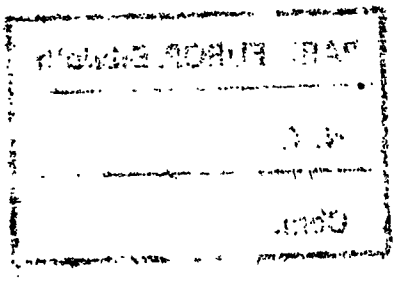
EUR 7924 EN

COMMISSION OF THE EUROPEAN COMMUNITIES

Multiannual Programme of the Joint Research Centre 1980-1983

1981 Annual Status Report

Protection of the environment



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Annual Status Report

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Published by the
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PROTECTION OF THE ENVIRONMENT

1981

Reaserch Staff:	90 men-year
Budget:	9.811.000 ECU *

Projects:

- ECDIN: Environmental Chemicals Data Information Network
- Exposure to Chemicals:
  - Indoor Pollution
  - Chemical Products (Organics)
- Air Quality
- Water Quality
  - Nutrient Mass Balance is Acquatic Ecosystems
  - Ecological Effects of Chemical Pollution
- Heavy Metal Pollution
  - I.L.E. (Pathway of Automotive Lead)
  - Exposure and Health Effects
- Environmental Impact of Conventional Power Plants

* allocated credits

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1. INTRODUCTION

The present 4 years programme (1980-1983) «Protection of the Environment» is the follow-up of the former programme «Environment and Resources» (1977-1980).
With a research staff of about 90 people working mainly at the Ispra and to a smaller extent at the Petten establishment, this programme represents about 8% of the total research effort of the Joint Research Centre.

The principal scope of the programme «Protection of the Environment» it to provide together with the related Indirect and Concerted Action Programme, scientific support to the Community's Programme of Action on the Environment (1977-1981). The following table gives a synoptic view of the major links of this action programme managed by D.G. XI (Direction: Protection and Improvement of the Environment) at Brussels with the above mentioned research programmes.

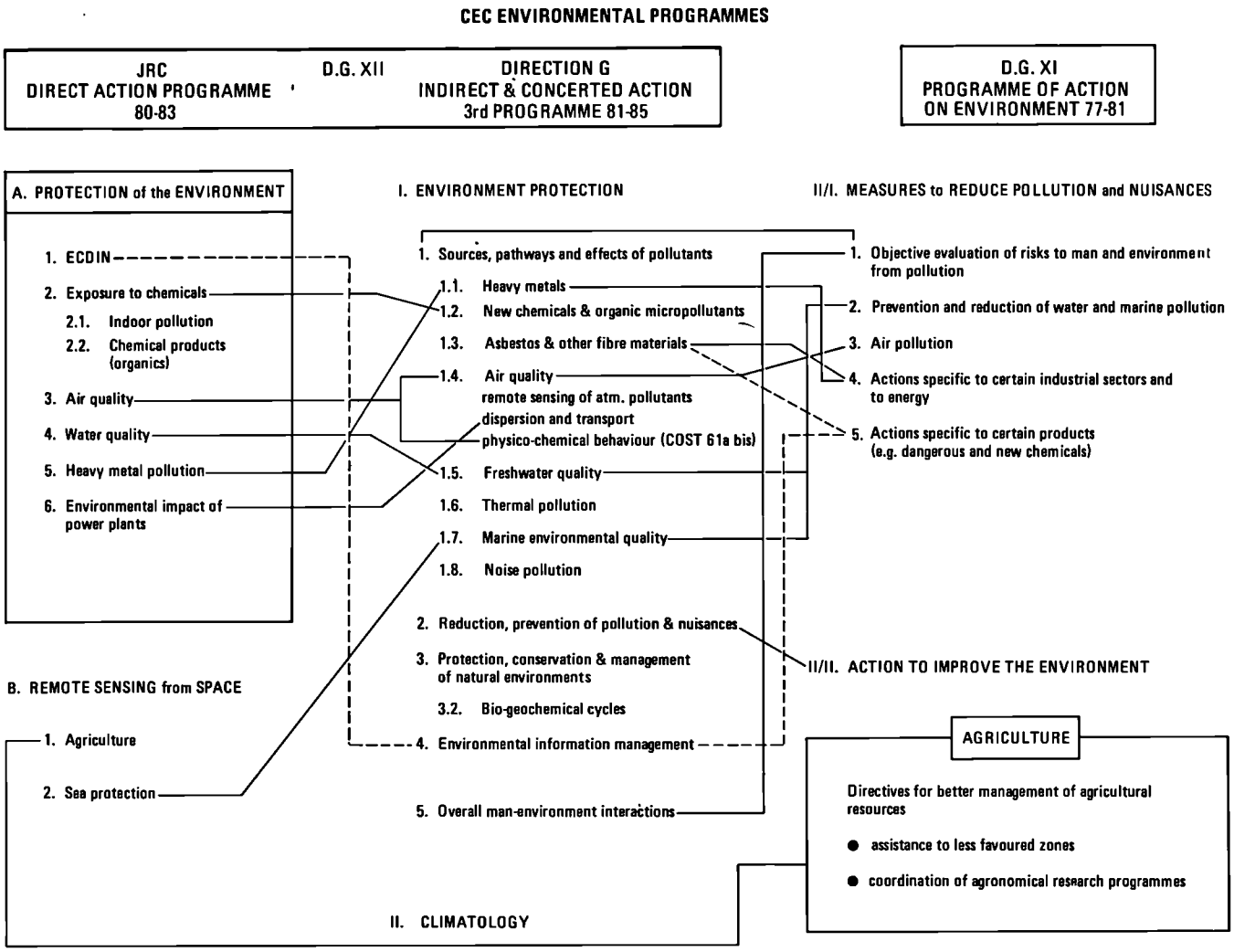
The chemical activities of the environmental research at the JRC Ispra have been progressively reoriented towards a new centre of gravity, i.e. «environmental chemicals». In this context the project ECDIN, a pilot-data bank on environmental chemicals could pay an important role in orienting the other chemical «laboratory» projects towards a common goal. Already now ECDIN is acting as an internal consultant to other Commission services and has proved its use and competence especially in establishing the European core inventory EINECS in behalf of the D.G. XI (Direction: Protection and Improvement of the Environment). The longend survival of this project will depend, however, on the successful implementation of a «commercial» ECDIN justifying an ongoing research effort of a «scientific» ECDIN inside the Joint Research Centre.

Striking differences in the air pollution level inside and outside of private houses and public buildings led to the conception of the «Indoor Pollution» project. The study will be focussed on organic emissions in private houses, school rooms and department stores. The final goal is to reconsider the relevance of air quality standards.

The title «Chemical Products (Organics)» is related to the activities of a research group at the Petten establishment. This work is mainly concerned with analytical and synthesis aspects of organic chemicals related to environmental protection problems (e.g. carcinogenic and toxic substances).

The project «Air Quality» deals with the analysis of atmospheric pullutants with special regard to particle formation and photochemical reactions. It is fully integrated into the COST 61a-bis concerted action «Physico-chemical behaviour of atmospheric pollutants».

The project «Water Quality» focuses on the mass balance of nutrients in lakes, using a physico-chemical modelistic approach and the use of bio-indicators for the characterization of freshwater pollution.



The project on «Heavy Metal Pollution» comprises the conclusion of the ILE project (pathway of automotive lead using natural isotopic tracers) and extends the assessment studies around conventional fossil fuelled power plants to other heavy metal pollution sources like incinerators and fertilizers. Metallo-biochemistry is the key method to elucidate the pathway and health effects of these pollutants.

The «Environmental Impact of Power Plants» project deals with the diffusion and transport of emissions (gaseous and particulate) from conventional power plants as well as the input-output balance of pollutants in industrial or urban areas. The project is fully integrated in similar national and Community wide projects.

Concerning the future of the JRC research activities, two major events have happened during the second half of 1981:

— the fusion of Directorate General JRC with Directorate General XII and the consequent formation of a «new» Directorate General XII responsible for both direct and indirect research activities;

— the initiative of the vice-president of the Commission, Mr. Davignon, who, together with his colleagues Messrs. Narjes, Richard, Delsager and Pisani, defined new lines for scientific and technological research of the European Communities.

The first should promote a better harmonisation and integration between different forms (direct, indirect, concerted) of research actions of the Commission although it has to be said that, as far as environmental research is concerned, an efficient level of integration had been achieved already in the past.
The second is aiming at a better use of the Commission's own research activities for the endorsement of community priority polices like agriculture, energy, resources and environment.
According to this idea the results of our environmental research activities should be better «used» by the Directorate General XI responsible for the implementation of the Communities' Action Programme on the Environment.

As a consequence the environmental research programmes, where necessary, should be reoriented towards activities with a more direct and immediate supporting impact for the regulatory and legal work of the Community.
This of course does not mean that long term research has to be abandoned but it underlines the importance to care more on the medium and short term application of our results.

Bearing this in mind and in order to achieve a better definition of the future research lines of our present activities, three round table discussions on Indoor Pollution, Heavy Metal Pollution and Ground-based Remote Sensing Techniques for Atmospheric Pollution have been organised with the participation of qualified experts from Member Countries.

2. RESULTS

ECDIN (Environmental Chemicals Data and Information Network)

During 1981 an experimental ECDIN service on EURONET DIANE was launched. Some 100 potential users of ECDIN were contacted towards the end of the year and about 80 of those contacted have so far replied favourably to the invitation to participate in the experiment. Preparation of user contracts governing access to the data was advancing well at the end of the year. During the year the reliability of the JRC Ispra EURONET interface improved noticeably. A user reaction study to be performed by ASLIB was initiated in September 1981 and preliminary steps for the monitoring of user reactions to ECDIN were completed.

Advances were made in the programming of a new version of the ECDIN display system. Using modular programming techniques the system has been extended to cover 15 data files and one new access point (EEC dangerous substances list - Directive 67/548/EEC). With the new approach to programming the system, the addition of extra files including the testing of menu selection and report generation has been reduced to a few manweeks per file. During the reprogramming several new commands have been added to the display system which should facilitate access to the data.

Progress was made with the elimination of the backlog of data awaiting loading to ECDIN. The rate of progress was reduced however by delays in recruiting a new data manager for ECDIN who was finally appointed in December 1981. The update system described in the 1980 report functions well and the elements now exist for a more routine operation of the data bank.

The ECDIN group has been nominated the Commission's Contact Point for EINECS (European Inventory of Existing Chemical Substances). Preparations for EINECS have proceeded well in 1981 and the basic documents necessary for constructing EINECS have been finalised. The eight volume set comprising the European Core Inventory (ECOIN) and the Compendium of Known Substances were published in September. The guideline booklet «Reporting for the EINECS Inventory» (which comprises 90 pages of technical instructions) was completed in English in June ad translations into the other six official languages were revised and corrected by JRC staff in October. The publication of these guideline booklets is expected in February 1982 in time for the start of the EINECS reporting period which begins on 31 March 1982. Preliminary work on the system for processing and tracking reporting forms is also complete.

EXPOSURE TO CHEMICALS

Indoor pollution

Three items were at the center of this activity which in 1981 has become operative:

Identification of reaserch goals and approaches. In view of the many different aspects and unresolved problems of indoor air pollution (IAP) and of the modest resources which can be allocated to this research by the JRC, a major effort has been made to identify activities which:

- are as effective as possible in providing useful information for an understanding of IAP problems,
- fit well to the competences and resources of the JRC,
- fit well to other related activities going on in Europe and
- are useful for sponsoring a European collaboration in the field of IAP.

A round table discussion on indoor pollution concerned at the JRC Ispra with invited European experts gave useful informations and reccomendations:

- Among the many parameters influencing indoor air quality (climatic conditions, biological pollution, pollution by radioactive radiation, by fibrous particulates, by particulate matter and by organic or inorganic chemicals), organic chemical pollution is the most complex and least understood one and is - in contrast to biological pollution - entirely anthropogenic.
- A virtually virgin field is that of the health effects of chemical IAP. Research efforts should be particularly devoted to the study of the impact of chemical IAP on human health and well-being.
- For the time being, however, no comprehensive, systematic approach to this central problem exists. Approaches to partial aspects of IAP should be designed in a way to include health aspects at a stage as early as possible.
- In view of the complexity of organic chemical IAP and the many uncertainties about it on one hand and the competences available at the JRC in the field of organic environmental analysis on the other, it was recommended that JRC research should concentrate on organic IAP in few selected environments.
- It has been emphasized that the JRC should make an effort to sponsor collaboration in the field of IAP on a European scale. Exchange of information and the preparation of common working protocols have been indicated as suitable starting actions.
- The use of common working protocols would be helpful to increase the comparability and, hence, the usefulness of results obtained by different laboratories and to ensure that observation of health effects and chemical analytical work complement each other.
- The establishment of an inventory of indoor pollution sources has been indicated as highly desirable, however, not feasable for the time being, due to practical obstacles. A useful intermediate approach would be the establishment of an inventory of indoor pollutants.
  It would be an appropriate task for the JRC to promote and coordinate a European effort to establish such an inventory.

Profiling of organic pollutants. A first measurement campaign has been performed in order to establish the 24 hrs exposure to organic vapours of a pupil visiting the European school at Varese and to correlate it to the organic vapour concentrations in the different indoor and outdoor environments to which the test person was exposed during the 24 hrs period.

Measurements have been performed by trapping of the organic vapours on TENAX adsorption columns using small personal pumps in order to pass measured amounts of air through the columns and by subsequent analysis of the adsorbed organics using GC-MS.

The following Table I summarizes the semi-quantitative results.

Table I. Organic vapour aspirated by a pupil over a 24 hrs period - Summary of semi-quantitative results of a first measurement campaign

Sample Description	(Mean) concentration of (1) vapour phase organics expressed as organic carbon (mgC/m^3)	Time spent in the different environments (hrs)	Approx. respiratory volume in the diff. environments (2) (m^3/hr)	Aspirated vapour phase organics (1) expressed as organic carbon (mg C)
Indoor air home (weighted mean of living + bedroom)	3,5	14,7	0,4	21
Indoor air school mensa	3,8	0,5	0,6	1,1
Indoor air class rooms	0,4	5,5	0,6	1,3
Indoor air bus	1,5	1,1	0,6	1
Total Value Indoor		21,8		24,4
Outdoor air school bus stop	0,75	0,3	0,9	0,2
Outdoor air school yard	0,2	1,9	0,9	0,3
Total Value Outdoor		2,2		0,5

(1) These values do not include C_1 - C_4 unpolar hydrocarbons which are not sufficiently retained on the TENAX adsorption column

(2) Estimated on the basis of values for children published in HEALTH 12,2 (1966), p. 173 ff., appendix II

It is obvious that no general conclusions can be drawn from these first results: they give, however, interesting indications for the further orientation of our work.

Among the environments considered in this study apparently private homes should be studied with highest priority in more detail. A comparative study of the organic vapour content of indoor air in a variety of private houses and of outdoor atmospheres is under way.

Development of analytical methods. Aldehydes and in particular formaldehyde play an important role in indoor air pollution. They are irritants and formaldehyde has even been suspected to be cancerogenic. Ketons are also found in indoor air. Their relevance for human health, however, is not yet well assessed.

With currently applied sampling and analysis methods for organic micropollutants using adsorption/enrichment on porous polymers, molecular sieves or charcoal, thermal or solvent elution and GC-MS analysis, these carbonyl compounds are easily overlooked. Formaldehyde presents unresolved difficulties for gaschromatographic separation and the other compounds are often overlapped by considerably larger amounts of hydrocarbons such as alkanes and alkenes which have many common mass spectral features with ketones and aldehydes.

Due to these difficulties and the important role which carbonyl compounds play not only for indoor air quality but also for ambient air chemistry, a specific analysis method for carbonyl compounds in air at the ppb (10^{-9}) level has been set up.

The method is based on a specific reaction of carbonyl compounds with 2,4 dinitrophenylhydrazine. Using this method most carbonyl compounds can be determined in indoor and ambient air down to concentrations below 1 ppb.

Chemical products (Organics)

Environmental carcinogens

Some more organic pollutants of the polycyclic aromatic heterocycle class have been characterised chemically and found to be moderately or weakly mutagenic. Two nitrogen containing compouns were shown to be highly toxic in bacterial tests. Samples of some of these heterocyclic substances and of cyclopenta (cd) pyrene, which was synthesized in high purity, were made available to various Community laboratories for analytical purposes or future bio-assays.

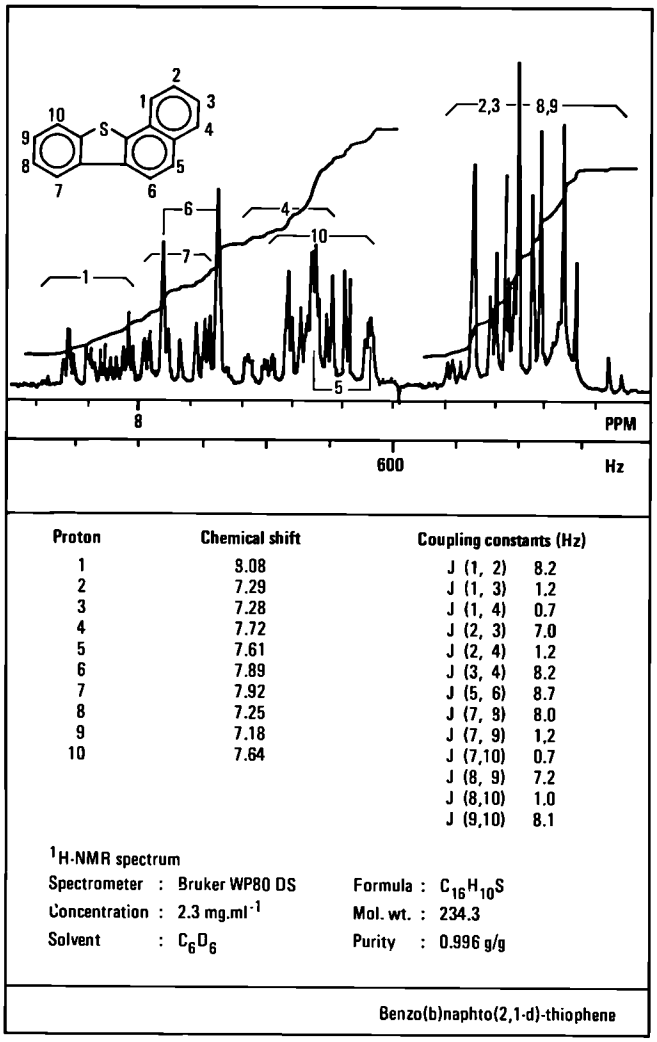
Work concerning the systematic collection of molecular spectra of polycyclic aromatic hydrocarbons has progressed further and the spectra of about 20 substances (chrysene and its methyl-, benzo- or dibenzoderivatives) are now available; an example is given in Fig. 1.

Occupational carcinogens/Toxic chemicals

In the study aimed at reducing contamination from food packaging components a new type of additive, which is retained more effectively in polymers through complex formation, was synthesized and tested in different matrices. Also, the third phase of an interlaboratory exercise directed at the assessment of reproducibility and repeatability of analytical procedures for determining migration and diffusion of antioxidants from food packaging materials was completed and evaluated.

AIR QUALITY

This project, which is aiming at environmental chemicals related to air quality, has during the last year dealt mainly with the preparation of the experimental facilities for this new task



Proton	Chemical shift	Coupling constants (Hz)	
1	8.08	J (1, 2)	8.2
2	7.29	J (1, 3)	1.2
3	7.28	J (1, 4)	0.7
4	7.72	J (2, 3)	7.0
5	7.61	J (2, 4)	1.2
6	7.89	J (3, 4)	8.2
7	7.92	J (5, 6)	8.7
8	7.25	J (7, 9)	8.0
9	7.18	J (7, 9)	1.2
10	7.64	J (7,10)	0.7
		J (8, 9)	7.2
		J (8,10)	1.0
		J (9,10)	8.1

^{1}H-NMR spectrum

Spectrometer : Bruker WP80 DS
Concentration : 2.3 mg.ml^{-1}
Solvent : C_6D_6
Formula : $C_{16}H_{10}S$
Mol. wt. : 234.3
Purity : 0.996 g/g

Benzo(b)naphto(2,1-d)-thiophene

Fig. 1.

(Infrared Fourier Transform Spectrometry) and with the continuing effort to solve the problem of particle and ozone formation during photo-oxidation episodes. The Long Path Infrared Absorption Technique has shown to be useful also for this part.

1. Ozone and Particle Formation

For the study of photo-chemical processes, experiments in teflon bags, using natural sunlight, have continued. Whereas methane could be ruled out, as being responsible for a major part of the ozone formation observed in outside air samples, the role of carbon monoxide as important precursor was intensively investigated in many simulation experiments. Unfortunately a major complication turned up, when we discovered that teflon bags can release appreciable amounts of carbon monoxide (up to several ppm) when irradiated with sunlight or artificial light sources. Therefore the importance of CO for the ozone formation is still unsolved. The CO concentration at our test site at Ispra seems to be typical for a non-polluted site (about 150-300 ppb). Dark experiments with terpenes and ozone in teflon bags showed that the condensation nuclei formation in this process was very effective already with very low quantities of the terpene, making it unprobable to find a correlation between ozone and terpene concentrations in outside air even near forests.

An activity started in 1980 to demonstrate the local influence of a wooded area on particles, ozone and nitrogen oxides has terminated in 1981. A small tower, reaching up to tree-level, was equipped with a complete set of instrumentation.
The results showed no indication for special gas to particle conversion processes. As expected, the wooded area is a strong sink for ozone, noticeable mainly during night time when air movement is restricted.

The measurement of aerosol size distributions in the outside atmosphere around Ispra has been terminated. Whereas in winter haze particles (0.1-1 μm diameter) can be correlated very well with SO_2 and are therefore clearly connected with primary emissions from domestic heating or special punctual sources (power plants), haze situations in summer show clearly a different origin of the aerosol. The size distribution analysis indicates eventually a photochemical and a purely chemical secondary particle formation process for size ranges lower than 10^{-2} μm. The particle growth during haze periods is accompanied by the simultaneous decrease in the concentration of Aitken nuclei (<0.1 μm). This could be explained by the situ formation of the haze particles (0.1-1 μm) by consecutive coagulation of previous nuclei and further gaseous condensations (mainly of water vapour) on these intermediate clusters. The dependence of light-scattering, resp. visibility, on relative humidity is straight forward.

The evaluation of the data from the air-borne measurements in the Netherlands in 1980 revealed in some cases situations similar to those found in the Po-Valley, but showed on the other hand also some unexpected phenomena, which are not to explain by our present knowledge. Several flight measurements carried out in summer 1981, in the frame-work of a collaboration contract with the Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt (DFVLR), Oberpfaffenhofen, FRG, in the Po-Valley were quite successful. The short notice operations allowed to concentrate on typical weather situations and the flights were performed during severe haze situations (up to 170 ppb of O_3) and in Föhn-events. Bad weather in September did not allow to arrange the conclusive flights, now foreseen for 1982. The data are under evaluation.

2. Application of Infrared Spectroscopy Techniques

The activity has been developed along three main lines:

a) set up of the experimental apparatus

b) implementation of supporting techniques for analysis of air spectra

c) applications to «photochemical» studies.

a) Experimental apparatus

Commercial gas cells with beam paths from 1.5 m to 72 m have been modified for use with the Bruker IFS 112 V interferometer operated in vacuum. A 72 m fixed path cell has been currently in use for the experiments mentioned in the following. The construction of a large photochemical reactor - 4 m base, 200 m total beam path, 700 liters volume - has been undertaken and completed during the year. A study aiming at the optimization of the operating conditions of the Fourier Transform Spectrometer has indicated major problems in non linearity of IR-detector response and medium term instrument stability for the achievement of 1 percent precision in the determination of atmospheric constituents (H_2O, CO_2, CO, N_2O, CH_4) in air samples.

b) **Supporting activities**

The modification of the available magnetic tapes and programmes for use with the JRC computering facilities has been completed. These tapes allow the compilation of spectral data and the generation of synthetic spectra from the line parameters of different gases (atmospheric constituents plus a selected number of minor pollutants). These data have been used for quantitative analysis of the spectra from individual spectral lines as well as for exploratory studies for selection of spectral regions and evaluation of interference in the measurement. An updating of the compilation of the bibliography of IR spectral data of atmospheric constituents and pollutants originally prepared in 1979 has been completed by the end of the year.

c) **Applications**

The long path infrared absorption system using the FTS and the 72 m cell has been shown to provide simultaneous determinations of the gases CO_2, CO, N_2O and CH_4 with a precision, at tropospheric concentrations, in the range 1-5%. Applications have been made in conjunction with teflon bag experiments in the control of air samples collected in different conditions in Ispra, evaluation of zero air generator performance and study of the behaviour of teflon bags under UV irradiation (release of organic compounds from irradiated bags).

Following a research line undertaken during the past years, attention has been focussed during 1981 on the photochemical behaviour of carbon monoxide. Isotopic dilution techniques have been investigated taking advantage of the separation of distinctive spectral feature of $^{18}C^{16}O$ from natural CO. This possibility is illustrated in Fig. 2. Preliminary studies in the late 1981 have been directed to evaluate sensitivity and precision of these measurements.

WATER QUALITY

Nutrient mass balance in acquatic ecosystems

The strong influence of phosphorous release from sediments (integral load) on pythoplankton growth has already been demonstrated for the Ponte Tresa basin of lake Lugano (near depth ~ 33 m).

In the last year research has been concentrated on the deeper Agno bay (near depth ~ 58 m) to verify it even in this complex case of more general interest. A detailed experimental and modellistic analysis of the phosphorus mass balance can succeed in quantifying

— the net phosphorus flux from sediments;

— the phosphorus epilimnic deficit (which is counterbalanced by the phosphorus flux through the thermocline).

An answer will only be possible after a careful elaboration of experimental data, collected in situ between two consecutive water overturns and following the same procedure as adopted for the Ponte Tresa basin.

Besides field work (water and sediment sampling at four stations in the bay, chemical and biological analyses), laboratory research (elutriation tests and bioassays on «Selenastrum Capricornutum») has been performed, in order to assess phosphorus availability in lake sediments for phytoplankton growth. Preliminary results indicate that the most available forms of phosphorus are non-apatite inorganic phosphorus (NAIP) and organic phosphorus compounds. An example of correlation between algal growth and various proportions of NAIP and organic phosphorus contained in the sediment samples is shown in Fig. 3.

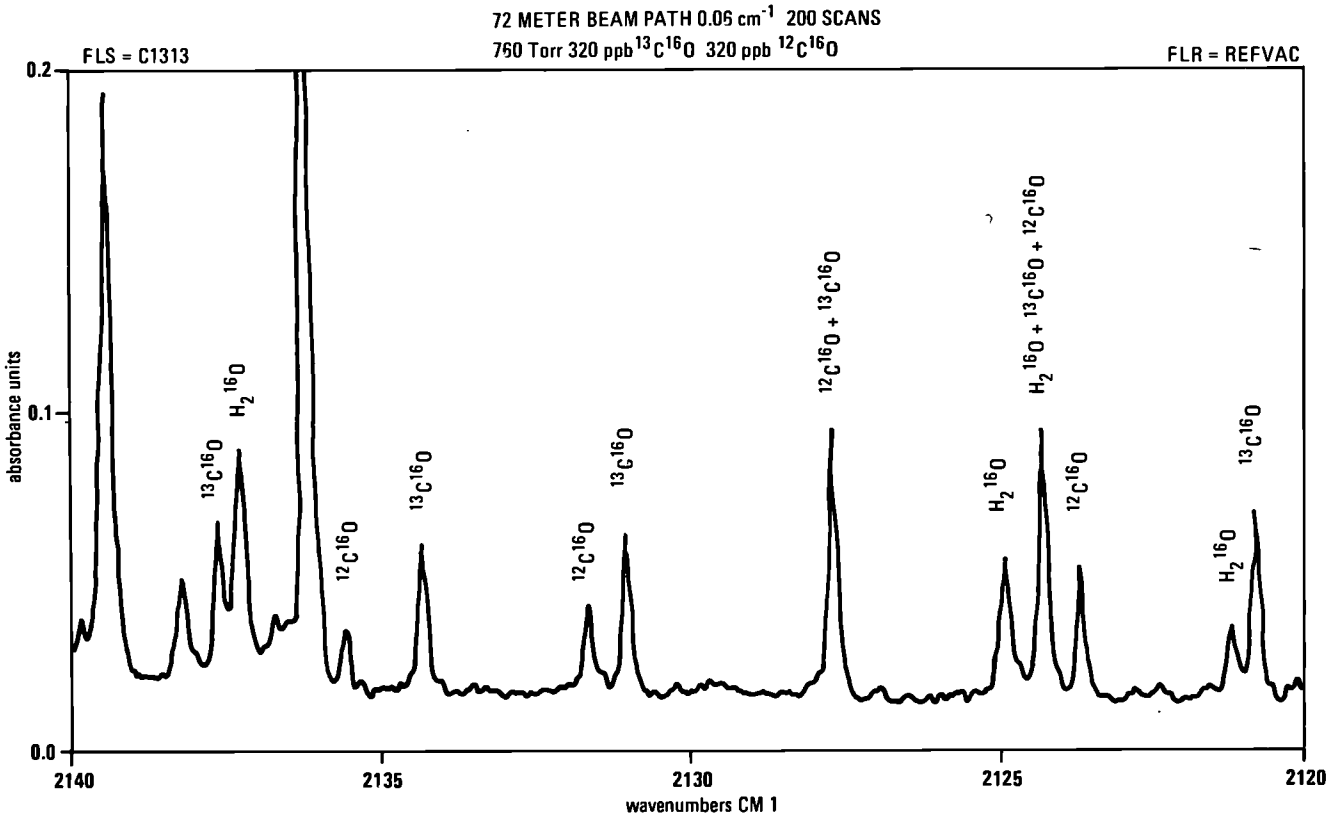


Fig. 2.

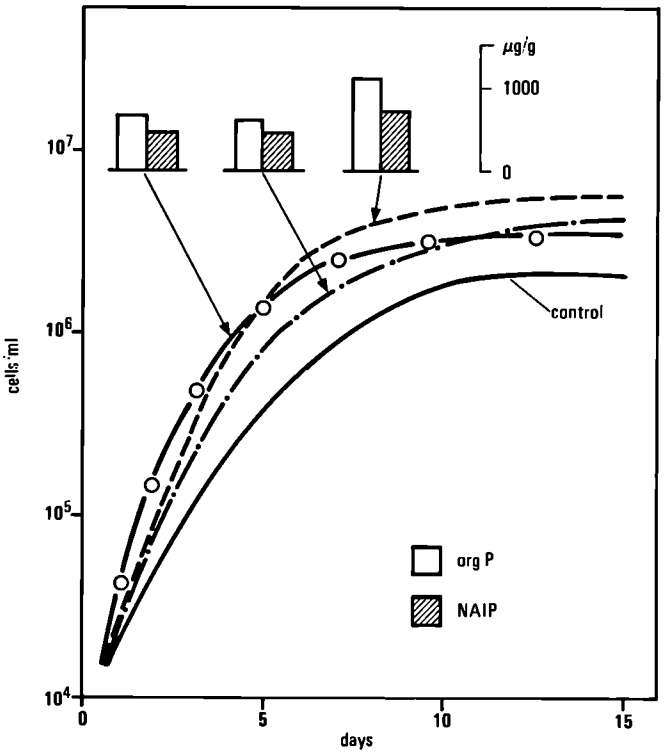


Fig. 3. Growth of Selenastrum Capricornutum Prinz for various contents of NAIP and organic P in sediment samples (June 1981)

A one-dimensional phosphorus diffusion model has been developed considering ortophosphate as a quasi-conservative tracer: measured P-PO_4^{3-} concentration protiles of the Ponte Tresa basin are well fitting.

Ecological effects of chemical pollution

The aim of this research is to evaluate the effects of toxic substances (e.g. Cu, Cd, Al) on freshwater communities under semi-natural conditions (enclosure method).
By thorough data analysis of enclosure experiments from previous seasons answers to some still open questions concerning the ecotoxicity of Al and Cd compounds could be found. It is now clear why sublethal concentrations of Al $(SO_4)_3$, a substance frequently used in sewage treatment plants as a phosphate reducing agent, present a more important impact on planktonic population than lethal concentration of Cd Cl_2.
From the experiments it was evident that, soon after the addition of Al_2 $(SO_4)_3$, the greatest part of the phytoplankton and many zooplankters were agregated in the Al-floccules and then sedimented. Almost all the Rotifers and Cladocerans were trapped in the floccules, whereas several Copepods (and particularly Cyclopoids) which are fast swimmers, were able to escape and survive in surface water poor in floccules.

These results, which agree with those obtained from enclosure experiments, demonstrate that the decrease of the plankton biomass and the variation of its structure is due to Al-flocculation and not to its toxicity. This important finding should be considered before planning to use Al salts in eutrophicated water bodies as phosphate reducing agent.

Another important finding is that the toxic effet of heavy metals on zooplankton has also an indirect effect on phythoplankton and therefore finally an impact on water quality.

HEAVY METAL POLLUTION

Isotopic Lead Experiment (I.L.E.)

ILE is a large scale, non radioactive tracer experiment, using as antiknock compound added to petrols, a lead from Australian Broken Hill mine of an isotopic composition (Pb-206/Pb-207 = 1.04) significantly different from the lead encountered in the environment of the test area (Pb-206/Pb-207 = 1.18) at the beginning of the project. The primary goal of the ILE experiment is to determine the pathways of automotive lead through air, vegetation, soil, food and, possibly, its distribution in the human body.
The test area is the Region of Piedmont in Northwest Italy.
The exchange of the lead in petrols started in Autumn 1975 and ended in April 1977.
The steady phase with almost 100% exchange began in May 1977 and was completed in October 1979. From the beginning of 1980 the ratio in petrol lead was reverting.
The sampling has been focused on the central part of the test area, namely the city of Turin and its surroundings to a 40 km radius. The sampling plan included refineries, petrol stations, atmospheric particulate, rain, snow, soil, vegetation, food and blood. The samples were analysed for their isotopic composition and all airborne filters and blood samples were also analysed for their total lead content.

The human population has been choosen in a way that the majority of the individuals be available for blood sampling throughout the period of the project. Another group consisted of children whose blood could only be sampled once.

The results obtained until now are summarized in the Fig. 4, which shows the behaviour of the Pb-206/Pb-207 ratio during the experiment.

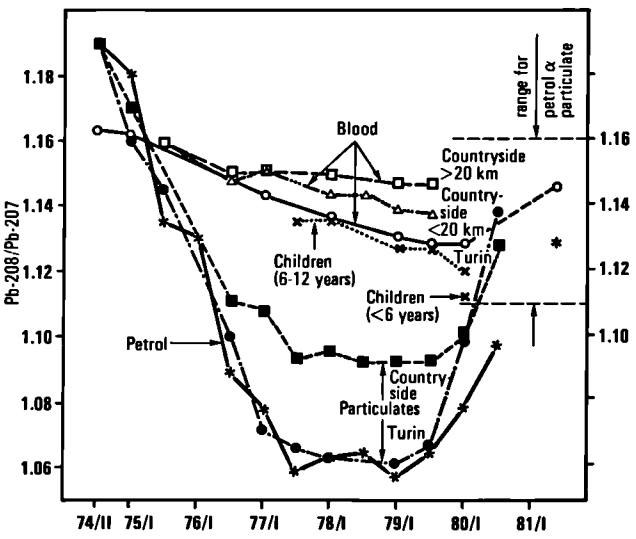


Fig. 4. Progression of Pb-206/Pb-207 ratios in alkyl lead, petrol, airborne particulate and blood from 1974 to 1981

The progression of the ratio for alkyl-lead and the petrols is clearly reported.

For the airborne particulate we had, during the steady-state phase, two levels of values, one for rural localities of about 1.09 and one for Turin of about 1.06. This last value shows that in the city there was, for the atmospheric particulate, a variation of the isotopic ratio similar to that of petrol. During 1981 the value of the ratio 206/207 in the airborne particulate both of Turin and countryside has reached a value around 1.13-1.14. As far as the blood is concerned there has been a fall in isotopic ratio, both in Turin and in country districts, which is a substantial fraction of the decrease in the ratio of airborne particulates.

The dispersion of isotopic composition of blood lead of the population at the beginning of the experiment resulted very small, 1.1627 ± 0.0022 for Turin and 1.1590 ± 0.0038 for countryside. The strongest decrease of the isotopic ratio in the period 1975-1979/80 was observed for subjects living in the city of Turin (1.1627 - 1.1268). Children of an age from 6-12 years have shown in 1979/80 even lower values (1.1189). The decreasing of the rural population is more evident for those of the zone adjacent to Turin (1.1593 - 1.1371) than for those living in zones distant more than 20 km from Turin (1.1586 - 1.1457). The results for follow-up subjects (12 in Turin and 13 in the countryside) are very close to those for the overall population. The preliminary results for blood samples taken in 1981 seem to indicate a response of the blood values in agreement with the reversion of the value of ratio Pb-206/Pb-207 for the airborne particulate.

The isotopic ratio of lead in rainwaters collected in Turin is almost the same than that collected in rural areas and higher than in air samples. The most surprising fact is that in certain periods of precipitations the isotopic ratio occasionally approaches the values observed before the isotopic marking took place. This can be explained by air mass circulation and by the predominant effect of rain-out over the wash-out mechanism in the rain formation.

The analysis of the agricultural soils collected in the villages belonging to the experimental area has given an average value of 1.17 for the ratio Pb-206/Pb-207, showing no overlapping with the Australian lead.

For the future it is foreseen to continue the determination of isotopic ratios in blood from Turin and from country sites until they revert closely to pre-experiment values.

A limited number of airborne, petrol, blood and environmental samples will still be taken.

Exposure and Health Effects

As in the previous programme this project is focussed on two research lines, sources and environmental pathways (assessment studies) and environmental biochemical toxicology (metabolism of heavy metal pollutants at present environmental levels).

Assessment studies

The environmental dynamic model to predict the evolution of HMs in the biosphere and assess dominant pathways was completed with special reference to the water system model. It allows predictions on the long term migration to groundwater of HMs released through atmospheric stack emissions of coal fired power plants (CFPP) on the territory of each Member State.

Applied to As little impact of this element on groundwater is suggested, the Maximum Permissible Concentration (MPC) adopted in the EC being never reached.

The assessment studies were further completed for B, Se, Hg: they present a different potential hazard to air and soil compared to all other elements previously analyzed. However, predictions based on the total concentration of these trace elements are not sufficient to evaluate rigorously the impact on ecosystems and man. A more detailed assessment of these three elements is therefore recommended.

Evaluations on the mobilization of HMs from CFPPs were extended to the assessment of the release of α-emitter elements. Radiometric analysis of the α-emitters in coals burnt in the EC power plants were used for a comparison with the amounts of emitters released by the nuclear fuel cycle (LWR). Results suggest that the amount of radioactivity released from nuclear power plants is comparable with that of power generation by coal burning. However, due to the higher specific radioactivity of uranium mill tailings in respect to that of coal ash, the total release of α-emitters from the nuclear fuel cycle presents a greater potential hazard to the environment and man compared to the use of coal from mining to burning.

Assessment studies have been extended to other selected exposure situations as HM pollution from fertilizer practice and municipal incinerators.

Evaluations of HMs from phosphatic fertilizers were focussed on the impact of As and Cr on groundwater. Results confirm that As can migrate from soil to groundwater to a minor extent.

An experimental activity for incinerators started with the analysis of HMs in fly ash, suspended particles and ash pond waters of a municipal plant. High concentrations of Cd, Cr, Mn and Zn were found in fly ash compared to the corresponding levels in coal ashes from CFPPs suggesting to pay much attention to these elements in leaching studies. Particularly important were the analyse of vapours and fumes collected as condensate and not retained by electrostatic filters. For Hg and Sb the contribution of the condensate was significant.

Experimental activities related to long term leaching and sorptive behaviour of HMs from waste of CFPPs and municipal incinerators were intensified.

V, As, Cd, Tl, Sb, including their chemical forms, were investigated using leaching of neutron activated fly ash by water in column and radiotracers for in batch and column experiments.

Environmental biochemical toxicology

Considerable progress has been achieved for the metabolism of V, As, Tl, Cd and Sb. Particularly interesting are the findings from intratracheal inhalation of $^{109}CdCl_2$. Cadmium was found present in the lung not only in the form of metallothionein but also associated to high molecular weight components (HMWC) (Fig. 5). The Cd-bound HMWC are more available than the Cd associated to metallothionein and can be translocated from lung to the liver. This may explain the significant increase of the hematic levels of Cd observed in the blood of subjects recently exposed to Cd dust.

These results and others on As and V confirm that inhalation studies of HMs on laboratory animals and volunteers are needed as further indicators for environmental exposure to HMs.

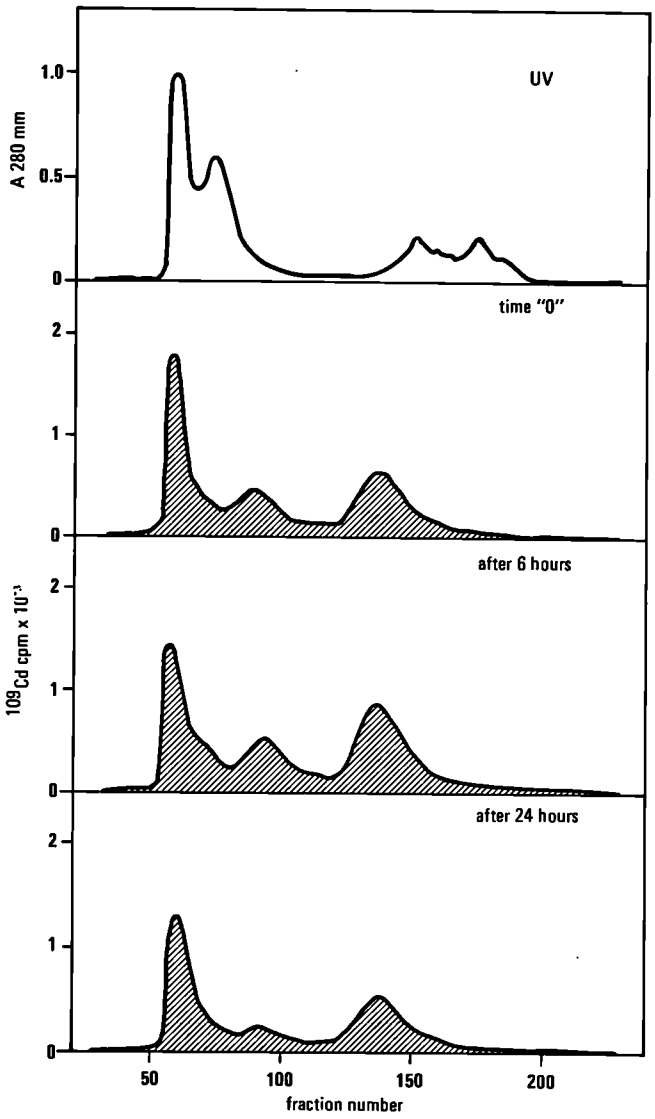


Fig. 5. Distribution of ^{109}Cd in the soluble fraction of rat lungs, at different time after l.t. instillation of 1 μg of ^{109}Cd/rat as $CdCl_2$

Multielement analysis has been done in fluids, autopsies and biopsies of humans differently exposed to HMs to confirm an eventual extrapolation of results obtained from laboratory animals to man. In this context neutron activation analysis (NAA) has been reoriented towards metallobiochemical investigations on HMs in human tissues. The problem related to the use of NAA of trace elements in human tissues have been defined and include identification and quantification of any possible source of contamination and loss of the elements during sampling and sample handling of tissues and biological fluids (analytical quality control research). Vanadium in blood and urine of different groups of workers exposed to this element during oil-fired boiler cleaning and repairing has been determined together with the Vanadium content in the workplace.

A round table discussion on the state of the art and future trends on Heavy Metal Pollution Research was convened at Ispra with invited experts from community countries. Besides a critical assessment of the ongoing activities (pathways and biochemical toxicology) the general analytical problems of HM determination in environmental and biological samples were addressed.

ENVIRONMENTAL IMPACT OF CONVENTIONAL POWER PLANTS

This project represents the follow-up of studies which were undertaken in recent years and progressively unified under the general theme «Remote Sensing of pollution phenomena around intense localized sources». Techniques and methods developed in this frame constitute a proven structure for application **in field**, as shown by joint participation of JRC-teams in national or European Campaigns. Four laboratories with different measuring techniques are contributing, namely: Micrometeorology; Correlation Spectrometry (COSPEC and TELETEC); LIDAR; Tracers.

The activities of these groups for 1981 can be summarized as follows:

— **Participation in the 5th CEC Campaign (Ghent).** In the month of June, two of our teams (Correlation Spectrometry and Micrometeorology) participated with their mobile units in this European field exercise, a follow-up of previous four held in France (Lacq and Cordemais), England (Drax) and Italy (Turbigo). It was organized in the frame of the Belgian R & D Environmental Programme, in collaboration with DG XII. During the Campaign, efforts have been concentrated on the measurements of emission and dispersion of the Ghent industrial area (power plants, refineries, chemical plants as major sources), in order to establish a mass balance of pollutants entering and leaving.

— **Mass balance investigations combining LIDAR and COSPEC measurements.** Joint application of light scattering and absorption techniques has been tested in a series of exercises around a conventional power plant. The possibility of obtaining a comparative description of aerosol behaviour vs. gaseous behaviour in the emitted plumes has been presented at the recent COST-Symposium on «Physicochemical behaviour of atmospheric pollutants» (Varese, Sept. 1981).

— **Tracer experiments.** Simultaneous release of three tracers (CF_2Br_2, $CFCl_3$ and SF_6) has been performed in some experiments at KFK Karlsruhe in the frame of a collaboration contract. The possibility to monitor pollutant dispersion from a system of multiple sources has been satisfactorily tested. Studies for extending the range of dispersion up to 50 km as well as the application of new tracers are progressing.

— **Pollutant mass flow over Milan area.** In the frame of a collaboration with the Brera Meteorological Observatory (Milan) series of surveys on a closed path around the city in different meteorological situations have been performed with our mobile laboratory adapted for pollution mapping. Evaluation of input and output mass flow of SO_2 is shown to be possible.

— **Micrometeorology.** A long-term program of measurements of heat flux and atmospheric turbulence around the Turbigo power plant has been prepared. A comparison with other instruments under different meteorological conditions is foreseen.

— **Round table discussion on future trends.** The implementation of research lines has been discussed in a round table

meeting among selected experts from the Member States, held in October at Ispra. Apart from a general appreciation of the past activity, the experts recommended to concentrate efforts on the practical application of new methodologies and intercomparison of existing instrumentation. The idea to organize topical workshops and seminars for information exchange on a European scale has been welcomed.

3. CONCLUSIONS

The project ECDIN has seen advances in the development of the ECDIN display system, the preparation of the user reaction study and increased reliability of the connection of the JRC computer to EURONET.

The ECDIN group has bees designated the Commission Contact Point for EINECS and is actively engaged in preparation for the Supplementary Reporting Period. The earlier work for D.G. XI has resulted in publication of a set of basic documents for EINECS (ECOIN, Compendium and reporting guidelines). Discussions on the role of ECDIN for the notification of «new chemicals» have started and a sound base for collaboration with D.G. XI on existing and new chemicals has been established.

Final discussion of the «ECDIN policy document» (present status and development) within the ACPM resulted in a general agreement on the utility of ECDIN for the Commission Services. A decision on the future of ECDIN as a comprehensive data bank network on a European scale is postponed for two years. Efforts on a «commercial ECDIN» are continuing with the help of DG XIII.

The activities of the Petter Establishment on **Organic Chemical Products** were continued successfully. The importance of hethocyclic polyaromatic hydrocarbons as cancer suspect environmental chamicals is related to the projected increase of coal-burning for electricity production.
More insight has been got in the feasibility of reducing toxic additives in plastic parkaging materials. (Special case of Indoor Pollution).

A round table discussion with invited experts gave rise for extensive discussion on the problematic nature of **Indoor Pollution** research. The variety of possible approaches makes a careful choice of the future orientation of this activity even more important. Compatible with the limited resources of the JRC, work on the elaboration and test of analytical methods for carbonyl compounds went on in the meantime. Passive sampling will be considered as an inexpensive and efficient means for surveying mean concentrations of inorganic and possibly some inorganic pollutants in future measuring campaigns.

The overall progress of the project **Air Quality** was satisfactory. Some activities, like the evaluation of air-borne data from the Netherlands (1980) and the comparative field-measurements of particle concentrations in a woody area of the JRC could be concluded. An extensive study of the aerosol-size distribution in rural atmospheres is in fair agreement with the commonly proposed processes for particle formation and growth. The role of carbon monoxide as an eventual precursor for the formation of tropospheric ozone is under investigation. Due to further delay of hardware delivery preliminary, measurements with the long path IRFTS system could be made only torwards the end of the year.

The project **Water Quality** continued along the two research lines «nutrient mass balance» and «ecological effects of chemical pollution».
For conclusions on the nutrient mass balance of the deeper Agno Bay and its comparison with the results of the previous Ponte Tresa Bay measurements, the completion of the annual cycle (Spring 1982) has to be expected.
New insight in the complex mechanism of eco-toxicity of heavy metals has been gained.

The ILE project already now is clearly demonstrating the contribution of automotive lead to total human lead exposure.
Analyses of isotopic Pb ratio are continuing with a limited effort to make the best use of the data and samples already available and to complete our knowledge on the complex pathway/uptake mechanism.

The project on **Heavy Metals Exposure and Health Effects** focusses on the eventual environment impact of heavy metals stemming from different anthropogenic sources like coal fired power plants, municipal incinerators, fertilizers and waste recycling. These assessment studies were backed up by a rather strong and extensive environmental research on the biochemical mechanisms of the up-take of these trace metals in laboratory animals and human tissues.

The assessment of the environmental risk of arsenic from conventional power production and phosphatic fertilizer application gave conforting values even for the long term trend.

For the **Project Environmental Impact of Power Plants** the data evaluation of the 5th CEC campaign (Ghent, June 1981) and the tracer experiments at Karlsruhe (April and September 1981) were the more demanding tasks.

The recommendation of the expert panel of a round table discussion on the «application of ground-based remote sensing of atmospheric pollutants» were especially welcomed as on the one side expensive and complex equipments and on the other side the limited staff available are demanding careful planning to make the best use of both in future research activities.

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