1.5 Outline of this book

With the aforementioned aim in view this study has been structured as follows:

Applying a top-down approach, the consecutive chapters can be grouped into five clusters: (i) three introductory and largely descriptive chapters, viz. Ch. 1, 2 and 3; (ii) three argumentative and particularly philosophical discussions conducted in Ch. 4, 5 and 6; (iii) four also argumentative, but especially taxonomical chapters, dedicated to classifying, demarcating and assessing key concepts, viz. Ch. 7, 8, 9 and 10; (iv) one chapter, Ch. 11, discussing primeval symmetry breakings insofar as relevant to the purpose of this investigation, and finally, (v) two concluding chapters, viz. Ch. 12 and 13, the latter of which is of a more contemplative nature.

More in particular the successive chapters contain the following topics, each serving purposes relevant to the central thesis of the book:

Chapter 1, the Introduction, aims to explicate the structure of the argument meant to step-by-step substantiate the central thesis as well as the methods applied to accomplish that task. Chapter 2 serves two distinct purposes: (1) Principally it discusses studies of systems of widely divergent scales of size and mass, laying bare striking similarities between their behaviour. In that context a brief review is given of the chaos- and fractal movement in the 1970s and 1980s, as well as of the work of three prominent scientists, viz., Leo Kadanoff, Philip Anderson and Ilya Prigogine, not associated with said movement. This is meant to support the claim that contemporary scientists studying complex systems have benefitted largely from the discoveries made in the area of non-linearity thirty to forty years ago. The subsidiary claim that for a time now again a shift in both research domain and research perspective has been going on is substantiated by providing evidence of the focus on the complex organization of matter in authoritative scientific journals, books, and in the research projects of science institutes worldwide. Next come six contemporary case-studies of self-organization in nature, reviewed and explained by prominent scientists from various disciplines. To conclude and to highlight the importance of convergence in science, the work of a few other contemporary scientists of entirely different expertise is discussed. (2) With this, Chapter 2 is an important link in the argumentative chain of this inquiry, supplying evidence in the form of analogies and commonalities between real-world and model-based emergent patterns of behaviour in support of the central thesis. Chapter 3 reverts to and elaborates this thesis, breaking it down into sub-claims, which are to be substantiated in the following chapters. It also presents provisionally six candidate organizing principles which are subsequently nominated and further explored in Chapters 7 and 8.

Chapter 4 contains an ontological analysis of the key concepts of this investigation, in which, among other things, organizing principles are confronted with fundamental physical laws by making an appeal to the anthropic principle. The distinction between the synchronic and the diachronic approach to reality is discussed. Various kinds of causation, relevant to complex systems, are reviewed, while “good old” Aristotle’s fourfold causation typology is revisited to throw light on questions concerning intricate circular causal relationships within such systems. Chapter 5 deals with epistemological,
conceputal and methodological issues; the notions of self-organization and complexity are analysed and defined, and the epistemological and computational limits to our knowledge of emergent phenomena in general are explored. In this context the alleged explanatory deficiency of fundamental force laws in regard to the emergent behaviour of complex systems is critically examined and established. Defining properties of emergence are summed up, and computational modelling is recognized as a methodology pre-eminently suited to and indispensable for understanding complexity. Chapter 6 clarifies the role of abduction as a fitting heuristic strategy, already referred to in Sections 1.1 and 1.2 of the Introduction. Some illustrative and spectacular examples of abduction, either successful or related to work in progress, are reviewed. This aims to support the argument that it makes sense for philosophers and scientists alike to explore, by means of abductive inference, the putative link between certain organizing principles and the emergence of self-organizing patterns.

Chapter 7 offers a general taxonomy of emergent phenomena and discusses in more detail, with the help of three tables listing illustrative examples, the distinctions between the various sub-classes. It proposes the six earlier suggested organizing principles which appear to be of particular importance to self-organization as candidates for final selection. In Chapter 8 these six principles are further examined in depth; their characteristics are described with a view to revealing and establishing their interrelationships, overlaps and universal applicability. To this end their particular relevance to the various subsidiary classes of emergence is also explored. This is achieved by relating them to the emergent phenomena listed in the abovementioned tables, for the purpose of finding a rough quantitative criterion by means of which the extent of their universality can be put to the test. Tentatively, three of them are retained. In Chapter 9 an intermediary, but, for the sake of conceptual clarity, necessary step is taken towards establishing the range of applicability of a number of key concepts, which involves exploring the potential for both widening and demarcating their scope and further classifying them where necessary. Eventually, in Chapter 10, through further elimination, two principles, i.e. symmetry breaking and the propensity for stability preservation, are retained as the most relevant to emergent pattern formation. The long reach of the two principles is highlighted and their predominance is further established. To achieve the optimal level of generalization of the phenomena to be explained the search for similar emergent patterns is extended to cosmological scales. On this basis it is argued that the principle of natural selection is in fact a special case of the propensity for stability preservation and thus does not qualify as a universal organizing principle in its own right. In this context also the role of altruism is discussed, on account of its contribution to the stable growth of populations, and because it bears out my claim about stability’s prevalence over biological fitness.

Chapter 11 is especially dedicated to exploring the origin of the so-called “arrow of time” and its deeper connection with symmetry breakings in the earliest moments of the universe’s existence.

In Chapter 12 the inquiry comes to a conclusion. The universality of both key principles, as compared to fundamental laws, is firmly established. Furthermore the relevance of law-like regularity,
predictability, determinism and contingency to these principles is analysed. To conclude the argument I present an outline of a theoretical framework with complementary conceptual and heuristic tools that may be seen as opportune in the case in hand, and, inasmuch as it draws on abductive inference, may be relevant to other puzzling phenomena in need of explanation. Essentially, the framework leads up to a recapitulation confirming the central hypothesis formulated in Sections 1.1 and 1.2 of this Introduction, and specifically designating the two retained organizing principles as the pre-eminently relevant ones.

The closing Chapter 13 contains some general reflections on the book’s substance seen in a wider perspective. The work done in the preceding chapters is viewed in retrospect from the philosopher’s viewpoint. In this context the use of abduction as a methodologically sound and heuristically effective strategy is reviewed. Special attention is paid to the growing tension and alienation between science and philosophy; in an attempt at easing that tension and at securing an identifiable field of operation for the discipline of philosophy of science ideas concerning its practical applicability with respect to problems facing our present-day society are presented. Furthermore the question why in this investigation the origin of earthly life, and of humankind and human consciousness, paradigmatic examples of emergence, have remained underexposed is attended to. Finally a plea is made for a treatment on equal footing of emergentism and reductionism, in the sense that they are taken to be mutually complementary research strategies considered subservient to heuristics as an effective method for scientific problem solving.