 Comeur B. Telefax +32 2 2358865.

Catalogue of Research Programmes within the Framework Programme of the European Community 1987-1991 (status 15 May 1990)

Copies can be obtained from Mrs K. Toft, see above.

Science and Technology for Europe- Joint Research Centre of the Commission of the European Communities

This brochure provides an overview of the services, facilities and exper-

Industrial Health and Safety

Survey of the Training Programmes in Toxicology in the Member States of the European Community

This book edited by **A. Berlin, P. Hoet, P. Lauwerys and M. Th. Van Der Venne** reports on training and information activities in the framework of the implementation of the programme of action of the European Communities on toxicology for health protection.

Published for the CEC by Craig Desk Top Productions, 4 Tosonce Road, Eskbank, Dalkeith EH22 3AG, UK, EUR 12386, ISBN 1-872-636-004.

Occupational Hygiene Education in the EEC: A Survey of Existing Programmes

This book by **D.B. Brown** is a timely guide to the profession of occupational hygiene in the EC and, specifically, to the ways in which different Member States offer education and training in this field.

The survey identifies universities and colleges offering degree-level courses in occupational hygiene and gives detailed information on the staff, syllabus and requirements for each course. For EC countries where no such degree-level courses exist (e.g. FRG), the survey describes the different ways in which training is given and assesses the role of governments, research institutes and professional associations. The author makes recommendations concerning standards, certification, financial support and exchange programmes.

Published by the CEC, EUR 12113 EN, ISBN 92-825-9921-3, and available from the Office for Official Publications of the EC, L-2985 Luxembourg.

The Toxicology of Chemicals-1 Carcinogenicity-Vol.1

This volume, the first of a series to be published annually, is edited by **A. Berlin, E. Draper, E. Krug, R. Roi, and M.Th. Van der Venne**. It contains summary reviews of the salient scientific evidence underlying

tise at the eight institutes of the JRC located in four sites (B, FRG, I, NI). The JRC performs scientific research and technology development for the CEC, national agencies, universities and corporate clients from Community Member States and other countries.

Published by the CEC-JRC (in english, french, german, french), EUR 12417 EN, 1989, and available from the Public Relations Press and Exhibitions Service, CEC-JRC Ispra, I-21020 Ispra. Telex 380042/380058 EURI. Telefax + 39 332 789502.

the assessment of 36 chemicals in terms of carcinogenicity. It provides the most relevant scientific data on widely used chemicals from studies in animals, from the results of short term tests for mutagens and carcinogens, and from epidemiological studies utilised in the risk assessment of a chemical.

This series should prove a valuable guide to those with responsibilities for worker protection.

Published by the CEC, EUR 12029 EN, ISBN 92-825-9381-9, 1989, and available from the Office for Official Publications of the EC, L-2985 Luxembourg.

Measurement Techniques for Carcinogenic Agents in Workplace Air

This book covers 31 key substances with known or suspected carcinogenic properties. It lists, for each substance, the CE Registry number, synonyms, manufacturing process and normal uses. The bulk of each chapter covers the recommended sampling and measurement method and the substance's performance characteristics.

The book will be an invaluable reference for anyone with day-to-day responsibility for health and safety at work, and for trade unions and others with a close interest in the field.

Published for the CEC by Royal Society of Chemistry Distribution Centre, Blackhorse Road, Letchworth, Herts SG6 1HN, UK, EUR 11897, ISBN 0-85186-098-2.

Critical Review of Animal Carcinogenesis by Nickel and its Inorganic Compounds

This book by **R. Maximilien** is published by the CEC: Part 1 Analytical Review-Conclusions EUR 12456 EN/1, ISBN 92-825-9792-X; Part 2 Appendices EUR 12456 EN/2, ISBN 92-825-9793-8; Parts 1 and 2 ISBN 92-825-9791-1. It is available from the Office for Official Publications of the EC, L-2985 Luxembourg.

Environment

Environmental Research in the Member States, 1990

This report was prepared by **G. Vonkeman and P. Maxson** of the Brussels' Office of the Institute for European Environmental Policy under contract for CEC-DG XII. Its aim is to compare and quantify the State-supported research programmes of the 12 Member States in the field of environmental and climate research.

Volume 1 describes the methodology followed for this study and presents the research matrix generated, showing the volume of research carried out in 1989 in 12 environmental fields by the 12 Member States. It provides an analysis of the matrix along with the implications for the future.

Volume 2 contains individual country reports.

For further information, please contact:

P. Reiniger, DG XII/E, CEC, 200 rue de la Loi, B-1049 Brussels. Tel. +32 2 2359586.

The Greenhouse Effect and its Implications for the European Community

This booklet, prepared by **R.A. Warrick, E.M. Barrow and T.M.L. Wigley** under contract for CEC -DG XII, reviews in a non-technical fashion the current scientific understanding of the greenhouse effect, making special reference to Europe. In particular, it examines the role of the greenhouse gases (including past and future trends in atmospheric concentrations) in changing climate; the results of general circulation models including their limitations and uncertainties; the range of esti-

mates of future global warming given the uncertainties in greenhouse-gas emissions and climate modelling; the extent to which Western Europe is contributing to the problem. Maps show spatial shifts in natural ecosystems, biomass potential and heating degree-days. Rising sea-levels are also discussed.

Published by the CEC, EUR 12707 EN, ISBN 92-826-1330-5, 1990, and available from the Office for Official Publications of the EC, L-2985 Luxembourg.

Inventory of Laboratories with Ecological Expertise in the European Communities

This book by **G. Persoone** and **A. Van de Vel** provides an ideal reference source for anyone working in the field of ecotoxicological testing and for organisations needing to have ecotoxicological tests carried out. It contains full data on 126 different laboratories. A named contact is listed for each site, and details are given on the various tests regularly carried out. Data is given on the 35 tests prescribed by the 6th Amendment of Directive 67/548/EEC on the classification, packaging and labelling of dangerous substances.

Published by the CEC, EUR 12296 EN, ISBN 92-826-0630-9, and available from the Office for Official Publications of the EC, L-2985 Luxembourg.

The European Community and the Problem of its Waters

This publication by **M. Ortiz** shows how the Community is concerned to improve and protect the way in which available water resources are used. A large number of Community Directives on water for human consumption, surface and underground water, water for bathing, and water for rearing fish and shellfish lay down objectives for the Member States regarding water quality and limits on the disposal of dangerous pollutants in water. The EC is also a signatory to various international agreements involving more countries than just the 12 Member States, on such matters as hydrocarbon pollution in the North Sea (Bonn Convention) and pollution in the Mediterranean (Barcelona Convention). Lastly it provides non-refundable subsidies and loans in support of projects to increase water resources and improve the quality of water.

Published by the CEC, EUR 12109 EN, ISBN 92-825-9919-1, and available from the Office for Official Publications of the EC, L-2985 Luxembourg.

Scientific Assessment of EC Standards for Drinking Water Quality

This report prepared by **G. Premazzi**, **G. Ghiudani** and **G. Ziglio** summarizes the results of the project on "Adaptation to technical and scientific progress of EEC Directive 80/778/EEC concerning the quality of water intended for human consumption" carried out under the collaboration programme (1988-1989) between JRC Ispra and DG XI. It provides a comparison between the EC Directive with the national legislations in different Member States and with WHO Guidelines.

Published by the CEC, EUR 12427 EN, ISBN 92-826-0805-0, 1989, and available from the Office for Official Publications of the EC, L-2985 Luxembourg.

Environmental Ethics: Man's Relationship with Nature, Interactions with Science

This book edited by **Ph. Bourdeau**, **P.M. Fasella** and **A. Teller** is the proceedings of the Sixth Economic Summit Conference on Bioethics held at Val Duchesse, Brussels on 10-12 May 1989.

The Conference discussed a range of specifically scientific questions which could improve the quality of environmental decision-making, and achieved a high degree of convergence. A recurring theme, already stressed by Jacques Delors in his opening speech, was the need for a code of environmental ethics, acceptable to people of all creeds and nations, which should provide a basis for environmental law and guidelines for the behaviour of individuals, public authorities and the private sector.

The content of the four separate sessions was as follows: (i) presentation of the scene and deals concerning current and predicted environmental problems; (ii) survey of man-nature relationships and of attitudes toward the environment; (iii) discussion around the question of what science should be done to identify the constituents and limits of environmental

ethics; (iv) conclusions from the extensive discussions of the main issues during the conference. The participants agreed on the need to define a simple code of environmental ethics based on these conclusions, a task now underway. These conclusions were presented at the Economic Summit held in Paris in July 1989.

Environmental ethics should be of interest to anyone concerned with the relationship between humans and their environment, the development of sound environmental policies, and the role of science in this respect.

Published by the CEC, EUR 12848, ISBN 92-826-1398-4, 1990, and available from the Office for Official Publications of the EC, L-2985 Luxembourg.

Annual Report '89 of the Environment Institute, CEC-JRC Ispra

The first annual report of the Environment Institute at the Joint Research Centre, Ispra Site, of the Commission of the European Communities was edited by **M. Borlè-Talpaert**, **F. Girardi**, **A. Stinglee** and **B. Versino**.

Progress is reported up to the end of 1989 for the Specific Research programmes (1988-1991) Environment Protection, including research on environment chemicals, air pollution atmospheric transport, water quality, chemical waste, food and drug analysis, and radioactive Waste Management, concentrating on safety assessment for final storage in geological formations. Moreover the Institute provided technical support to the implementation of EC directives in the fields of chemicals, atmospheric pollution, water quality, chemical waste and radioactive environmental monitoring (REM). Finally, miscellaneous activities related to work for third parties are reported and the participation on the Institute in the EUREKA and COST projects outlined. A list of associated laboratories, large installations as well as tables of human resources and finances complete the report.

Published by the CEC, EUR 12868 EN, and available from:
Environment Institute, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789834. Telefax +39 332 789222.

Annual Report '89 of the Institute for Safety Technology, CEC-JRC Ispra

The report was edited by **H. Holtbecker**, **P. Fasoli-Stella**, **C. Busse**, **J. Donea**, **H. Dworschak**, **G. Barbera** and **P. Von der Hardt**.

Results achieved in the areas Reactor Safety and Industrial Risk, in which the Institute has a leading role, are reported. Activity performed for the programmes Fusion, Safeguards, Waste and Teledetection, in which the Institute makes available its expertise, are discussed.

The Commission Support activities are presented and indications are given of Third Party Work executed by the Institute.

Published by the CEC, EUR 12885 EN, and available from:
Institute for Safety Technology, CEC-JRC Ispra, I-21020 Ispra. Tel. +39 332 789743. Telefax +39 332 789903.

Information on recent scientific and technical publications from the EC R&D programmes is regularly provided in a booklet entitled **Publications on Science & Technology** and in the periodical **Euroabstracts**.

Further information can be obtained from:
Scientific and Technical Communication Unit, DG XIII/C3, CEC, Jean Monnet Building, L-2920 Luxembourg.

Note from the Editor

The information contained in this Newsletter has been drawn from material supplied by the same persons indicated in each chapter as possible correspondants for further information.

Texts have been checked and apologies are given for omissions or errors.

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Contents will include in particular information on research and regulatory action concerning environmental chemicals, environment and human health, water, soil, ecosystems, climatology and natural hazards.
Publication is scheduled for December 1990.