

Preface

This book offers, to a diverse nonspecialist audience, a panorama of contextual perspectives on the topics of space and time. Almost every field has in its language, a notion of space and time. This duo is intertwined into the fabric of our existence. If you are an aficionado of classical music, you would see that absolute music and programmed music differ not only in their nature but also in purpose. While the former is composed for its own sake, the latter is composed keeping in mind a context. Akin to this, space and time, have been analyzed either for their own sake or to fit a context and thereby to serve some purpose. To each his own.

When this collection was planned, it seemed natural to organize the articles, written by towering figures belonging to seven diverse fields, into various sections to facilitate a better understanding. And with the hope that a global meaning would emerge from such contextual viewpoints when the dots are connected. We thus segregated this volume into various fields, namely philosophy, physics, mathematics, biology/cognitive science, logic/computer science and a section ‘Miscellaneous’ which includes literature, space–time geography and art.

Einstein once remarked, “Space and Time are modes by which we think and not a condition in which we live.” The Philosophy section is therefore devoted to some foundational and metaphysical aspects of Space and Time, which are intuitive in nature. Articles contain views of philosophers like Descartes, Newton, Leibniz, Hume, Kant, Poincare, Cassirer, Sartre, Husserl, etc., on space and time. In addition to the western philosophy, two articles are dedicated to elaborating on the views of space and time of the Indian schools of thought—Vedic and *Nyaya*. It also contains a treatise on the nature of space and time.

Thinking often gets translated into a theory after it passes the toll gate of the scientific method, which not only verifies the claims experimentally but also checks their consistency. The Physics section is aimed at providing a clear and precise account of empirical/physical status of space and time. Its articles cover topics ranging from relativity theory to quantum theory, ideas of Minkowski, Einstein, and Hermann Weyl, and others, and some more recent advances in our understanding of Space and Time.

The Book of Nature is written in the language of mathematics, as Galileo remarked. The next section deals with the mathematical foundations of space and time. Articles address themes such as the nature of metric, manifolds, spatial relationships, and the nature of the continuum. They draw from the works of Euclid, Leibniz, Einstein, Hermann Weyl, Grothendieck, and others, thereby trying to analyze and model the notions of Space and Time from a mathematical setting. These contributions are both pedagogical and expository in nature.

Space and time are intangible. But our consciousness paints them for us all the time. Be it when our house is packed with guests or when a deadline is pressing. But what are these notions produced by our brains? The section Biology/Cognitive Science deals with spatial and temporal perceptions and how they are grounded in our cognition, space in biological systems, time in biological systems (circadian rhythms) and time from an evolutionary perspective.

Merrick Furst once remarked, “The biggest difference between time and space is that you can’t reuse time.” Within the computational context, we concern ourselves with storage (space), computing time (time) and their associated complexities. This section, Logic/Computer Science, deals with topics such as computational complexity, space–time tradeoffs in analytic engines and topics in classical and modern logic that pertain to the second part of the title, limits of human understanding/thinking. It offers a concise account of the logician Kurt Godel’s work which includes his incompleteness theorems, their impact on theoretical physics and economics and his views on time.

The last section, ‘Miscellaneous’, contains handpicked articles which elucidate the notions of space and time with in the fields of literature, space–time geography and visual arts.

An intriguing foreword by Prof. John Stachel and a captivating afterword by Prof. Noam Chomsky add icing to the cake. All the 44 authors have taken utmost care to keep the articles as nontechnical as possible and self-contained. They have included an appendix with their articles (when needed) to furnish the technicalities for those keen to explore deeper.

During my undergraduate days, I, like many others, was deeply influenced by the fresh worldview found in Douglas Hofstadter’s books. He is in a sense the ‘Pied Piper’, that Hermann Weyl once addressed David Hilbert as, who seduced many rats to follow him into the deep river of thinking. His emphasis that analogy making is at the core of our cognition, motivated me and eventually led to inception of this volume.

An original thinker belonging to any domain of science should be Sherlock’ian in many aspects. Just as Holmes decodes the mysterious stick figures inscribed on the walls (The adventure of the Dancing Men) by finding patterns and thereby extracting meanings, the true pursuit of science begins with decoding such analogical stick figures painted by Mother Nature on the canvas of perceived reality. They can be tracks on bubble chambers or patterns within numbers. In such a

pursuit, one greatly benefits from knowledge of diverse fields which can trigger cross-domain analogies. We sincerely hope, through this erudite volume, that a symphony of patterns and a tapestry of intuitions will emerge, providing a holistic insight into the questions: ‘What is Space?’ and ‘What is Time?’

Juhu, Mumbai

Shyam Wuppuluri

Space, Time and the Limits of Human Understanding

Wuppuluri, S.; Ghirardi, G. (Eds.)

2017, XXIII, 530 p. 51 illus., Hardcover

ISBN: 978-3-319-44417-8