

Cosmic Evolution The Rise Of Complexity In Nature

Inflationary cosmology has been developed over the last twenty years to remedy serious shortcomings in the standard hot big bang model of the universe. This textbook, first published in 2005, explains the basis of modern cosmology and shows where the theoretical results come from. The book is divided into two parts; the first deals with the homogeneous and isotropic model of the Universe, the second part discusses how inhomogeneities can explain its structure. Established material such as the inflation and quantum cosmological perturbation are presented in great detail, however the reader is brought to the frontiers of current cosmological research by the discussion of more speculative ideas. An ideal textbook for both advanced students of physics and astrophysics, all of the necessary background material is included in every chapter and no prior knowledge of general relativity and quantum field theory is assumed. Presents an illustrated guide to the universe and to Earth's relationship to it, moving from theories of creation to humankind's discovery of the cosmos, to general relativity, to space missions, and beyond.

Lee Smolin offers a new theory of the universe that is at once elegant, comprehensive, and radically different from anything proposed before. Smolin posits that a process of self organization like that of biological evolution shapes the universe, as it develops and eventually reproduces through black holes, each of

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which may result in a new big bang and a new universe. Natural selection may guide the appearance of the laws of physics, favoring those universes which best reproduce. The result would be a cosmology according to which life is a natural consequence of the fundamental principles on which the universe has been built, and a science that would give us a picture of the universe in which, as the author writes, "the occurrence of novelty, indeed the perpetual birth of novelty, can be understood." Smolin is one of the leading cosmologists at work today, and he writes with an expertise and force of argument that will command attention throughout the world of physics. But it is the humanity and sharp clarity of his prose that offers access for the layperson to the mind bending space at the forefront of today's physics. Identifying the Mayan World Tree with the central axis of the cosmos, the author shows how evolution is not random • Shows how the evolution of the universe emanates from the cosmic Tree of Life • Explains the origin and evolution of biological life and consciousness and how this is directed Using recent findings within cosmology, coupled with his broad understanding of the Mayan Calendar, biologist Carl Johan Calleman offers a revolutionary and fully developed alternative to Darwin's theory of biological evolution--and the theory of randomness that holds sway over modern science. He shows how the recently discovered central axis of the universe correlates with the Tree of Life of the ancients. This provides an entirely new context for physics in general and especially for the origin and evolution of life and suggests that we look upon ourselves as parts of a

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hierarchy of systems that are all interrelated and evolve in a synchronized way. Calleman's research demonstrates that life did not just accidentally "pop up" on our planet, but that Earth was a place specifically tagged for this. He demonstrates how the Mayan Calendar describes different quantum states of the Tree of Life and presents a new explanation for the origin and evolution of consciousness. Calleman uses his scientific background in biology and cosmology to show that the idea of the Purposeful Universe is real. He explains not only how DNA but also entire organisms have emerged in the image of the Tree of Life, a theory that has wide-ranging consequences not only for medicine but also for the origin of sacred geometry and the human soul. With this new theory of biological evolution the divide between science and religion disappears.

"Offering a sweeping tour of fantastic physics and cosmic history, Gravity's Engines provides a view of the most fearsome places in the universe, and finally asks what it will take to see the event horizon of a black hole"--

In Cosmic Biology, Louis Irwin and Dirk Schulze-Makuch guide readers through the range of planetary habitats found in our Solar System and those likely to be found throughout the universe. Based on our current knowledge of chemistry, energy, and evolutionary tendencies, the authors envision a variety of possible life forms. These range from the familiar species found on Earth to increasingly exotic examples possible under the different conditions of other planets and their satellites. Discussions of the great variety of life forms that could

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evolve in these diverse environments have become particularly relevant in recent years with the discovery of around 300 exoplanets in orbit around other stars and the possibilities for the existence of life in these planetary systems. The book also posits a taxonomic classification of the various forms of life that might be found, including speculation on the relative abundance of different forms and the generic fate of living systems. The fate and future of life on Earth will also be considered. The closing passages address the Fermi Paradox, and conclude with philosophical reflections on the possible place of Homo sapiens in the potentially vast stream of life across the galaxies.

This issue of the almanac aims at filling the gap in the mega-evolutionary research. The Editors believe that the present Almanac, which brings together scientists working in different areas of the vast evolutionary field, will hopefully make a contribution to this process. The contributions to this volume are subdivided into three sections: 'Universal Evolution', 'Biological and Social Forms of Evolution: Connections and Comparisons', and 'Aspects of Social Evolution'. Subjects and issues of the contributions to all three sections have a great deal in common and significantly supplement each other. An astrophysicist, an organic chemist, and an anthropologist discuss some of mankind's most basic questions about the creation of the universe, the first particles, and the evolution that led to contemporary life forms.

Our cosmic story explores the potential our universe has for fostering life and civilization. The book starts by looking back

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at the story of Earth and our civilization, and then evaluates the idea that other sentient creatures in the cosmos may be doing the same.

Presents a revolutionary new theory that bridges the divide between science and spirituality • Discloses the ramifications of non-localized consciousness and how the physical world and spiritual experience are two aspects of the same reality • Includes contributions from Jane Goodall, Ed Mitchell, Stanislav Grof, Ralph Abraham, and Christian de Quincy, among others

What scientists are now finding at the outermost frontiers of every field is overturning all the basic premises concerning the nature of matter and reality. The universe is not a world of separate things and events but is a cosmos that is connected, coherent, and bears a profound resemblance to the visions held in the earliest spiritual traditions in which the physical world and spiritual experience were both aspects of the same reality and man and the universe were one. The findings that justify this new vision of the underlying logic of the universe come from almost all of the empirical sciences: physics, cosmology, the life sciences, and consciousness research. They explain how interactions lead to interconnections that produce instantaneous and multifaceted coherence--what happens to one part also happens to the other parts, and hence to the system as a whole. The sense of sacred oneness experienced by our ancestors that was displaced by the unyielding material presumptions of modern science can be restored, and humanity can once again feel at home in the universe.

Galaxies, along with their underlying dark matter halos, constitute the building blocks of structure in the Universe. Of all fundamental forces, gravity is the dominant one that drives the evolution of structures from small density seeds at early times to the galaxies we see today. The interactions among myriads of stars, or dark matter particles, in a gravitating

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structure produce a system with fascinating connotations to thermodynamics, with some analogies and some fundamental differences. Ignacio Ferreras presents a concise introduction to extragalactic astrophysics, with emphasis on stellar dynamics, and the growth of density fluctuations in an expanding Universe. Additional chapters are devoted to smaller systems (stellar clusters) and larger ones (galaxy clusters). *Fundamentals of Galaxy Dynamics, Formation and Evolution* is written for advanced undergraduates and beginning postgraduate students, providing a useful tool to get up to speed in a starting research career. Some of the derivations for the most important results are presented in detail to enable students appreciate the beauty of maths as a tool to understand the workings of galaxies. Each chapter includes a set of problems to help the student advance with the material.

Along the way he examines the development of the most microscopic and the most immense aspects of our universe and the complex ways in which they interact."--Jacket.

We know the universe has a history, but does it also have a story of self-creation to tell? Yes, in Roy R. Gould's account. He offers a compelling narrative of how the universe—with no instruction other than its own laws—evolved into billions of galaxies and gave rise to life, including humans who have been trying for millennia to comprehend it. Far from being a random accident, the universe is hard at work, extracting order from chaos. Making use of the best current science, Gould turns what many assume to be true about the universe on its head. The cosmos expands inward, not outward. Gravity can drive things apart, not merely together. And the universe seems to defy entropy as it becomes more ordered, rather than the other way around. Strangest of all, the universe is exquisitely hospitable to life, despite its being constructed from undistinguished atoms and a few

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unexceptional rules of behavior. *Universe in Creation* explores whether the emergence of life, rather than being a mere cosmic afterthought, may be written into the most basic laws of nature. Offering a fresh take on what brought the world—and us—into being, Gould helps us see the universe as the master of its own creation, not tethered to a singular event but burgeoning as new space and energy continuously stream into existence. It is a very old story, as yet unfinished, with plotlines that twist and churn through infinite space and time.

A coherent introduction for researchers in astronomy, particle physics, and cosmology on the formation and evolution of galaxies.

Cosmology is the study of the origin, size, and evolution of the entire universe. Every culture has developed a cosmology, whether it be based on religious, philosophical, or scientific principles. In this book, the evolution of the scientific understanding of the Universe in Western tradition is traced from the early Greek philosophers to the most modern 21st century view. After a brief introduction to the concept of the scientific method, the first part of the book describes the way in which detailed observations of the Universe, first with the naked eye and later with increasingly complex modern instruments, ultimately led to the development of the "Big Bang" theory. The second part of the book traces the evolution of the Big Bang including the very recent observation that the expansion of the Universe is itself accelerating with time.

"Who can ask for better cosmic tour guides to the universe than Drs. Tyson and Goldsmith?" —Michio Kaku, author of *Hyperspace and Parallel Worlds* Our true origins are not just human, or even terrestrial, but in fact cosmic. Drawing on recent scientific breakthroughs and the current cross-pollination among geology, biology, astrophysics, and

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cosmology, *Origins* explains the soul-stirring leaps in our understanding of the cosmos. From the first image of a galaxy birth to Spirit Rover's exploration of Mars, to the discovery of water on one of Jupiter's moons, coauthors Neil deGrasse Tyson and Donald Goldsmith conduct a galvanizing tour of the cosmos with clarity and exuberance.

Specialist scientific fields are developing at incredibly swift speeds, but what can they really tell us about how the universe began and how we as humans evolved to play such a dominant role on Earth? John Hands' extraordinarily ambitious book merges scientific knowledge from multiple disciplines and evaluates without bias or preconception all the theories and evidence about the origin and evolution of matter, consciousness, and mankind. The result, a "pearl of dialectical reasoning" (Publishers Weekly, starred review), provides the most comprehensive account yet of current ideas such as cosmic inflation, dark energy, the selfish gene, and neurogenetic determinism. In the clearest possible prose it differentiates the firmly established from the speculative and examines the claims of various fields to approach a unified theory of everything. In doing so it challenges the orthodox consensus in those branches of cosmology, biology, and neuroscience that have ossified into dogma. Its "shocking and invigorating" analysis (Daily Telegraph, A Best Science Book of 2015) reveals underlying patterns of cooperation, complexification, and convergence that lead to the unique emergence in humans of a self-reflective consciousness that enables us to determine our future evolution. This

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groundbreaking book is destined to become a classic of scientific thinking.

In this companion to a PBS series, the authors explore cosmic science's stunning new insights into the formation and evolution of the universe--of the cosmos, of galaxies and galaxy clusters, of stars within galaxies, of planets that orbit those stars, and more.

"[Tyson] tackles a great range of subjects...with great humor, humility, and—most important—humanity."

—Entertainment Weekly Loyal readers of the monthly "Universe" essays in Natural History magazine have long recognized Neil deGrasse Tyson's talent for guiding them through the mysteries of the cosmos with clarity and enthusiasm. Bringing together more than forty of Tyson's favorite essays, *Death by Black Hole* explores a myriad of cosmic topics, from what it would be like to be inside a black hole to the movie industry's feeble efforts to get its night skies right. One of America's best-known astrophysicists, Tyson is a natural teacher who simplifies the complexities of astrophysics while sharing his infectious fascination for our universe.

In this fascinating journey to the edge of science, Vidal takes on big philosophical questions: Does our universe have a beginning and an end or is it cyclic? Are we alone in the universe? What is the role of intelligent life, if any, in cosmic evolution? Grounded in science and committed to philosophical rigor, this book presents an evolutionary worldview where the rise of intelligent life is not an accident, but may well be the key to unlocking the universe's deepest mysteries. Vidal shows how the fine-tuning controversy can be advanced with computer

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simulations. He also explores whether natural or artificial selection could hold on a cosmic scale. In perhaps his boldest hypothesis, he argues that signs of advanced extraterrestrial civilizations are already present in our astrophysical data. His conclusions invite us to see the meaning of life, evolution and intelligence from a novel cosmological framework that should stir debate for years to come.

Evolution of Stars and Stellar Populations is a comprehensive presentation of the theory of stellar evolution and its application to the study of stellar populations in galaxies. Taking a unique approach to the subject, this self-contained text introduces first the theory of stellar evolution in a clear and accessible manner, with particular emphasis placed on explaining the evolution with time of observable stellar properties, such as luminosities and surface chemical abundances. This is followed by a detailed presentation and discussion of a broad range of related techniques, that are widely applied by researchers in the field to investigate the formation and evolution of galaxies. This book will be invaluable for undergraduates and graduate students in astronomy and astrophysics, and will also be of interest to researchers working in the field of Galactic, extragalactic astronomy and cosmology. comprehensive presentation of stellar evolution theory introduces the concept of stellar population and describes "stellar population synthesis" methods to study ages and star formation histories of star clusters and galaxies presents stellar evolution as a tool for investigating the evolution of galaxies and of the universe in general

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The author addresses some of the most basic issues we can contemplate: the origin of matter and the origin of life, and the ways matter, life, and radiation interact and change with time. Guided by notions of beauty and symmetry, Chaisson designs an expansive yet intricate model depicting the origin and evolution of all material structures, from quark to quasar, from microbe to mind. 8 halftones. 35 line illustrations.

Presents a history of physics, examining the theories and experimental practices of the science.

A substantial update of this award-winning and highly regarded cosmology textbook, for advanced undergraduates in physics and astronomy.

Are we alone in the universe? It is a captivating question, but one that historically eluded proper scientific investigation. The new discipline of astrobiology changes the game, introducing rigor to the quest for extraterrestrial life. *Life in the Cosmos* surveys the field, showing how cutting-edge research is closing in on the answers "out there."

A prize-winning popular science writer uses mathematical modeling to explain the cosmos. In *Calculating the Cosmos*, Ian Stewart presents an exhilarating guide to the cosmos, from our solar system to the entire universe. He describes the architecture of space and time, dark matter and dark energy, how galaxies form, why stars implode, how everything began, and how it's all going to end. He considers parallel universes, the fine-tuning of the cosmos for life, what forms extraterrestrial life might take, and the likelihood of life on Earth being snuffed out by an asteroid. Beginning with the Babylonian integration of mathematics into the study of astronomy and cosmology, Stewart traces the evolution of our understanding of the cosmos: How Kepler's laws of planetary

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motion led Newton to formulate his theory of gravity. How, two centuries later, tiny irregularities in the motion of Mars inspired Einstein to devise his general theory of relativity. How, eighty years ago, the discovery that the universe is expanding led to the development of the Big Bang theory of its origins. How single-point origin and expansion led cosmologists to theorize new components of the universe, such as inflation, dark matter, and dark energy. But does inflation explain the structure of today's universe? Does dark matter actually exist? Could a scientific revolution that will challenge the long-held scientific orthodoxy and once again transform our understanding of the universe be on the way? In an exciting and engaging style, *Calculating the Cosmos* is a mathematical quest through the intricate realms of astronomy and cosmology.

This book follows the evolutionary trail all the way from the Big Bang 13.7 billion years ago to conscious life today. It is an accessible introductory book written for the interested layperson – anyone interested in the ‘big picture’ coming from modern science. It covers a wide range of topics including the origin and evolution of our universe, the nature and origin of life, the evolution of life including questions of birth and death, the evolution of cognition, the nature of consciousness, the possibility of extraterrestrial life and the future of the universe. The book is written in a narrative style, as these topics are all parts of a single story. It concludes with a discussion on the nature and future of science.

This edition of *Science and Creationism* summarizes key aspects of several of the most important lines of evidence supporting evolution. It describes some of the positions taken by advocates of creation science and presents an analysis of these claims. This document lays out for a broader audience the case against presenting religious concepts in science classes. The document covers the origin of the universe,

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Earth, and life; evidence supporting biological evolution; and human evolution. (Contains 31 references.) (CCM)

Cosmic Dawn describes a highly interdisciplinary tour of billions of years of cosmic history, an epochal saga drawing on every field of modern science — astronomy, physics, chemistry, biology, geology and anthropology — to address the two most fundamental problems of all: the origins of matter and life. Winner of the Phi Beta Kappa Award, the American Institute of Physics Award, and a National Book Award Nomination.

Chaisson addresses some of the most basic issues we can contemplate: the origin of matter and the origin of life, and the ways matter, life, and radiation interact and change with time. He designs for us an expansive yet intricate model depicting the origin and evolution of all material structures.

This book examines how humans evolved from the cosmos and prebiotic earth and what types of biological, chemical, and physical sciences drove this complex process. The author presents his view of nature which attributes the rising complexity of life to the continual increasing of information content, first in genes and then in brains.

From the internationally acclaimed author of *Magnificent Universe*, Ken Croswell, comes the definitive story of the golden age in our understanding of the universe -- the age we live in right now. The universe's origin, evolution, and fate have long fascinated humanity, but until recently these subjects resided in astronomy's never-never land. The last ten years, however, have witnessed a stunning turnabout: an avalanche of new cosmological discoveries that illuminate the greatest questions of all. *The Universe at Midnight* is a platform from which to observe these new deep-space landmarks. Mammoth new telescopes on Earth, such as the Keck Observatory in Hawaii, the Very Large Telescope in Chile, and Japan's Subaru Telescope, as well as the Hubble

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Space Telescope overhead, are probing the frontiers of the universe with stunning results. In 1996 astronomers pinpointed the center of the elusive "Great Attractor," a mass of galaxies 250 million light-years away that is trying to tug our Galaxy and thousands of others across the universe. In late 1997, two teams hunting supernovae in galaxies billions of light-years away shocked their colle

An introduction to Einstein's theory of relativity for nonscientists, this book takes into consideration many of the interesting possibilities that the theory suggests

Are humans a galactic oddity, or will complex life with human abilities develop on planets with environments that remain habitable for long enough? In a clear, jargon-free style, two leading researchers in the burgeoning field of astrobiology critically examine the major evolutionary steps that led us from the distant origins of life to the technologically advanced species we are today. Are the key events that took life from simple cells to astronauts unique occurrences that would be unlikely to occur on other planets? By focusing on what life does - it's functional abilities - rather than specific biochemistry or anatomy, the authors provide plausible answers to this question. Systematically exploring the various pathways that led to the complex biosphere we experience on planet Earth, they show that most of the steps along that path are likely to occur on any world hosting life, with only two exceptions: One is the origin of life itself – if this is a highly improbable event, then we live in a rather “empty universe”. However, if this isn't the case, we inevitably live in a universe containing a myriad of planets hosting complex as well as microbial life - a “cosmic zoo”. The other unknown is the rise of technologically advanced beings, as exemplified on Earth by humans. Only one technological species has emerged in the roughly 4 billion years life has existed on Earth, and we don't know of any other technological species elsewhere. If

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technological intelligence is a rare, almost unique feature of Earth's history, then there can be no visitors to the cosmic zoo other than ourselves. Schulze-Makuch and Bains take the reader through the history of life on Earth, laying out a consistent and straightforward framework for understanding why we should think that advanced, complex life exists on planets other than Earth. They provide a unique perspective on the question that puzzled the human species for centuries: are we alone?

“A compelling appeal, at just the right time, for continuing to look up.”—Air & Space America’s space program is at a turning point. After decades of global primacy, NASA has ended the space-shuttle program, cutting off its access to space. No astronauts will be launched in an American craft, from American soil, until the 2020s, and NASA may soon find itself eclipsed by other countries’ space programs. With his signature wit and thought-provoking insights, Neil deGrasse Tyson—one of our foremost thinkers on all things space—illuminates the past, present, and future of space exploration and brilliantly reminds us why NASA matters now as much as ever. As Tyson reveals, exploring the space frontier can profoundly enrich many aspects of our daily lives, from education systems and the economy to national security and morale. For America to maintain its status as a global leader and a technological innovator, he explains, we must regain our enthusiasm and curiosity about what lies beyond our world. Provocative, humorous, and wonderfully readable, *Space Chronicles* represents the best of Tyson’s recent commentary, including a must-read prologue on NASA and partisan politics. Reflecting on topics that range from scientific literacy to space-travel missteps, Tyson gives us an urgent, clear-eyed, and ultimately inspiring vision for the future. A NEW YORK TIMES NOTABLE BOOK OF 2020 NAMED A BEST BOOK OF THE YEAR BY * THE WASHINGTON

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POST * THE ECONOMIST * NEW SCIENTIST * PUBLISHERS WEEKLY * THE GUARDIAN From one of the most dynamic rising stars in astrophysics, an “engrossing, elegant” (The New York Times) look at five ways the universe could end, and the mind-blowing lessons each scenario reveals about the most important concepts in cosmology. We know the universe had a beginning. With the Big Bang, it expanded from a state of unimaginable density to an all-encompassing cosmic fireball to a simmering fluid of matter and energy, laying down the seeds for everything from black holes to one rocky planet orbiting a star near the edge of a spiral galaxy that happened to develop life as we know it. But what happens to the universe at the end of the story? And what does it mean for us now? Dr. Katie Mack has been contemplating these questions since she was a young student, when her astronomy professor informed her the universe could end at any moment, in an instant. This revelation set her on the path toward theoretical astrophysics. Now, with lively wit and humor, she takes us on a mind-bending tour through five of the cosmos’s possible finales: the Big Crunch, Heat Death, the Big Rip, Vacuum Decay (the one that could happen at any moment!), and the Bounce. Guiding us through cutting-edge science and major concepts in quantum mechanics, cosmology, string theory, and much more, *The End of Everything* is a wildly fun, surprisingly upbeat ride to the farthest reaches of all that we know. This book is a simple, non-technical introduction to cosmology, explaining what it is and what cosmologists do. Peter Coles discusses the history of the subject, the development of the Big Bang theory, and more speculative modern issues like quantum cosmology, superstrings, and dark matter. ABOUT THE SERIES: The Very Short Introductions series from Oxford University Press contains hundreds of titles in almost every subject area. These pocket-

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sized books are the perfect way to get ahead in a new subject quickly. Our expert authors combine facts, analysis, perspective, new ideas, and enthusiasm to make interesting and challenging topics highly readable.

In a simple manner, explains the frontiers of astronomy, how fractals appear in cosmic physics, offers a personal view of the history of the idea of self-similarity and of cosmological principles and presents the debate which illustrates how new concepts and deeper observations reveal unexpected aspects of Nature.

There is a widespread assumption that the universe in general, and life in particular, is 'getting more complex with time'. This book brings together a wide range of experts in science, philosophy and theology and unveils their joint effort in exploring this idea. They confront essential problems behind the theory of complexity and the role of life within it: what is complexity? When does it increase, and why? Is the universe evolving towards states of ever greater complexity and diversity? If so, what is the source of this universal enrichment? This book addresses those difficult questions, and offers a unique cross-disciplinary perspective on some of the most profound issues at the heart of science and philosophy. Readers will gain insights in complexity that reach deep into key areas of physics, biology, complexity science, philosophy and religion.

This book offers a study of the three evolutions in a circle (cosmos, life, and knowledge) with the aim of discussing human social behavior, a metaphor of the general behavior of nature (from which man derives) within the fluctuating equilibrium between the opposite tendencies to cohesion and shredding; a circularity revealing an indefinite and probably never conclusive run-up of human beings to the knowledge of nature; an analysis that demonstrates any theoretical/practical impossibility to formulate absolute

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certainties, since it depicts a situation in which man finds himself hovering between a rational way of living and the contradictory modus operandi of mythos. All that, within a society where the powerful communication and transportation technologies give rise to conflicts and fragmentations, where anyone's will to self-distinguishing is enhanced by highlighting any small difference and obscuring any large similarity. The main difference between this book and existing ones stems from its interdisciplinary nature, particularly because it establishes a close connection between three, apparently so different disciplines—cosmology, life sciences, and sociology—compared with respect to their increasing complexity laws, giving rise to always more chaotic configurations.

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