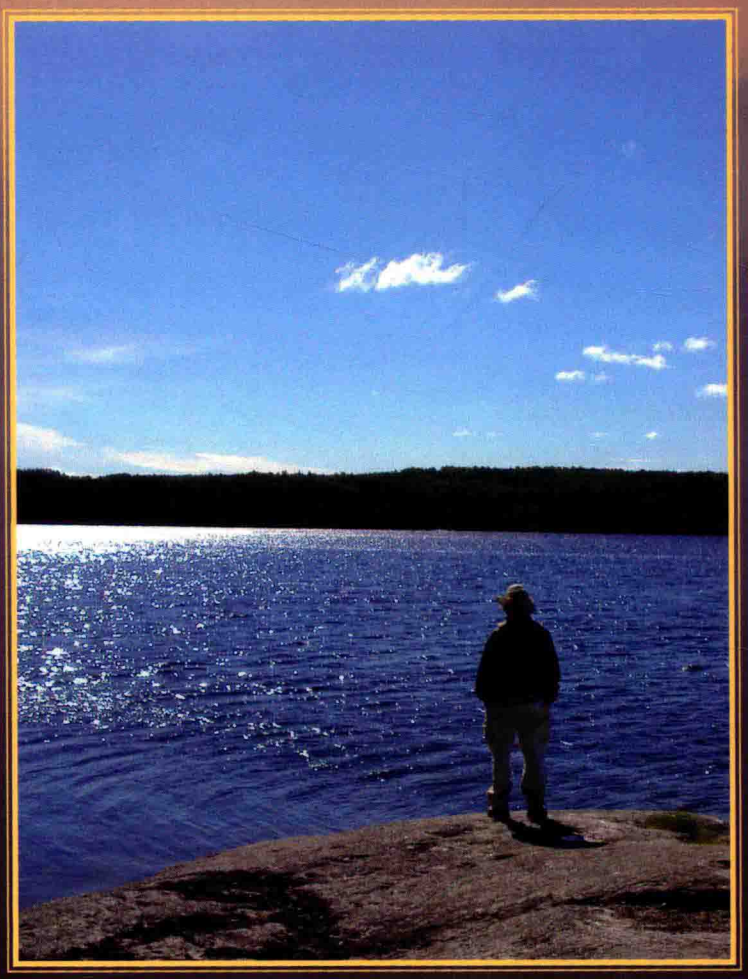
Handbook of
THE PHILOSOPHY OF SCIENCE

General Editors: DOV M. GABBAY, PAUL THAGARD, AND JOHN WOODS

PHILOSOPHY *of* ECOLOGY



Edited by Kevin deLaplante
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Handbook of the Philosophy of Science

Volume 11

Philosophy of Ecology

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GENERAL PREFACE

Dov Gabbay, Paul Thagard, and John Woods

Whenever science operates at the cutting edge of what is known, it invariably runs into philosophical issues about the nature of knowledge and reality. Scientific controversies raise such questions as the relation of theory and experiment, the nature of explanation, and the extent to which science can approximate to the truth. Within particular sciences, special concerns arise about what exists and how it can be known, for example in physics about the nature of space and time, and in psychology about the nature of consciousness. Hence the philosophy of science is an essential part of the scientific investigation of the world.

In recent decades, philosophy of science has become an increasingly central part of philosophy in general. Although there are still philosophers who think that theories of knowledge and reality can be developed by pure reflection, much current philosophical work finds it necessary and valuable to take into account relevant scientific findings. For example, the philosophy of mind is now closely tied to empirical psychology, and political theory often intersects with economics. Thus philosophy of science provides a valuable bridge between philosophical and scientific inquiry.

More and more, the philosophy of science concerns itself not just with general issues about the nature and validity of science, but especially with particular issues that arise in specific sciences. Accordingly, we have organized this Handbook into many volumes reflecting the full range of current research in the philosophy of science. We invited volume editors who are fully involved in the specific sciences, and are delighted that they have solicited contributions by scientifically-informed philosophers and (in a few cases) philosophically-informed scientists. The result is the most comprehensive review ever provided of the philosophy of science.

Here are the volumes in the Handbook:

Philosophy of Science: Focal Issues, edited by Theo Kuipers.

Philosophy of Physics, edited by Jeremy Butterfield and John Earman.

Philosophy of Biology, edited by Mohan Matthen and Christopher Stephens.

Philosophy of Mathematics, edited by Andrew Irvine.

Philosophy of Logic, edited by Dale Jacquette.

Philosophy of Chemistry and Pharmacology, edited by Andrea Woodsy, Robin Hendry and Paul Needham.

Philosophy of Statistics, edited by Prasanta S. Bandyopadhyay and Malcolm Forster.

Philosophy of Information, edited by Pieter Adriaans and Johan van Benthem.

Philosophy of Technology and Engineering Sciences, edited by Anthonie Meijers.

Philosophy of Complex Systems, edited by Cliff Hooker.

Philosophy of Ecology, edited by Bryson Brown, Kent A. Peacock and Kevin deLaplante.

Philosophy of Psychology and Cognitive Science, edited by Paul Thagard.

Philosophy of Economics, edited by Uskali Mäki.

Philosophy of Linguistics, edited by Ruth Kempson, Tim Fernando and Nicholas Asher.

Philosophy of Anthropology and Sociology, edited by Stephen Turner and Mark Risjord.

Philosophy of Medicine, edited by Fred Gifford.

Details about the contents and publishing schedule of the volumes can be found at http://www.elsevier.com/wps/find/bookdescription.cws_home/BS_HPHS/description#description

As general editors, we are extremely grateful to the volume editors for arranging such a distinguished array of contributors and for managing their contributions. Production of these volumes has been a huge enterprise, and our warmest thanks go to Jane Spurr and Carol Woods for putting them together. Thanks also to Lauren Schultz and Gavin Becker at Elsevier for their support and direction.

PREFACE

The most pressing problems facing humanity today—over-population, energy shortages, climate change, soil erosion, species extinctions, the risk of epidemic disease, the threat of warfare that could destroy all the hard-won gains of civilization, and even the recent fibrillations of the stock market—are all ecological or have a large ecological component, and it is fitting that philosophers turn their attention to understanding the science of ecology and its huge implications for the human project. Numerous excellent collections on the philosophies of biology, physics, and mathematics have appeared in the past twenty years, but there have been relatively few books actually to have the phrase "philosophy of ecology" in their titles. A notable exception is the fine anthology edited by Keller and Golley [2000], which appeared almost ten years ago. That seems like a long time passing; since then we have had "wars and rumours of wars," the report of the IPCC in 2007, SARS and H1N1, devastating earthquakes and tsunamis, summers when the forests of Europe burned, melting icesheets and a dramatically warming Arctic, and an increase in the human population of nearly another billion hungry mouths. While not all papers in the present volume are directly concerned with the enormous and urgent challenge of environmental remediation, all seek philosophical perspectives on the scientific study of "organisms at home (*oikos*)" in the biophysical world they have built.

The science of ecology directly confronts the huge intellectual challenge posed by our efforts to understand biophysical systems that are immensely rich and complex, and subject to outside influences that can shift and disrupt the patterns of interaction that unify them. Attempts to model complex, open systems cannot be expected to lead to reliable predictions of specific outcomes (regardless of the pressures that practical policy concerns may place on scientists to produce such predictions). However, they can help us identify trends and possible responses (sometimes obvious, sometimes not) to such trends. We can identify important ecological processes and gain more than a glimmering of the various risks posed by changes in ecological systems and their surroundings. The science of ecology is of special philosophical interest because of the synergies between the purely theoretical and the grassroots-practical levels of understanding that it demands. We can't get the application of ecology to policy or other practical concerns right unless we have a clear and disinterested philosophical understanding of ecology

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which can help identify the practical lessons that science can teach us. Conversely, the urgent practical demands humanity faces today cannot help but direct scientific and philosophical investigation toward the basis of those ecological challenges that threaten human survival. To adapt a phrase from Dr. Johnson, the prospect of ecological catastrophe focusses the mind wonderfully. We hope that this book will help to fuel the timely renaissance of interest in philosophy of ecology that is now occurring in the philosophical profession.

This volume owes the possibility of its existence to the imagination and initiative of the series editors, John Woods, Dov Gabbay, and Paul Thagard, who conceived of an ambitious, multi-volume set that could present the latest thinking in the philosophies of all the key sciences. Everyone involved in the *Handbook* series is deeply indebted to Elsevier Publishers for making this adventure possible. The editors of this volume enjoyed the almost unprecedented luxury of being able to tell its authors that they had no specific length limits and that this was their chance to write that opinionated review of their field they had always wanted to write. The result is a richly diverse collection of papers. While some have an encyclopedic character, all attempt to synthesize in novel ways, to break ground, and to challenge. This volume is not merely a Handbook (if one conceives of that sort of book as merely a work of reference) but a call to intellectual arms for many of the key issues that will define philosophical thought about ecology in the next decades.

Thanks and acknowledgements are due to many people and organizations. All three editors are very grateful to Jane Spurr and John Woods for their help, good advice, and patience during the long gestation period of this project. K. P. and B. B. thank the Social Sciences and Research Council of Canada for financial support of their research, and the University of Lethbridge for sustenance, financial and otherwise. K. P. is grateful to Richard Delisle, Cody Perrin, and Sharon Simmers for assistance and advice. B. B. thanks Ron Yoshida, for his support and encouragement as co-developer and teacher of our earth and life sciences course, and especially Linde Bruce-Brown for her support and patience with the long process of working on this volume. K. D. offers thanks and gratitude to Iowa State University for support and assistance; to Arnold van der Valk for his partnership as co-instructor of our history and philosophy of ecology course; to Kent Peacock for introducing K. D. to the environmental philosophy literature as a young graduate student; and to Brenda Theoret for her love and endless patience.

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Introduction

PHILOSOPHY OF ECOLOGY TODAY

Bryson Brown, Kevin deLaplante and Kent A. Peacock

INTRODUCTION

Ecology is a young science, having emerged as a discipline during the latter half of the nineteenth century. It is also contested ground, both because of the richness and complexity of its subject matter, and because of its close ties to important political and economic issues. This volume gathers reflections on the science, its history and its applications to policy-making and ethical choices. We have divided the papers into two groups, the first group focusing on philosophical questions about ecology and its history as a science while the second focuses on applications of ecology to environmental issues.

One theme that makes an appearance in many of the essays, and lies close below the surface for many others, is a sense of deep worry about the state of our world. Aside from the familiar and already troubling damage that we humans continue to wreak on our environment, from deforestation, soil-depletion, desertification to the rapid decline of fisheries due to devastating over-exploitation, it has become increasingly clear over the last decade that we are now conducting one of the most dangerous uncontrolled experiments in history: the increasingly rapid increase of atmospheric levels of greenhouse gases. The implications of this experiment for climate, ocean levels and ocean pH are truly frightening; still more frightening is the possibility that positive feedbacks may become too strong for us to stop these changes from reaching catastrophic levels. Nearly every ecological system in the world (and just about every system that affects our own well-being) is threatened by this possibility. We hope that this experiment can be shut down before disaster ensues, and that the deep interest in scientific, ethical and public policy issues in ecology expressed by all our contributors may inspire in some of our readers the political will to change course.

PART 1: PHILOSOPHICAL ISSUES IN THE HISTORY AND SCIENCE OF ECOLOGY

The first paper here is "Origins and Development of Ecology" by **Arnold van der Valk**. In it, van der Valk explores the origins of ecology and asks, following C. S. Peirce, what new abductions (hypotheses) were at the root of ecology's emergence as a science, and to what extent ecologists have managed to converge on some central hypotheses.

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When new abductions that take us outside of the range of hypotheses considered in established sciences arise, scientists can ignore them, expand existing science(s) to include them or begin a new branch of science based on them. In order for the last of these possibilities to occur, both novelty and success or productivity are required. For example, in ecology, we need the new abductions to be useful in a wide range of geographical situations or species. Van der Valk aims to identify the novel abductions, their sources, their influence on ecology's development, and how much convergence on a "consistent and widely accepted" set of hypotheses has occurred subsequently.

Van der Valk describes the origins of ecology as polyphyletic. In its early stages, the field was dominated by scientists trained as botanists and zoologists. Some of these figures focused on terrestrial systems (many among this group were located in the U.S. midwest) while others concentrated on the oceans (many of these were, naturally enough, located in coastal regions). Very different field techniques were involved, and the work of both groups proceeded quite independently. Drawing on early texts, van der Valk identifies the interests and insights of these 'pioneer ecologists'. Among the early ecological topics van der Valk identifies the following: factors limiting growth, the distribution of organisms, communities of organisms, their organization, food chains, and succession.

Van der Valk's investigation reveals three important "initial defining hypotheses" that were seminal for the development of ecology: (i) that adaptations to varying environmental conditions are responsible for the distribution of organisms; (ii) that ecological communities tend toward equilibrium; and (iii) that communities are a type of organism that develop along predictable lines (as in Clementsian succession). All three defining hypotheses resulted in the development of major ecological research agendas in the late 19th and early 20th centuries. Van der Valk notes with some irony that these three hypotheses may in fact be inconsistent, as the first provides the foundation for the reductionistic, evolutionary, population-oriented approaches to ecology that developed later, while the second and third were the foundation for the more holistic approaches in community and ecosystem ecology that emphasize the analogy between community and ecosystem development and the ontogeny of individual organisms.

The essay closes with some worries about convergence. Van der Valk is concerned that the diversity of ecologists has allowed dubious or even refuted ideas to continue in use, thus blocking the development of "a unified ecology with consistent hypotheses". Here van der Valk is less generous than Christopher Eliot in his contribution regarding the possibility of reconciliation between mechanistic, individualistic views and holistic views of ecological phenomena. For van der Valk, the popular analogy between ontogeny of organisms and succession is simply false. More generously, we would recognize that while the analogy can be, and often has been, taken too far (especially in its rhetorical employment) it has also been a useful guide to inference, and served to inspire much further inquiry. It was not a fruitless notion, despite the obvious fact—acknowledged by Clements, as Eliot notes—that organisms have far more systematic and tightly unified responses to