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BOOK REVIEWS

Risk Assessment of Chemicals in the Environment, edited by M.L. RICHARDSON, Royal Society of Chemistry, London 1988, 579 + xx pages, price: £ 59.50, ISBN 0-85186-118-0.

The assessment of risk associated with chemicals which enter any part of the environment is a task which cannot be undertaken without an adequate knowledge of the chemistry of the substances involved. Having this in mind, the Working Part of Chemistry and the Environment of the Federation of the European Chemical Societies undertook in 1983 the task to update the knowledge on hazards of chemicals to the environment, including man.

It took 5 years to prepare an international conference, with carefully planned sessions. The leading scientists over the world were invited to give lectures. The conference organized by the Royal Society of Chemistry on behalf of Working Part of FECS was held on 11–14th July, 1988, at the University of Surrey, Giuldford, UK.

The book is largely based on the papers presented at that conference. The editor invited some contributors to guarantee covering all major problems connected with risk assessment of chemicals in the environment. The papers were divided into four major sections. The 1st section (*Introduction* and *Overview*) has an introductory character. It covers risk assessment and acceptability of control of industrial chemicals, standards of chemical safety and new procedures for the quantitative assessment of structure-activity relationships.

In the 2nd section (*Contributions of Toxicology to Risk Assessment*), the techniques used in risk assessment of carcinogenic compounds are described. Some data on effects of solvent abuse and physiologically-based pharmacokinetic approaches to the problem are given. In other words, in this part there are presented the methods used by toxicologists and the way in which toxicological data may be used for evaluation of hazards in the environment.

The next two sections deal with evaluation of hazards coming from incidental and intentional emissions. Incidental emission of chemicals into air is discussed from the standpoint of decision analysis in control of chemicals posing health risk and as well modelling of the risk of acid rain. In the case of water environment, the pollution of River Danube and its risk assessment, total index environmental quality, structure-activity relationships as applied to fish and other aquatic species, risk assessment of dyestuffs in the environment, together with a novel means of selecting substances requiring priority action are described in detail. In the section focused on intentional emissions, the hazard and risks assessment and acceptability of chemicals in the environment are reviewed. Examples cover pesticides, cytotoxic drugs, the acceptability of chemicals in the environment, including by-products of multi-purpose fine chemicals manufacture, etc. There is also a review of of deterministic and probabilistic trends.

In addition, the book contains a very useful glossary of terms and a list of useful addresses, although almost totally limited to UK institutions. The glossary is particularly important, because without a common definition of terms a meaningful international discussion of this complex subject area is impossible. Thus, the book covers a wide spectrum of problems related to risk assessment of chemicas in the environment.

A few general, warning conclusions may be drawn. In the environment, one is dealing with risks that are generally low and which can only be quantified by some assumed risk-dose relationship at very low doses. Inobservable effect level does not guarantee that there are no effects. It is impossible to provide an unequivocal answer to the question of whether the release of some particular chemicals will not harm the environment. This is particularly true for man when there are considered the extreme variability of response of the human system to any stimulus as well as the possibilities of remote coincidence and synergisms and weaknesses, which may render certain individuals vulnerable.

Proof of the absence of chronic effects, which may take a long time to materialize from sub-acute doses of chemicals known to have some toxic effects on animals when at high concentrations, is a classical problem. Further-

more, lack of evidence is no evidence of real lack. To do nothing is a decision which may have serious consequences, as positive action is necessary. Also, there are difficulties in distinguishing sharply between the effects of one xenobiotic against a general background of even lower concentrations of all xenobiotics and all natural products.

The book seems to be very valuable source of information to all environmentalists.

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Atmospheric Ozone Research and its Policy Implications, Proceedings of the 3rd US–Dutch International Symposium, Nijmegen, The Netherlands, 9–13th May, 1988, edited by T. SCHNEIDER, National Institute of Public Health and Environmental Protection, Bilthoven, The Netherlands, S.D. LEE, Harvard University, Energy and Environmental Policy Center, Cambridge, MA, USA, G.J.R. WOLTERS, Ministry of Housing, Physical Planning and Environment, Leeidschendam, The Netherlands, and L.D. GRANT, US Environmental Protection Agency, Research Triangle Park, NC, USA, Studies in Environmental Science, 35, Elsevier, Amsterdam 1989, xviii + 1048 pages, price: US $ 192.75/Dfl. 395.00. ISBN 0-444-87266-3.

I came across the book *Atmospheric Ozone Research and its Policy Implifications* when I was busy writing a book on environmental chemistry. This obliged me to look through a lot of publications, not always connected with my personal area of research, and to synthetize a great deal of scientific and technical information. That is the reason why I have skimmed through the book, although "ozone problem " is not the subject of my interest. I was surprised to find more than 1000 pages devoted to that rather narrow topic. I was even more surprised when I discovered that "ozone problem" is fundamental and important for environmental chemistry. Two layers of ozone should be distinguished: tropospheric ozone, which is sometimes referred to as ambient, or "bad" ozone, formed near the ground as a result of photochemical reactions of oxygen. It is a major component of urban smog, threatening both human health and environment. A thin layer of stratospheric or "good" ozone within the outer part of the atmosphere benefits human and environment. Many would argue that this thin layer of stratospheric ozone has been essential in the evolution of life on Earth, and that its disruption or depletion may have very serious consequences.

The fact that human health is seriously affected by tropospheric ozone has led the authorities of the United States to set a one-hour standard of 0.12 ppm. That standart was periodically reassessed in the light of the most recent scientific data. New tests on animals show that short- and long-term exposure to high concentrations of ozone can cause permanent structural damage to animal lungs and/or impair lung immune defense systems. Of particular importance are new findings that suggest changes in lung function with prolonged (6–8th) exposures to ozone at concentrations below the current 0.12 ppm one-hour standard.

The other papers are devoted to the effect of ozone on vegetation and ecosystems. High ozone concentrations can affect not only cities, but rural areas as well due to large-scale regional distribution of air masses polluted with photochemical oxidants. Episodic accumulation of such pollutants that are formed over urban centers and then transported to rural areas can reduce crop yields and seriously damage sensitive forest lands, including commercially important plants. Both the forest dieback in the Appalachian Mountains and recent forest damage in Europe represent two examples where ozone is suspected as a major contributor to these phenomena.

International cooperation is clearly needed to study and control such damages caused by ozone. Because polluted air masses do not "respect" international boundaries, they have the potential to cause economic damage in neighbouring countries. In less developed countries, "transboundary" ozone could further exacerbate existing problems of deforestration and inadequate food production.

There are also a few papers on risk assessment. To highlight a tropospheric ozone problem, I would like to quote Vaun A. Newil who said in his keynote address:

"I shall conclude my comments on tropospheric ozone by noting that the severity of the ozone problem in many cities in the United States and elsewhere will likely necessitate the implementation of more stringent air pollution control programs. These new programs are expected to be both costly and controversial. Unlike many other air pollution problems, ozone is not caused by few large and well-defined sources. Small, widely dispersed sources will have to be controlled in order to reduce ozone concentrations in many areas. For example, everyday human activities such as driving automobiles, refueling at gas stations, drycleaning clothes, and using household products such as paints and cleansers all contribute to the formation of ozone. Reducing those kinds of activities, or finding substitutes for those kinds of products, may require substantial changes in lifestyle".

The other, very important problem covered by the proceedings is stratospheric ozone depletion and the interrelated problem of global warming, or the so-called "greenhouse effect". These two problems are clearly international in nature, both in regard to their sources and the scope of their potential impacts on human health and environment. Increased industrial and agricultural activities during the past two centuries have resulted in substantial atmospheric loadings of certain gases, such as carbon monoxide, methane, and chlorofluorocarbons (CFC's). These and many other chemicals are responsible for important changes in the chemical composition of the atmosphere. Of particular concern is the fact that the continued or increased use of CFC's may lead to a substantial net depletion of stratospheric ozone – an environmental degradation that may be more advanced than previously believed.

A significant reduction of ozone content in the upper layers of atmosphere could mean a long-term increase in the frequency of skin cancer and cataracts worldwide. It could also have significant impacts on our terrestrial and aquatic ecosystems. In addition, the gases affecting ozone exhibit greenhouse properties; because they trap solar energy in the atmosphere, they could contribute to future warming of the earth. The diverse effects of global warming over the long-term extend well beyond higher temperatures. The greenhouse effect could also result in substantially altered rainfall patterns, increases in sea level, loss of soil moisture and changes in the movement of storms. These shifts could alter agriculture, forests, wetlands, water resources and coastal cities. Let me allow to quote Vaun A. Newil to highlight this problem:

"As we look for solutions, we must recognize the unusual nature of these new challenges. Both the causes and effects of ozone depletion and global warming are distributed unevenly throughout the world – not just between two countries or within the region. Furthermore, in most cases the adverse environmental impacts in a particular country will not be proportional to its emissions of harmful air pollutants.

Thus, traditional approaches to problem solving – domestic legislation, rulemaking, and enforcement –are inadequate to deal with these new problems. The United States has already taken some important domestic regulatory steps to control CFC's, beginning with a ban on their use in aerosols in 1978. The United States Senate has ratified the Montreal Protocol. Even so, more needs to be done. More research is needed to delineate the full scope of expected impacts due to stratospheric ozone depletion and global warming, along with considerable international cooperation to develop and implement effective control strategies".

According to my knowledge the "ozone problem" is not well recognized in many countries. It seems to be the other "wolf" threatening our environment on the global scale.

Therefore, the proceedings are of great importance for two reasons:

1. They describe the current state-of-the-art of ozone research. As such they are a valuable source of the most recent scientific information for researchers.

2. They warn us of a new threat to environment and provide information for policy makers on necessary action to be taken on national and international levels.

Lucjan Pawłowski

Advances in Environmental Modelling, Proceedings of a symposium, 22–26th June, 1987, Venice, Italy, sponsored by the International Society for Ecological Modelling (ISEM), edited by A. MARANI, Dipartimento di Scienze Ambientali, Universita di Venezia, Venice, Italy, Development in Environmental Modelling, 13, Elsevier – Amsterdam 1988, xviii + 692 pp., US $ 144.75/Dfl. 275.00, ISBN 0-444-98894-7.

Environment is a very complicated system. Thousands of scientists collect the data, which often do not clearly depict changes occurring in the environment, since there is no clear matrix of interactions. Environmental modelling may help to decide in what order the data collected will be arranged. It is extremely difficult to build up a model, based on real physical, chemical and biological processes occurring in the environment, since the pathways of lots of processes are still unknown. Therefore, most models basing on very simplified and artificial assumptions do not depict any real processes. A real value of environmental modelling is to put in order the complicated environmental system.

The book has been divided into seven parts: I. *Introduction*, II. *Ecology and Hydrology*, III. *Systems Theory and Modelling Techniques*, IV. *Terrestrial Ecosystems*, V. *Marine and Coastal Ecosystems*, VI. *Lakes, Lagoons and Wetlands*, VII. *Decision-Making Process*.

There are two main means of transportation of pollutants in the environment, i.e., with mass of water and with mass of air. Both water and air carry pollutants. A lot of attention was given to hydrological modelling. It is a very valuable part of the book. Unfortunately, much less attention was given to modelling of air movement, and only a little to transformation of chemicals during transportation.

I think that the environment should be preserved not just for itself, but, first of all, for rational human being. Since it is impossible to assure all man's expectations, there is a need to establish some priorities. This strictly relates to decision-making processes. Nowadays, enormous amounts of data should be taken into account in such a process. Therefore, J.B. Wood and G. Chesters write:

"The management of massive amounts of data became child's play with their computers, and they provided us with the most advanced communications system ever known.

But, like the concealed warriors of ancient Homer's Iliad, they also brought death and destruction. The chemicals that grew the crops also polluted our ground water. The science that provided the surgeon with a scalpel of light put the laser cannon in our arsenal. The medical advances that saved and prolonged lives did not come fully assembled with the wisdom that would enable us to feed, house, clothe and educate, or deal with byproducts of a larger population. The technology that put mass production, new products and jobs in our hands, also put toxics in our air. We learned to process information with amazing precision, but we still communicate haltingly and imperfectly. They taught us how to talk to a hundred million people at the same time, only for us to discover that the person who can talk to a hundred million people feels little need to listen to anyone".

"The answer to that political malaise is that we all live in a world beset by a complex and interdependent malfunctioning of science, technology and attitude".

From this perspective, the last part of the book, *Decision-Making Process*, is very valuable. Due to information, especially that in the paper written by J.B. Wood and G. Chesters, we can try to answer, how, for what reason and in behalf of whom the environmental knowledge of basic environmental models can help to plan scientific research and collect properly data on state of the environment. Therefore a propagation of modelling is worthwile from the standpoint of the efficiency of the environmental studies.

The book *Advances in Environmental Modelling* is a collection of papers presented at ISEM's 6th International Conference, showing the most recent findings in modelling. It is, first of all, intended for those, who deal with environment from the more holistic standpoint. They will find some advices how to simplify and integrate the problem of the environment.

Lucjan Pawłowski

Geochemistry of Sulfur in Fossil Fuels, edited by WILLSON L. ORR and CURT M. WHITE, American Chemical Society, Washington, DC 1990, hardcover, 708 p., price US $ 109, ISNB 0-8412-1804-8.

Most people, if asked about sulfur in the environment, would indicate its contribution to acid rain, one of the most known threats to the environment on a vast scale. However, it is only a part of the truth, because sulfur is also a necessary nutrient for biota.

The crucial problem is how to maintain its concentration and forms at an optimum biological level in the environment.

The book is devoted to sulfur in fossil fuels. It attempts to explain its presence there and to show what its chemical form is.

All fossil fuels contain sulfur, but the sulfur content varies from traces concentration to more than 10%, and the chemical forms themselves are diverse. The presence of sulfur exacts economic penalties at all intermediate stages of exploitation, from recovery (oil and gas production, mining, storage, transportation) to processing (refining, cleaning, upgrading), the extent depending on the amount and chemical form of sulfur. In short, removing sulfur from fuels means greater costs to industry, consumers, and goverment. These costs can be minimized by increasing our basic understanding of the sulfur system in fossil fuels.

Major advances have been made in the past decade, largely because of improved analytical techniques that have made easier the identification of organic sulfur compounds at the detailed molecular structure level. Due to these advances the sulfur-compound biomarkers have been established, which has to a great extent clarified our understanding of how and when most of the sulfur is introduced into the surviving biogenic materials that eventually become fossil fuels. The latest advances included in this volume have many implications for practical utility. Quantitative evaluations of compound abundances and distributions in specific fossil fuels (in relation to their geologic history and geologic settings) and case studies of sedimentary depositional environments will help to integrate and consolidate our understanding of the geochemistry of sulfur in fossil fuels.

Geochemistry of Sulfur in Fossil Fuels fills a significant gap in the technical literature. The geochemical focus updates our understanding of the chemical processes in geologic environments giving rise to sulfur in fossil fuels. It will be a valuable reference to a diverse audience: marine, fuel, and environmental scientists; analytical and organic chemists; and government administrators and technical staff for energy and environmental programs.

Lucjan Pawłowski

Chemical Modeling of Aqueous Systems. II, D.C. MELCHIOR, Ebasco Services, R.L. BASSET, University of Arizona, ACS Symposium Series No. 416 – developed from a symposium sponsored by the Division of Geochemistry at the 196th National Meeting of the American Chemical Society, Los Angeles, California, September 25–30, 1988, price: US & Canada $ 89.95, Export price $ 107.95, ISBN 0-8412-1729-7, clothbound 538 p., illustrated, indexed, LC 89-28446.

Modeling of environmental systems becomes very popular. Although there is no model which would exactly depict any part of the environment, modeling is an extremely useful tool in environmental research, since it establishes order in gathering data, and helps us understand the whole system.

Chemical Modeling of Aqueous Systems is an area of intensive research into environmental problems, evaluation of sedimentary diagenesis, mineral deposition and mineral recovery, geothermal energy, and radioactive waste processes, to name but a few. The science behind chemical modeling and the numerous applications of chemical modeling have evolved over the past 20 years, since Werner Stumm organized a symposium on equilibrium concepts in natural water systems in 1967. The symposium resulted in the publication of *Equilibrium Concepts in Natural Water Systems, Advances in Chemistry '67.* Many of the issues addressed during that symposium still confront modeling practitioners today.

This volume that has resulted from a symposium covers the current status of models and the area in which significant progress has been made over the past 20 years, as well as new concepts and approaches to address future modeling issues.

In addition, several chapters present theoretical approaches to evaluation of the behaviour of dissolved species in aqueous systems.

Generally, the book deals with a very specialized aspect of aqueous systems, and for this reason it is rather recommended for those involved in theoretical research.

Lucjan Pawłowski

Metal Complexes in Fossil Fuels Geochemistry, Characterization, and Processing, ROYSTON H. FILBY and JAN F. BRANTHAVER, ASC Symposium Series, 344, American Chemical Society, Washington, DC 1987, OSBN 0-8412-1404-2, price: US $ 96.85, hardcover, 436 + xx p.

Knowledge of the content of heavy metals and their forms in fossil fuels is of great importance for pollution control. The existence of porphyrins was disovered by Alfred Treibs in the 1930s.

Since that time, many works have been published on the geochemistry of porphyrins and other metal complexes in geological materials. In most of these works the emphasis was put on metalloporphyrins and chlorins because these compounds possess spectral characteristics that permit their detection in small concentrations, and chemical properties that sometimes allow substantial purification from background materials. Investigations of geoporphyrins have featured structure determinations, the results of which have shown that a great variety and number of compounds are derived apparently from a few biological precursors as a consequence of geochemical processes. The nature of these geochemical processes has been inferred from the transformations observed. These processes are of particular interest to those who search for fossil fuels, particularly petroleum.

While the geochemistry of metal complexes was being studied, it was found that metal complexes in fossil fuels cause serious problems in processing. Thus, while geochemists attempted to discover how metal complexes occur in fossil fuels, chemical engineers were trying to find ways to get them out or otherwise deal with their deleterious effects. Interaction between the two groups of researchers has been somewhat limited.

This book presents in 26 chapters recent findings on the geochemistry, characterization, and processing of metal complexes, including metalloporphyrins, in fossil fuels. Geochemical studies include origins of sedimentary porphyrins, application of metal complexes in petroleum to exploration, and distribution of transition metals in North Alaskan oils. Characterization studies include techniques for isolation and characterization of chlorins and geoporphyrins, axial coordination in nickel and vanadium porphyrins, and interaction of Ni(II) complexes with asphaltenes. Processing studies include the reaction sequence of metalloporphyrins during heavy residuum upgarding, and modes of operation in hydrodemetallization.

The book seems to be of interest for geochemists and environmental chemists.

Lucjan Pawłowski

Modelling in Ecotoxicology, edited by S.E. JORGENSEN, Langkaer Vaenge 9, 3500 Vaerlose, Copenhagen, Denmark, (Developments in Environmental Modelling, 16), 1990, 360 p., price: US $ 100.00/Dfl. 195.00, ISBN 0-444-88699-0.

Ecotoxicology is a new discipline that emerged from toxicology and ecology. It attempts to describe an impact of chemical substances on the living organisms. Due to the enormous number of chemicals and a great variety of natural biochemical processes which are very complicated and not fully understood, it is impossible to exactly predict the effect a chemical may exert on living organism.

Consequently, the problems dealt with in the chemistry and biology of toxic substances occurring in the environment are extremely complex and a lot of data are needed to cope with them. The data provided during the last ten, fifteen years of intensive research, although great in amount, is stil insufficient. Furthermore, since many components and their interactions cannot be examined by simple methods, it is necessary to develop models able to synthesize our knowledge and provide an overview of the problems.

The application of such models has therefore been necessitated by a natural development in ecotoxicology and this book outlines the state-of-the-art of modelling the fate and effects of toxic substances in the environment. Modelling in ecotoxicology differs from modelling in other fields as it still lacks a considerable amount of data. The quality of the models is to a large extent dependent on the parameters established, and since our knowledge of the parameters in ecotoxicological processes is inadequate, it is essential to develop reliable methods for their estimation.

The models used may be either physical or mathematical. Physical models contain the main components of the real system. For instance, if we want to study the interactions between a toxic substance and a system of plants, insects and soil in nature, we may construct a simplified system which contains only these components. Physical models are often named microcosmos, as they contain all major components of a larger system, but on a smaller scale, However, this book focuses almost entirely on mathematical models, which are based on a mathematical formulation of the processes that are most important for the problem being considered.

The field of environmental modelling has developed very rapidly during the last decade due essentially to two factors:

1. The development of computer technology, which has enabled us to handle very complex mathematical systems.

2. A general understanding of pollution problems, including the problems related to the application of toxic substances.

In the simplest approach toxic substances are released from man-made or man-controlled systems to the environment (ecosystems), where they are harmful to living organisms and may change the reactions, the function or even the structure of the entire system. Complete elimination of all emissions is impossible with a global human population of 5 billions to feed. But if we can relate an emission with its ecological implifications for the environment, we shall be able to provide recommendations on which emissions we have to eliminate or reduce, and how much they have to be reduced to guarantee no, or almost no, adverse effect. The idea behind the use of model is to come up with the best possible estimation for the relation between emission and ecological consequences, by synthesizing all the knowledge – or the most important parts of this knowledge – to be able to make an overview of the problem in focus.

The resulting recommendations may be either in the form of emission limitations, or in the form of a ban on the use of the toxic substance in question. This is a political decision. Although the model may give a rather clear answer, there is always an economic cost involved in such decisions. It is possible in some instances to construct ecological-economic models which consider also the economy of the problem, but those models are not yet sufficiently developed to give reliable guidelines in more than a few cases. But ecological-economic models will most probably be further developed in the near future, and during the next decade they will be used most widely in environmental management.

The difficult part of modelling is not the mathematical formulation or the translation of the mathematics into a computer language. The introduction of personal computers and easily applicable software has made it much easier to handle these steps of modelling. The more difficult part is to provide the necessary knowledge in order to be able to estimate which components and processes should be included in the model. An ecologist or ecotoxicologist with some knowledge of mathematics and computer science is better fitted to construct ecotoxicological models than a mathematician with some knowledge of ecotoxicology and ecology.

While the first part of the book reviews the methodology of modelling, the second concentrates on case studies. The case studies have been selected to illustrate the spectrum of applicable models in various directions.

It illustrates very clearly that it is possible to develop simple models useful in environmental management. One of the models relates chromium concentration in discharged waste water with chromium concentration in the sediment as a function of the distance from the discharge point, and with the chromium concentrations in mussels. It is based on two equations only: a hydrodynamic equation and one describing the bioaccumulation from sediment to mussels. The model prognosis has been validated with surprisingly good results in spite of its simplicity.

A mercury model is based on a problem similar to the chromium model. Mercury is able to react with the organic matter in the sediment and bioaccumulates in pelagic and benthic food chains as well. This implies that a more complex model must be used to solve this problem. The model must account for the release of methyl- and dimethyl-mercury from the sediment and must furthermore consider the relationship between the weights of fish species and the mercury concentration.

A comparison between the chromium and the mercury model illustrates very clearly that a profound knowledge of the geobiochemistry of the heavy metal considered is needed to be able to select the right approximations. Mercury has a more complex geobiochemistry than chromium and it requires a more complex model than chromium under the same environmental conditions.

A copper model differs from the chromium and mercury model by its more simple hydrodynamics. A more comprehensive description of the geochemistry of the copper species is however needed and the model is an illustrative example of a geochemical model. It is more complex than the chromium model in the description of

the exchange processes of copper between sediment and water, but does not contain a hydrodynamic component as the chromium model does.

Another model describes the flow of cadmium and lead from soil of known composition and pH to cultivated plants. It illustrates the difference between modelling an aquatic and a terrestrial ecosystem. The flow processes in soil are very complex and a detailed description of these processes would require a very detailed knowledge of the permeability of soil at different sites and depths. Consequently these flow processes have been described very simply and the emphasis has been put on the factors that are regulating the uptake of heavy metals, including the solubility of the heavy metal ions.

The case study illustrates how complex the effects on the plants are and how much more knowledge we need before we can model the effects of air pollutants properly. The scope of most ecotoxicological models is not to go into such details and the detailed description of this model is therefore not needed in most ecotoxicological models; however, if the aim of the model is to describe the ecotoxicological processes in plants, it can be done as this case study shows. One case study differs as seen from the other by the size of the system and the details included. Each level in the environmental hierarchy requires its own model, but it may cause difficulties to couple such models to one comprehensive model, as this will involve the use of too complex a model.

The cause studies illustrate ecotoxicological problems related to heavy metals, gases and organic pollutants. They also show that a profound knowledge of the physical, chemical and biological processes is needed to make the right simplifications. They demonstrate the different significances of the flow processes in the three spheres, and the difference between a distribution and an effect model, and between models of different scales. The selected case studies should give the reader a good knowledge of the spectrum of models available today in ecotoxicology.

Additionally, the reader can find in the book tables listing physical-chemical parameters and toxicity data which are needed for modelling.

Lucjan Pawłowski