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COVER SHEET
FOR TRIP REPORTS SUBMITTED TO THE OFFICE OF ENERGY RESEARCH

Destination(s) and Dates for Which Trip Report Being Submitted: Budapest, Hungary 4/25-29/88; Vienna, Austria 5/2-12/88; Neuherberg, Federal Republic of Germany 5/2-4/88; Schmallenberg, Federal Republic of Germany 5/4-5/88

Name of Traveler: R. Gordon Blaylock

Joint Trip Report ☒ Yes ☐ No

If so, Name of Other Traveler(s): F. Owen Hoffman

Steven M. Bartell

OAK RIDGE NATIONAL LABORATORY

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ORNL

FOREIGN TRIP REPORT

ORNL/FTR-2880

DATE: June 3, 1988

SUBJECT: Report of Foreign Travel of B. G. Blaylock, F. O. Hoffman, and S. M. Bartell, Research Staff Members, Environmental Sciences Division

TO: Alexander Zucker

FROM: B. G. Blaylock, F. O. Hoffman, S. M. Bartell

PURPOSE:

To participate in the Sixth Biospheric Model Validation Study meeting in Budapest, Hungary; to attend the Coordinated Research Program and a technical consultants meeting on Model Validation in the Urban, Terrestrial, and Aquatic Environments sponsored by the International Atomic Energy Agency (IAEA) in Vienna, Austria; and to present a seminar, "Current Issues and Thoughts in Ecological Risk Analysis," at the Gesellschaft fur Strahlen-und-Umweltforschung (GSF) in Neuherberg, Federal Republic of Germany, and at Fraunhofer Institut in Schmallenberg, Federal Republic of Germany.

SITES VISITED:

4/25-29/88	National Research Institute for Radiobiology and Radiohygiene	Budapest, Hungary	B. Kanyar E. Hidvegi
5/2-12/88	IAEA meeting	Vienna, Austria	H. Koehler M. Crick G. Linsley
5/2-4/88	GSF seminar	Neuherberg, Federal Republic of Germany	M. Matthies J. Benz K. Voigt
5/4-5/88	Fraunhofer Institute seminar	Schmallenberg, Federal Republic of Germany	J. Volmer G. Schumann M. Weiss

ABSTRACT:

Drs. Blaylock, Hoffman, and Bartell attended the Sixth Biospheric Model Validation Study (BIOMOVS) meeting in Budapest, Hungary. BIOMOVS is an international cooperative effort to test models designed for calculations of environmental transfer and bioaccumulation of radionuclides and other trace substances. The participants from ORNL served as task group leaders, sessions chairmen, scientific consultants, and contributors to modeling efforts and task discussions at this meeting. BIOMOVS is completing the third year of a 5-year study; many of the tasks assignments are nearing completion, and draft reports are being written. Three final reports were available for distribution. After the BIOMOVS meeting, at the invitation of the International Atomic Energy Agency (IAEA), Dr. Hoffman attended a Coordinated Research Program meeting entitled "Model Validation in the Urban, Terrestrial, and Aquatic Environments" and a technical consultants meeting to help formulate plans for the IAEA to continue studies similar to the BIOMOVS effort. Dr. Bartell was invited to Gesellschaft fur Strahlen-und-Umweltforschung (GSF) in Neuherberg, Federal Republic of Germany, and to Fraunhofer Institut in Schmallenberg, Federal Republic of Germany to present seminars on research concerning current issues in ecological risk analysis.

THE SIXTH BIOMOVS MEETING, BUDAPEST, HUNGARY, APRIL 25-29, 1988

This meeting was attended by Drs. Bartell, Blaylock, and Hoffman from ORNL. BIOMOVS is an international cooperative effort to test models designed for calculation of environmental transfer and bioaccumulation of radionuclides and other trace substances.

BIOMOVS is governed by an agreement between the participating organizations.

Currently, 14 organizations from 12 different countries participate in the BIOMOVS study. The U.S. Department of Energy (DOE) is one of those organizations. The participating organizations sponsor project teams for the actual project work, including model calculations and collection of data sets, and they cover the cost of participating members.

The Swedish National Institute of Radiation Protection (NIRP) sponsors a Project Secretariat, while the Nordic Liaison Committee for Atomic Energy (NKA) and the International Union of Radioecologists (IUR) give some financial support to the study. In addition, IAEA and the Nuclear Energy Agency of the Organization for Economic Cooperation and Development Agency (OECD/NEA) participated as observers. Dr. Hoffman is the scientific consultant for BIOMOVS and is sponsored by NIRP.

The primary objectives of BIOMOVS are (1) to test the accuracy of the predictions of environmental assessment models for selected contaminants and exposures scenarios; (2) to explain the differences in model predictions due to structural deficiencies, invalid assumptions, and/or differences in selected input; and (3) to recommend priorities for future research for improving the accuracy of model predictions.

To fulfill these objectives, two approaches were taken. The first approach, Approach A, involves the formulation of test scenarios based on suitable data and a comparison of model predictions against these independent data sets. The second approach, Approach B, involves the comparison of model predictions and associated estimates of uncertainty for specific test scenarios selected on the basis of assessment priorities. When BIOMOVS was first launched at a meeting in Paris, France, on February 24-27, 1986, it was surmised that most of the environmental transport models were based on the best data sets available at that time; therefore, there was a limited amount of independent data for testing the transport of radionuclides in the environment. As a result, considerable emphasis was placed on obtaining data sets for contaminants other than radionuclides, and a scenario on mercury in the aquatic environment was developed. In addition, Approach B was developed for comparing model predictions for which independent data sets were not available. This approach also served another purpose, for in some cases, no data are available for assessments predictions, such as those that are made for several thousands of years into the future.

The Chernobyl accident, which occurred in May 1986, provided an opportunity to obtain a large number of independent data sets for testing radionuclide transport models. The accident generated considerable interest in the BIOMOVS study because the study provided an international mechanism for testing radiological transport models.

BIOMOVS is planned as a 5-year study and will end in 1990. The IAEA has become interested in continuing a study along the same lines as BIOMOVS and is in the initial stages of planning a 5-year coordinated research program that will use Chernobyl data for testing model predictions. Drs. Hoffman and Blaylock were invited to attend the initial meeting of the IAEA Coordinated Research Program in Vienna during the week following the BIOMOVS meeting. Dr. Hoffman attended the IAEA meeting, whose results are included in this report. Dr. Hoffman was also requested to stay an additional 3 d as a special consultant to the IAEA in the development of a working plan for the Coordinated Research Program. W. L. Templeton (Battelle Pacific Northwest Laboratory, Richland, Washington), who was chairman of the coordinated research meeting, and Dr. R. Boge (NIRP, Sweden), were also asked to help draft the working plans for the Coordinated Research Program.

The National Research Institute for Radiobiology and Radiohygiene of Budapest hosted the Sixth BIOMOVS meeting, which was attended by representatives from 21 organizations in 16 countries. The United States was represented by the travelers from ORNL and by D. Breshears and Drs. F. W. Whicker and T. Kirchner from Colorado State University.

Prior to the official meeting, Drs. Blaylock and Hoffman attended a meeting of working group leaders on April 24, 1988, to confirm the agenda of the official meeting, to report on the status of the working groups, and to discuss the preparation of the technical reports and the final report of the BIOMOVS study.

The meeting began with reports on the status of the scenarios. Dr. Blaylock reported that all information on Scenario A-1, "Mercury in the Aquatic Environment," had been received and that analyses of the data had been completed. As leaders indicated, most of the scenarios are nearing completion, and technical reports are being drafted. Three technical reports are complete and available for distribution.

After the opening session there were several plenary sessions, followed by meetings of different scenario panels throughout the week. Working sessions were conducted in the mornings and afternoons up to Friday. Usually the travelers attended different sessions and were actively involved in most sessions.

SCENARIO A-4: "THE USE OF CHERNOBYL DATA TO TEST MODEL PREDICTIONS OF THE TRANSPORT OF ^{131}I AND ^{137}Cs FROM AIR TO PASTURE TO MILK, MEAT, AND GRAINS"

These discussions were chaired by H. Koehler of the IAEA. In this scenario, data were distributed to numerous modeling groups for a blind test of model predictions. These data described the initial conditions of air concentrations and deposition, including the prevailing agricultural and dairy management practices for 13 locations that are situated throughout the Northern Hemisphere and that received Chernobyl fallout in the form of either wet or dry deposition.

For ^{131}I, the modelers were challenged to calculate the time-integrated and time-dependent concentrations in milk and pasture; for ^{137}Cs, they were challenged to calculate the concentrations in milk, meat, and grain. Information on the actual measured concentrations in rain, food items, and animal feed were not revealed until all model predictions had been submitted to Mr. Koehler. In all, 22 different models were represented in this scenario.

During the Budapest meeting, it was concluded that there is empirical evidence indicating that ^{131}I is less efficiently retained by vegetation during wet deposition than is ^{137}Cs. As a result, there is surprisingly less variability in the transfer of ^{131}I from the atmosphere to pasture vegetation than in the transfer of ^{137}Cs. Models that explicitly account for the effects of rain scavenging and interception of wet deposition by vegetation tended to substantially overestimate the measured concentrations of ^{131}I in pasture vegetation. Their predictions, however, were fairly accurate for ^{137}Cs.

Exceptions to these results were the predictions for pasture concentrations produced by RAGTIME87 (developed by former ORNL staff member G. G. Killough and F. O. Hoffman) and ECOSYS (developed at GSF), which were relatively accurate (within a factor of two) for both ^{131}I and ^{137}Cs. The predictions of RAGTIME87 were based on preliminary data obtained during 1987 from ORNL field studies. These studies used artificially enhanced concentrations of ^{131}I as periodate and iodide along with ^{7}Be in simulated rain. The experimental results for ^{7}Be were used directly in RAGTIME87 as an analogue for ^{137}Cs. The predictions of

ECOSYS were based on theoretical considerations of the water-holding capacity of vegetation and the leaf adsorption properties of ^{131}I and ^{137}Cs.

RAGTIME87 and ECOSYS produced almost identical results when their assumptions were normalized for the chemical composition of the gaseous fraction of ^{131}I in air. For all sites for which the measurements are not suspect, their predictions were well within a factor of two of observations. Indications are that if the biological behavior of Chernobyl fallout can be generalized to other accident conditions, the foodchain transport of ^{131}I and ^{137}Cs will be demonstrated to be of lesser importance than was previously thought. For exposures to large population groups, the inhalation of ^{131}I in air will be a competing pathway of importance; likewise, the external exposure to ^{137}Cs deposited on the ground surface may dominate the collective dose commitment, making food intervention of importance only to critical population subgroups.

Scenario A-4 will continue, with each modeling group responsible for the analysis of its own model calculations. All data will be verified and then distributed to each modeling group. The data will be in electronic format and readily suited for spreadsheet analysis. In addition, four groups will analyze all results across all sites and models. Statistical approaches are being developed by T. Kirchner and D. Breshears at Colorado State University to facilitate the analysis of this large mass of data. These analyses will be completed prior to the next meeting in Japan.

At the Japan meeting, emphasis will be placed on finalizing the discussions of this scenario. These discussions will identify the primary causes of misprediction and will recommend methods for improving the accuracy of model predictions about the behavior of ^{131}I and ^{137}Cs released from reactor accidents.

SCENARIO A-5: "CHERNOBYL LAKE"

This scenario is still undergoing development. Bjorn Sundblad (Studsvik Energiteknik, Nykoping, Sweden), the task leader, had presented the details of the scenario at the December BIOMOVS meeting. The purpose of the scenario was to use Chernobyl data from watersheds and lakes in Sweden, Denmark, and Finland to follow the transport of ^{137}Cs from the watershed and the subsequent accumulation in aquatic food chains. Model predictions had not been made for this scenario; however, at the discussion session Dr. Bartell presented a preliminary model for the transport and accumulation of ^{137}Cs in an aquatic system. This model was compared with and contrasted to other models to be used by other scenario participants. Higher concentrations of ^{137}Cs than anticipated occurred in fish in some freshwater lakes as a result of Chernobyl fallout. Model predictions for this scenario should be helpful in identifying the processes that influenced these relatively high concentrations as well as presenting a challenge to the modelers.

SCENARIO B-5: "EVOLUTION OF A LAKE"

This scenario is near completion, and a report has been drafted. This scenario involves the prediction of the fate of radium and thorium that have been released into a freshwater lake. The predictions cover many thousands of years, similar to the predictions requested in many waste disposal assessment scenarios. One of the important accomplishments of this scenario was to identify the significance of long-term changes in lake morphometry and adjacent land use patterns that would affect the fate of radium and thorium in the environment. Dr. Bartell provided assistance in revising the final draft of this scenario. He was also able to provide experience in the development, application, and analysis of environmental models for toxic chemicals as this experience related to similar problems in predicting radionuclide behavior in the environment.

SCENARIO B-7: "TRANSPORT OF RADIONUCLIDE FROM GROUNDWATER TO SEDIMENT"

This scenario is being developed by Dr. Theo H. Zeevaert from Mol, Belgium. The scenario is one in which groundwater from a radioactive disposal area is contaminating sediment in a small river in The Netherlands. The scenario was made more interesting through the inclusion of river dredging and secondary inputs of cesium from the surrounding watershed. Modeling results to predict the radiation dose to man via the aquatic pathways (drinking water, eating aquatic biota, and exposure from contaminated sediments) with distance downstream are requested by the next meeting. Because only 2 years are left in the BIOMOVS study, there is concern that a new scenario cannot be completed during this time. However, the experience that has been gained in the previous scenarios was obvious in the discussion on the development of this scenario. Fewer delays occurred in this scenario than in the early scenarios, indicating a maturing of the BIOMOVS study.

SCENARIO B-8: "IDENTIFYING PATHWAYS LEADING TO RADIATION DOSE TO MAN"

The purpose of this scenario is to identify the various pathways and the importance of their contribution to the radiation dose to man. Dr. Whicker of Colorado State University was appointed task leader. The dominant foodchain pathways were to be identified along with the uncertainties associated with these pathways. These pathways may draw heavily upon concepts and methods for quantifying model sensitivities developed and routinely practiced by staff in the Environmental Sciences Division at ORNL. In addition, this scenario, which was changed to a task study, will evaluate the overall contribution of BIOMOVS to the assessment of radionuclides in the environment by identifying conditions under which uncertainties associated with biospheric transport of radionuclides will be of dominant importance to the assessment of dose or risk to humans.

SCENARIO A-1: "MERCURY IN THE AQUATIC ENVIRONMENT"

Dr. Blaylock presented the analysis and conclusions of this scenario at the final plenary session. Modelers were given three scenarios for which

the concentration of mercury in the edible tissue of fish was to be predicted. General conclusions from this discussion were (1) simple models could accurately predict the concentrations of mercury in fish when mercury in the aquatic environment was at equilibrium; (2) under dynamic conditions, more complicated models are needed to predict the concentration of mercury in fish; (3) uncertainties reflect the confidence that modelers have in their model; (4) when uncertainties are based on judgment, experience is the most important factor in determining the quality of the uncertainty estimates; and (5) in a scenario that included fish population dynamics, the uncertainty estimates associated with some model predictions were not sufficient to include the 95% confidence limits of the data.

Results of the discussion of the A-1 scenario was that the analysis was complete and that the final report, which is in draft form, should be completed by the next BIOMOVS meeting, in November 1988. The task leader was also encouraged to submit the results for open literature publication.

In the A-1 scenario it was assumed that modelers lacked confidence in their models when the uncertainties were greater than one order of magnitude. This stimulated a discussion on the importance of uncertainties and on the conditions under which uncertainties are so large that they should not be considered. This became one of the main topics of the summarizing session.

UNCERTAINTY DISCUSSION

During the final plenary session, a special discussion was held to address concerns shared by all working groups with regard to uncertainty estimates. Dr. Hoffman served as discussion leader. Many participants felt uncomfortable with the large uncertainty estimates given for predictions for many of the scenarios. Although most uncertainty estimates were within one order of magnitude of the predicted values, uncertainty estimates ranged over several orders of magnitude for the B scenarios dealing with potential releases lasting thousands of years into the future.

Some participants argued that when uncertainty estimates exceeded several orders of magnitude, one would not need a model at all, because one could simply guess at the answer. Others contended that when uncertainties were this large they simply should not be given and that additional work obviously must be conducted to reduce the uncertainty estimates. Despite these concerns, it was concluded that the uncertainty estimates were honest and accurate reflections of the lack of confidence that the modeling groups placed on their predicted answers. This is why uncertainty estimates were especially large for predictions made for hypothetical waste management scenarios in which releases occurred over thousands of years.

The group concluded that, even with these large uncertainties, predicted consequences that are well below a decision-making criterion are useful results. However, when uncertainties infringe on the decision criterion,

there is incentive for improving the base of information available to improve the model prediction. At the very least, the provision of uncertainty estimates along with a predicted result will inform the decision-maker about the confidence that the modeler has placed in his predicted result. The decision-maker is thus made aware of the possibility that his decision criterion might be violated. In making decisions, the decision-maker should weigh the consequences of a possible violation of a decision criterion against the consequences of a decision that is made to ensure that such a violation would not occur.

BIOMOVS FINAL REPORT

A plenary session was devoted to the proposed contents of the final report, which is due in 1990. After a lengthy discussion, it was concluded that the report should not be a rehash of the technical reports for the various scenarios; instead, the report should concentrate on the accomplishments of the BIOMOVS study. The final report will highlight statements that can be made as a result of the study and that transcend all scenarios. Results of the individual scenarios documented in technical reports would be referenced as examples in the final report. Drs. Blaylock and Hoffman have been requested to serve as initial authors in drafting chapters about the data requirements of models and the use of data for testing model predictions.

CONCLUSIONS

DOE was well represented at the meeting and is fulfilling its obligation to the BIOMOVS program; however, these obligations are being carried out more by individual initiative than by programmatic support. One of the common complaints is that programmatic support is not available for work on the BIOMOVS program although the importance of such a study has been demonstrated by the fact that IAEA is planning a 5-year coordinated research effort on the subject.

One of the most important benefits of the BIOMOVS study for DOE and ORNL is the access to Chernobyl data bases. BIOMOVS has provided a mechanism for obtaining Chernobyl data and for establishing contact with individuals intimately familiar with the data sets, thereby providing a unique opportunity to test models with independent data sets.

DR. E. J. HIDVEGI

Dr. Hidvegi, who had visited the Biology Division at ORNL, is head of the Molecular Biology Section at the Joliot-Curie National Institute for Radiobiology and Radiohygiene in Budapest. The institute has about 300 employees and is the largest Hungarian institute devoted to biological research. The institute, which is located in a renovated castle, has research efforts in radiobiology, molecular biology, and nuclear medicine, and it provides the radiopharaceuticals for Hungary.

The institute was also responsible for the Chernobyl data base for Hungary. Dr. B. Kanyar from the institute is the Hungarian representative to BIOMOVS and was the official host for the Budapest meeting.

Dr. Hidvegi informed us that the institute had been encouraged to sponsor the BIOMOVS meeting and that they hope to sponsor more international meetings in the future. As a result, the facilities and arrangements were excellent, and the meeting received a lot of publicity. The opening session was televised, several of the participants were interviewed for radio broadcast, and the meeting was covered in a front-page article in the newspaper. It was obvious that the institute was making every effort to ensure a successful meeting from the standpoint of the host.

MEETING OF THE IAEA COORDINATED RESEARCH PROGRAM ON MODEL VALIDATION IN THE URBAN, TERRESTRIAL, AND AQUATIC ENVIRONMENTS, VIENNA, AUSTRIA, MAY 2-6, 1988, AND TECHNICAL CONSULTANTS MEETING, MAY 9-12, 1988

Dr. Hoffman attended both of these meetings as a technical consultant to the IAEA. Mr. Templeton served as the general chairman. The participants included members from Austria, Belgium, Canada, Czechoslavakia, Federal Republic of Germany, Italy, France, Finland, Hungary, Poland, Sweden, United Kingdom, the Soviet Union, and the United States. Scientific secretaries from the IAEA were H. Koehler, M. Crick, and G. Linsley. The program objectives were to establish data bases containing information for use in model calibration or testing related to the transfer of radionuclides in terrestrial, urban, and aquatic environments. The discussions focused to a large extent on the need to use data from the Chernobyl accident.

It was decided that the IAEA would not repeat tasks accomplished in BIOMOVS but would either address those questions identified in BIOMOVS as being in need of resolution or attempt testing on a scale that would be broader in scope than is currently possible in the BIOMOVS exercise. Thus, the CRP will consider model testing on a process level, as well as coordinate formal blind tests similar to the group A scenarios in BIOMOVS. In addition, general questions will receive attention to improve the extent to which Chernobyl data can be generalized to other accidental releases of radionuclides.

Many of the items identified for process-level model testing were factors that make up the parameters in typical radiological assessment models. These items were (1) wet and dry deposition of gases and particles, (2) vegetation and artificial surface retention of these deposited materials, (3) watershed catchment and subsequent transport of terrestrially deposited fallout to aquatic systems, (4) foodchain bioaccumulation, and (5) the role of soils and sediments as sinks and secondary sources of release of radionuclides to the environment. There was a special interest in the role of the forest environment and the presence of pathways of exposure to critical population subgroups not accounted for in present assessment models. Pathways of concern were (1) enhanced deposition and retention of gamma-emitting radionuclides,

leading to potentially higher external exposures of persons inhabiting forested regions, and (2) high bioaccumulation in edible plants as well as in foodchains, leading to contamination of the tissues of wild game and resident and migratory bird species. Concern was also focused on the urban environment, especially on testing predictions of the adsorption to and weathering from natural and artificial surfaces and the effect of these processes on the rate of external gamma doses received by members of the public.

One of the major "blind test" scenarios developed during these two meetings is a multiple pathway assessment of internal and external exposure to ^{137}Cs; the assessment will use measurements collected on whole body concentrations and external gamma dose rates for specific regions. This test scenario will be given the status of a major task. It is envisioned that detailed data will be acquired from three to five locations and that these locations will be further developed into specific test scenarios. Sites currently being solicited for data suitable for model testing are located in Finland, Sweden, Hungary, Poland, Bavaria, Austria, and the Soviet Union. No commitments have been made by the Soviet participants, although they seemed willing to assemble data for the watershed around Chernobyl and the recipient populations downstream from the reactor. The urgency of Soviet data for this research program was emphasized by all participants.

The time envisioned for this task will be 3-5 years. H. Koehler will serve as the initial secretary at the IAEA, and Dr. Hoffman will serve as chairman. At least 1.5 years will be required for data acquisition and evaluation before actual scenarios will be developed for "blind testing" of model predictions. A tentative schedule of events will involve two questionnaires and small consultant meetings over the course of the first 2 years of this project.

Other "blind tests" will proceed in the urban and aquatic environments, but these tests will be on a smaller scale. There is some indication that data will become available to permit a test scenario of the transport of radionuclides in the river systems feeding the Dneiper River and their further transport to the Black Sea. Most of the other activities will involve interested investigators evaluating available data to test the conceptualizations of important processes.

A major issue raised during the meetings was the uniqueness of the Chernobyl fallout data. If these data are unique, then the use of these data will be of limited value for model testing. The results of such tests will be applicable to the Chernobyl accident but may be of limited use for modeling other releases of the same types of radionuclides.

Although several environmental chemists have commented on the relative insolubility of Chernobyl particulates, specific experiments conducted at Riso, Denmark, GSF, and at the Center for Nuclear Research in Mol, Belgium, have shown that the biological uptake of Chernobyl cesium by dairy cattle is no different from the uptake of soluble cesium chloride and weapons fallout cesium from soil by plant roots. Nevertheless, the

coefficients for the transfer of these materials and Chernobyl ^{137}Cs from vegetation to milk appear to be less than commonly assumed or documented in the literature. Similar evidence appears to support the generality of transfer coefficients values obtained for ^{131}I. In addition, the weathering of Chernobyl radionuclides from urban surfaces appears to be traced quite well by the weathering of cosmogenic ^{7}Be.

The success of this coordinated research program will depend on the commitment given by the individuals assigned specific tasks and on the incentive given to the investigators and institutes that volunteer the use of their data. Involvement by DOE in these activities will have obvious benefits because DOE will have access to data residing in Europe. However, continued reduction in support from the technical program offices within OHER/DOE will limit the extent to which investigators at ORNL will be able to commit resources to this research effort. Given the opportunity to use Chernobyl fallout data to investigate processes on a global scale, we urge that these activities be fully supported by DOE.

This trip represents part of a continuing collaboration between GSF and ORNL scientists that began in 1985 (see ORNL-FTR 2208). During this brief visit, Dr. Bartell presented an invited seminar entitled "Current Issues and Thoughts in Ecological Risk Analysis" to GSF staff interested in chemical fate and effects in the environment. In addition to the seminar, Dr. Bartell discussed recent development of models for translating acute toxicity data measured in the laboratory into estimates of expected effects in complex aquatic foodwebs. Dr. Bartell also demonstrated an interactive computer program that employs models currently used in the ORNL-ESD project for estimating ecological risks to aquatic populations and ecosystems. In turn, GSF staff demonstrated an interactive data base package for storing and retrieving information that describes the basic chemistry, environmental behavior, and toxicity of chemical compounds of interest to regulatory agencies within the Federal Republic of Germany.

GSF scientists that specialize in issues concerning environmental chemistry described current and future projects related to model development. One study closely parallels an ongoing ORNL-ESD project sponsored by EPA. These projects feature an integration of modeling and experimental approaches for examining the effects of phenolic compounds in ponds. GSF staff expressed the desire to share models and data with Dr. Bartell and ORNL scientists. The two groups also discussed joint efforts in developing models for simulating the effects of phenolic compounds in experimental ponds and exchanged ideas for a combined effort in modeling large-scale regional pollution problems in the Rhine River. At the invitation of Dr. M. Matthis, Dr. Bartell visited GSF to discuss current developments in the use of computer models to predict the transport, accumulation, and toxic effects of potentially hazardous chemicals in the environment. We will attempt to work these ideas into a research proposal to the West German government. We also mentioned combining this effort with a similar effort concerning large river systems in the United States, for example, the Ohio or Mississippi river systems. Because a jointly sponsored program involving DOE, EPA, and the West

German Umweldtbundesamt (UBA) seems worthy of pursuit, we will explore the possibility of exchanging not only data and models but also personnel. We envision that such staff exchanges will occur periodically, with each one lasting for a short time, several weeks or a month.

FRAUNHOFER INSTITUT, SCHMALLENBERG, FEDERAL REPUBLIC OF GERMANY, MAY 4-5, 1988

At the invitation of Dr. W. Klein, the Director of the Fraunhofer Institut, Dr. Bartell visited the institute to meet with scientists who are in the initial stages of forming a group in environmental toxicology and chemistry. He presented a formal seminar on ORNL-ESD research concerning ecological risk analysis.

Dr. Bartell discussed the use of ecosystem models for predicting the risk posed to aquatic populations by toxic chemicals. Methods for quantifying models' sensitivities to estimated parameter values were also discussed during this visit.

Dr. Volmer and his colleagues are in the process of accumulating and implementing a set of ecological and environmental toxicology models. These models will be forwarded to agencies within the West German government for use in chemical assessments. The Fraunhofer Institut will not perform the assessments. A major sponsor of this activity is the UBA, an agency analagous to EPA. Dr. Bartell was invited to the institute because of his experience in developing and analyzing aquatic ecosystem models used to forecast the fate and effects of toxic chemicals in aquatic environments. Dr. Volmer and his staff are interested in using or modifying these models and adding them to their collection of assessment tools collated for the UBA.

Dr. Bartell also has experience in the development of quantitative structure-activity relationships (QSAR) for organic chemicals. These QSARs have been useful in deriving model parameter values for compounds from basic chemicals descriptors. In the absence of data, such relationships are useful for assessing the environmental fate of chemicals. The environmental toxicology group at the Fraunhofer Institut is currently developing a sophisticated software package capable of addressing diverse chemical data bases throughout Europe and the United States. These chemical data are used to construct QSARs for assessing and deriving model parameters.

Separate discussions were held with Dr. Volmer, Dr. Weiss, and Dr. Schumann. Dr. Volmer, a biologist by training, heads up the newly formed group on environmental toxicology and chemistry. He served as Dr. Bartell's primary host for the brief visit. Dr. Weiss demonstrated some computer software used in constructing data bases for interactive use in the development of quantitative structure-activity relationships for a variety of chemical compounds. Dr. Schumann is actively working to identify more-detailed chemical structure and function to include in the structure-activity analyses.

APPENDIX A

PRELIMINARY AGENDA: BIOMOVS MEETING IN BUDAPEST, APRIL 25 TO 30, 1988

Monday

10.00 Opening session

10.30 Project status, by the Secretariat, Status in each scenario, by the Working Group leaders, Status of Technical Reports

12.30 Lunch

13.30 Working Groups:

Scenario A4a: I-131 in milk after the Chernobyl accident
WG-leader: Harry Koehler

Scenario B5: Ageing of a lake
WG-leader: Graham Smith

18.00 Reception

Tuesday

09.00 Plenary
Summary of work by the WG-leaders, discussion

10.30 Working Groups:

Scenario A4b: Cs-137 in milk, beef and barley after the Chernobyl accident
WG-leader: Harry Koehler

Scenario B6: Transport of contaminated groundwater to soil
WG-leader: Celia Jones

12.30 Lunch

13.30 Excursion

Wednesday

09.00 Plenary
Summary of work by the WG-leaders, discussion

10.30 Working Groups:

Scenario A4b: Cs-137 in milk, beef and barley after the Chernobyl accident
WG-leader: Harry Koehler

Scenario B7: Transport of contaminated groundwater to a river
WG-leader: Theo Zeevaert

12.30 Lunch

13.30 Working Groups:

Scenario A1: Release of mercury into a river
WG-leader: Gordon Blaylock

Scenario A4b: A4b: Cs-137 in milk, beef and barley after the Chernobyl accident
WG-leader: Harry Koehler

20.00 Conference dinner

Thursday

09.00 Plenary
Summary of work by the WG-leaders, discussion

10.30 Working Groups:

Scenario A5: Dynamics within a lake system
WG-leader: Bjoern Sundblad

Scenario B8: The importance of different pathways on radiological assessment
WG-leader:

12.30 Lunch

13.30 Plenary:
Summary of work by the WG-leaders, discussion

14.30 Prerequisite of modelling, Mr. Ulf Bäverstam, NIRP
Discussion

Friday

09.00 **Plenary session: Summary and conclusions of further work; Owen Hoffman**
Time schedules
Allocation of work
Continuity
Summary and conclusion of the Workshop
Final Reports

12.30 Closing of the Workshop

14.00 Coordinating Group meeting

APPENDIX B

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