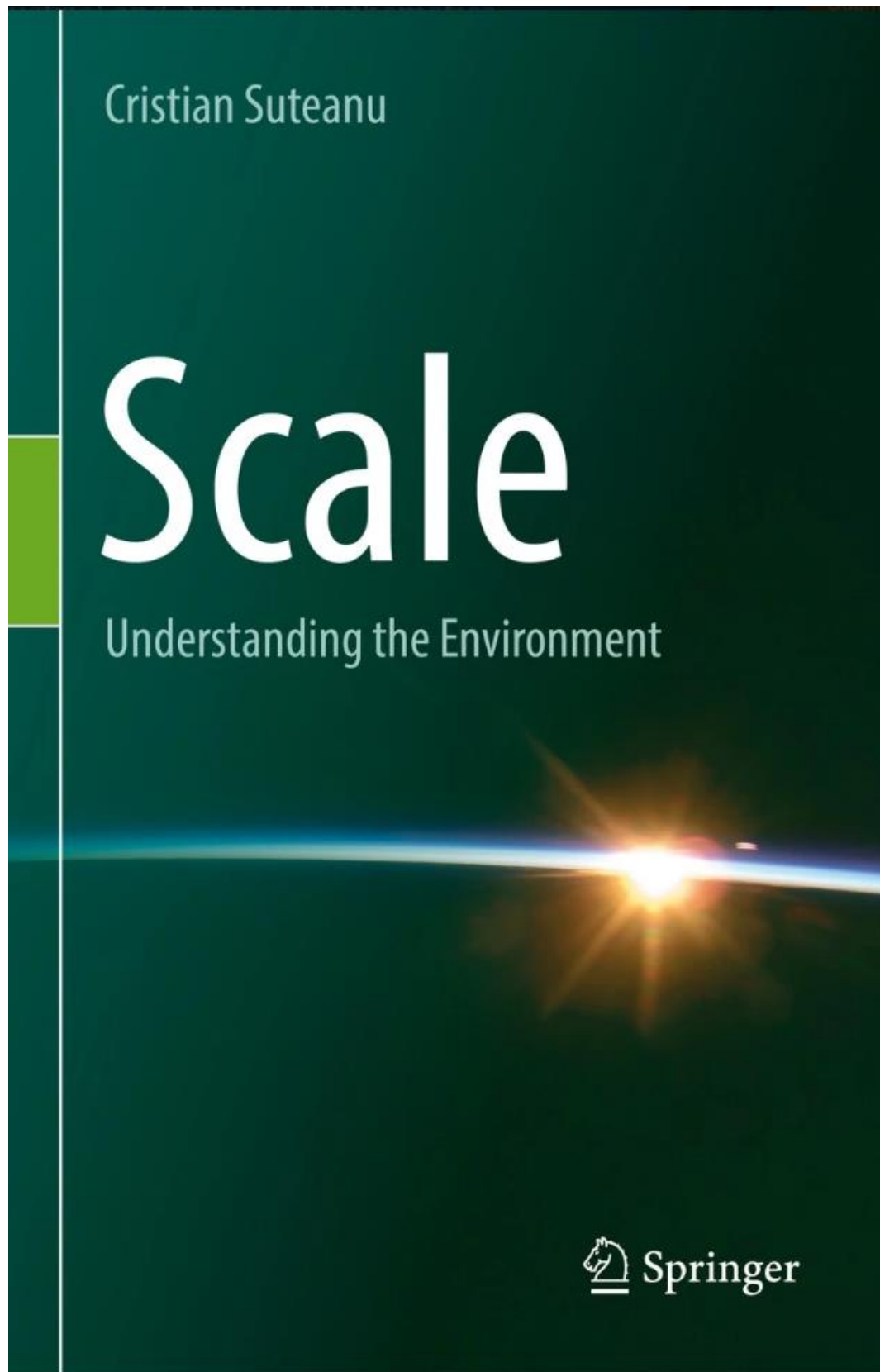


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Find the book here: <https://link.springer.com/book/10.1007/978-3-031-15733-2>

Scale

Cristian Suteanu

Scale

Understanding the Environment

 Springer

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ISBN 978-3-031-15732-5 ISBN 978-3-031-15733-2 (eBook)
<https://doi.org/10.1007/978-3-031-15733-2>

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To my wife, Mirela

Preface

Scale can be likened to a beehive. On the outside, it is a wooden box standing in a meadow. Inside, however, it is bursting with life of complexity that is difficult to grasp – even if you remove its roof and look inside at its inner workings. More importantly, scale is unfailingly present when we relate to our environment, no matter how broadly we may define the concept of environment.

These two key aspects of scale represent the main threads that run through the book. It was from their perspective that the selection of the topics was made. While the number of themes related to scale can be literally endless, having two sharp criteria at work was very helpful. In summary, the book emphasizes the understanding of scale, especially regarding the way in which scale helps us to understand the environment. These two lines of inquiry complement and support each other.

Given the nature of the subject, the book is not intended to be a collection of facts and images put together after one's journey, for visitors to see. It is meant to consist of shorter and longer trips, which the reader is invited to join: In this spirit, the author chose to walk the walk and actually take these trips anew, rather than relying on memories from the landscape.

The continuous process of understanding presupposes an active involvement with questions, with problems, and readers are encouraged to confront the encountered vistas from various angles. In this context, the views of major figures in our intellectual history are sometimes mentioned: not because they would hold definitive answers, but because seeing the world from their point of view can offer the traveler a privileged experience. It can expand one's capacity to embrace reality in more than one way and enhance one's power of discovering new connections and new paths in the knowledge space. This is particularly true when those tall peaks bear names such as Locke, Kant, or Husserl.

Unlike many concepts that can be found at the intersection of different fields, scale is right at the core of a wide variety of disciplines. The book does not intend to mention them all, but it points to this diversity throughout its inquiry on the essence of scale. For example, it refers to physical geography and to geophysics, but also to art theory, literature, and human geography. There are two main reasons for this choice. On the one hand, comprehension of a concept is better supported by a

diversity of perspectives. On the other hand, by following paths of inquiry and problem solving in other fields than one's own, one can be stimulated and inspired to find new approaches for problems in one's area of interest.

At the same time, while pursuing its main objective – to support a deeper understanding of scale and its role in our understanding of the environment – the book only briefly mentions some of the most often treaded paths. This is mainly the case for topics that are described at length in numerous books, including some intended for the undergraduate level. For instance, one may expect cartography to take up most of the book, and yet it does not. One can think of a monument sitting in the middle of a town's central square: as it is often visited and photographed by everyone, a monograph could be entirely dedicated to it. Alternatively, a monograph may only refer to some extent to the monument, while also exploring other landmarks and artifacts, near and far, which are related to that monument in terms of symbolic meanings, means of representation, historical developments, etc.: eventually, the amount of space dedicated to the monument *per se* may be unexpectedly low, given its prominent presence in the town square. And yet, the study of the monument's meaning and importance can be deepened and enhanced by this latter approach.

It is a well-known fact that in some cases it is harder to explain simple things than complicated things. Complicated subjects can usually be described in terms of simpler ones. However, basic concepts can be difficult to define. Moreover, especially in one's early stages of scholarly pursuits, after the first successful steps in a certain area, one may perceive the domain as being so clear that it becomes almost transparent. "As owls' eyes are at noonday, so is our mental vision blind to what in its own nature is the most evident of all," warns us Aristotle. There is not much one can do about this natural tendency. However, it might help to be aware of it. This is the reason why in this book we turn from time to time to the foundations. For example, when we talk about scale as ratio, we present the underlying framework: affine transformations. When we look at scale as rank, we open up the basics of the theory of categories.

After all, from an applicative point of view, much of what is needed about scale seems to be achievable in 10 minutes of theory and another 50 minutes of practice. In terms of the above metaphor, this is almost equivalent to merely noticing that a beehive is present. Learning about its richness and about its role in our lives is a different matter. If the book will open a window into the buzzing world of the hive, and offer some notions of a language we can use to interact with the hive and with the environment, it will have accomplished its goal.

Understanding is, after all, what science is all about.
Roger Penrose, *Shadows of the Mind*

Acknowledgments

My thanks radiate in many directions, and I am aware that I couldn't possibly thank everyone who helped me on the path to this book. However, some forms of help stand out. My wife Mirela has a major contribution to this endeavor, from lively discussions of ideas to the immeasurable support she has been offering me at every step. Compared to the extent of her help, my thanks can only be perceived on a small, very small scale. My special thanks also go to my daughters Maria Cristina and Oana Monica for their constant encouragement and for thoughtful comments on various parts of the text. I am particularly thankful to Mamina for her relentless care and support. I am deeply grateful to my parents, who were passionate professors and role models of both scientific scholarship and family commitment.

My scientific career owes much to Florin Munteanu, who was my friend and mentor from the time when he introduced me to fractal theory and dynamic systems as an undergrad student in the early 1980s all the way through my graduate studies. I was privileged to be a long-time member of his interdisciplinary research group on nonlinear science, and to work with brilliant colleagues and valued friends like Cristian Ioana and Edmond Cretu, at the Romanian Academy's Sabba S. Stefanescu Institute of Geodynamics: this was a remarkable research institution due to the design and leadership of Dorel Zugravescu – a passionate scholar to whom I am grateful for the relentless invaluable support and the creation of an outstanding environment for young scholars to thrive. My thanks also go to Crisan Demetrescu, an esteemed collaborator and friend for many years, and my former colleagues and friends at the Institute of Geodynamics of the Romanian Academy. It is also a pleasure to thank Mircea Rusu for his superb sessions on nonlinear physics and his mentorship. I am especially grateful to Joern Kruhl, distinguished scholar and life-long friend and collaborator, for his continuous support and collaboration over the years. Deep thanks go to David Deutsch for his far-reaching advice and the thought-provoking discussions. The nonlinear science community has been very important to me. In particular, I would like to thank Shaun Lovejoy for his generous support and for fruitful discussions; I am also grateful for useful insights from Armin Bunde and Don Turcotte. At the same time, I would like to give special thanks to Bob McCalla for his genuine interest in my research and for his important support along

the way. My thanks also go to Tony Charles for bibliographic help in his field of research, and to all my colleagues and friends at Saint Mary's University who have been supportive of my work.

Furthermore, I would like to thank Malcolm Bott, Eric Gaba, Gilles Messian, and Ralf Roletschek for kindly permitting the inclusion of their photographs in this book. I would also like to acknowledge permission from the National Aeronautics and Space Administration (NASA), the National Oceanic and Atmospheric Administration (NOAA), the United States Fish and Wildlife Service (USFWS), the United States Geological Survey (USGS), and the Centers for Disease Control and Prevention (CDC) to include their illustrative material in the book. Last, but not least, I would like to thank the team at Springer, in particular Zach Romano, editor, who stimulated me to write this book in the first place and has always been supportive, and Zoe Kennedy, who has been constantly helpful throughout this book project.

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