



Book review

**PERSISTENCE AND SPATIAL RANGE OF
ENVIRONMENTAL CHEMICALS.**

New Ethical and Scientific Concepts for Risk Assessment

Martin Scheringer

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The book of Martin Scheringer *Persistence and Spatial Range of Environmental Chemicals. New Ethical and Scientific Concepts for Risk Assessment* has as starting point the fact that in the last years the current methods for assessing the environmental behavior of anthropogenic chemicals meet considerable difficulties. They need much time and resources that they cannot be applied to the huge amount of chemicals requiring evaluation; they only cover a certain set of known effects and need to be expanded if new phenomena such as the endocrine activity of various chemicals are discovered; due to the complexity of environmental systems, they often lead to inconclusive results leaving space for controversial interpretations.

To some extent, these difficulties are caused by the very nature of the assessment problem, *i. e.* the tremendous complexity of environmental systems and the huge number of chemicals. However, there is also a methodological problem that is inherent to the current scientific approach. This problem also contributes to the difficulties and, therefore, needs increased attention. It is rooted in the unclear relationship between "objective" scientific facts, on the one hand, and ethical, legal, and economic evaluations, on the other hand.

One important cause of this methodological problem is the principle of "non-normativeness" of scientific results, which even today, after several decades of environmental research, impedes a comprehensive scientific treatment of environmental problems. The question of to what extent and in what way the principles of "non-normativeness" need to be revised in today's environmental research is the main subject of this book.

The book covers two aspects, scientific analysis and ethical evaluation, which are normally discussed separately. Besides specific questions from both fields, the main subject of investigation is the question of how these two aspects, description and evaluation, can be combined in a conclusive manner.

Chapter 1 focuses on the environmental problems caused by the chemical industry. The chemical contaminants with environmental impact are considered, mainly nonpolar organic compounds such as solvents and semivolatile chemicals such as polychlorinated biphenyls (PCBs).

The methods of chemical assessment referred to are mainly the risk assessment of existing and new chemicals currently used in the EU and, a more comprehensive approach, the life-cycle assessment (LCA). Finally, the concept of *Green Chemistry* or *Sustainable Chemistry* is a broad-based approach to designing a more environmentally benign chemistry. Green Chemistry requires criteria for the assessment of toxicity and degradability of chemical products to be available. The range-based assessment is meant as one contribution to answering this need.

Because the environmental changes caused by the release of anthropogenic chemicals are not purely natural phenomena, there are several steps in the process of risk assessment which do require value judgments: the selection of relevant phenomena to be included into the assessment and the evaluation of findings obtained by the assessment.

The range-based assessment of chemicals also is discussed. Two indicators, namely *persistence* (or *temporal range*) and *spatial range* of chemicals, are defined and the investigation of their normative background is presented. The two indicators: persistence and spatial range are related to principles of justice and also to the Precautionary Principle.

In Chapter 2 is described how the problem of environmental pollution through chemical products has become more and more serious since 1940s. This development is illustrated with the example of halogenated hydrocarbons. The current scientific approach to the assessment of chemicals is briefly described and some key problems encountered by this approach are pointed out.

In Chapter 3, the evaluation of anthropogenic changes is discussed in more detail. In a first step, the function of established *categories of damage* in evaluating environmental changes is investigated. Next, fundamental limitations to the analysis and evaluation of environmental changes are derived from results of ecological research. The terms of *over complexity* and *normative indeterminacy* of environmental systems are introduced.

Chapter 4 underlines the fact that the relevance of scientific findings to the assessment of anthropogenic environmental changes is greater the more the scientific investigation of environmental changes corresponds to normative principles defining the aims of the assessment and the corresponding data needs. This means that the acquisition of data with scientific methods and evaluation of these data should not be performed as two subsequent steps largely independent of each other. On the contrary, already prior to ascertaining scientific findings, normative principles relevant to the environmental problem being investigated should be considered. In combination with the properties of the environmental system, these normative principles influence the selection and/or the new definition indicators and thereby determine the relevance and meaning of the scientific findings.

Principles of justice such as the Golden Rule and the Polluter-Pays Principle are used as normative points of reference for the indicators persistence and spatial range.

Persistence and spatial range describe the spatial and temporal extent of environmental contaminations and aim to help identify parties who are affected by displaced exposure to chemicals.

Chapter 5 leads into the field of environmental chemistry. With the example of CFCs, which are highly persistent and spread globally, it is illustrated how persistence and spatial range are determined and what their features are. Besides the described normative connection, the distinction of *influences* and *consequences* is crucial in the assessment approach using persistence and spatial range. Influences are caused by anthropogenic agents such as noise, heat, pressure, and chemicals that are released to the environment and act on organism and ecosystems. Consequences (or effects) are the reactions of organism and ecosystems to anthropogenic influences. Consequences that are evaluated negatively are *damages* while influences are the preconditions of damages, which mean, on the normative side, that they represent *threats*. Because persistence and spatial range are chemical-specific quantities derived from the environmental distribution dynamics of chemicals, they describe chemical influences and can be interpreted as measures of environmental threat. The advantages and limitations of assessing chemicals in terms of persistence and spatial range are discussed.

In Chapter 6, methods for calculating persistence and spatial range from temporal and spatial concentration distributions are presented.

In Chapter 7, different models that can be used to calculate the environmental distribution behavior of chemicals are described and compared. The model used in study is multi-compartment or multi-media box models belonging to the group of *unit-world* models. Several multi-media box models facilitating the calculation of persistence and spatial range on regional and global scales are presented with the focus on the simple global model *ChemRange*.

In Chapter 8, the relationship between persistence and spatial range is investigated with model results. These results demonstrate that this relationship is not a simple function but exhibits some scatter. This is due to the fact that many chemicals are distributed among different media (soil, water, air) and that these media have different mobility and capacities to degrade a chemical. Next, the *ChemRange* model is applied to a variety of organic compounds, which are then ranked according to their persistence and spatial range. Finally, some of uncertainties associated with the model and the model results are specified.

Chapter 9 deals with the group of *Persistent Organic Pollutants* (POPs). These chemicals have a tendency to adsorb onto particles in water and air, which significantly influences their environmental fate. The effect of interaction with particles on the persistence and spatial range of POPs is investigated in detail.

In Chapter 10, the range-based assessment of chemicals and the existing assessment framework focusing on toxic effects are compared. The differences between a more risk-oriented and a more precaution-oriented approach are pointed out and suggestions are made as to how these approaches can be combined systematically in the assessment of chemicals.

Also, an outlook is given at future challenges and needs for improvement of assessment methods and the vision of a "chemistry of short ranges" are proposed as a guideline for the development of chemical products.

The book is addressed to scientist working in the field of chemical assessment or involved with the assessment of anthropogenic environmental changes. It contains concrete suggestions for new approaches to the assessment of chemicals and also aims to foster the discussion about value judgments in environmental research. The book is also addressed to researchers from the social sciences and humanities who are interested in the implementation of normative criteria in environmental research. In this sense, the book is also meant as a contribution to a more intensive connection of natural sciences, on the one hand, and social sciences and humanities, on the other hand, in environmental research.

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