

Deep Simplicity John Gribbin

HIS DARK MATERIALS IS SOON TO BE AN HBO ORIGINAL SERIES STARRING DAFNE KEEN, RUTH WILSON, JAMES McAVOY, AND LIN-MANUEL MIRANDA! Philip Pullman's His Dark Materials trilogy is renowned for its mystery and magic. What's the truth behind it all? Is the golden compass actually based in science? How does the subtle knife cut through anything? Could there be a bomb like the one made with Lyra's hair? How do the Gallivespian's lodestone resonators really work? And, of course, what are the Dark Materials? Drawing on string theory and spacetime, quantum physics and chaos theory, award-winning science writers Mary and John Gribbin reveal the real science behind Philip Pullman's bestselling fantasy trilogy in entertaining and crystal-clear prose. Don't miss Philip Pullman's epic new trilogy set in the world of His Dark Materials! ** THE BOOK OF DUST ** La Belle Sauvage—now in paperback The Secret Commonwealth—coming October 3

Filled with the latest astronomical findings and accompanied by gorgeous full-color photographs, a fascinating foray into space discusses new theories and discoveries and covers every aspect of our universe.

Examines the concepts of information, meaning, and purpose, describes the function of information at various levels of organization, and discusses the theories of Edward Fredkin, Edward O. Wilson, and Kenneth Blouin

In 1972, when James Lovelock first proposed the Gaia hypothesis--the idea that the Earth is a living organism that maintains conditions suitable for life--he was ridiculed by the scientific establishment. Today Lovelock's revolutionary insight, though still extremely controversial, is recognized as one of the most creative, provocative, and captivating scientific ideas of our time. James Lovelock tells for the first time the whole story of this maverick scientist's life and how it served as a unique preparation for the idea of Gaia. Drawing on in-depth interviews with Lovelock himself and unprecedented access to his private papers, John and Mary Gribbin paint an intimate and fascinating portrait of a restless, uniquely gifted freethinker. In a lifetime spanning almost a century, Lovelock has followed a career path that led him from chemistry, to medicine, to engineering, to space science. He worked for the British secret service and contributed to the success of the D-Day landings in World War II. He was a medical experimenter and an accomplished inventor. And he was working with NASA on methods for finding possible life on Mars when he struck upon the idea of Gaia, conceiving of the Earth as a vast, living, self-regulating system. Deftly framed within the context of today's mounting global-warming crisis, James Lovelock traces the intertwining trajectories of Lovelock's life and the famous idea it brought forth, which continues to provoke passionate debate about the nature and future of life on our planet.

A look at the rebellious thinkers who are challenging old ideas with their insights into the ways countless elements of complex systems interact to produce spontaneous order out of confusion

The IgNobel Prize-winner and author of Rock, Paper, Scissors applies science-based solutions to seemingly complex problems in life.

The theory of evolution by natural selection did not spring fully formed and unprecedented from the brain of Charles Darwin. The idea of evolution had been around, in various guises, since the time of Ancient Greece. And nor did theorizing about evolution stop with what Daniel Dennett called "Darwin's dangerous idea." In this riveting new book, bestselling science writers John and Mary Gribbin explore the history of the idea of evolution, showing how Darwin's theory built on what went before and how it was developed in the twentieth century, through an understanding of genetics and the biochemical basis of evolution, into the so-called "modern synthesis" and beyond. Darwin deserves his recognition as the primary proponent of the idea of natural selection, but as the authors show, his contribution was one link in a chain that extends back into antiquity and is still being forged today.

Accessible exploration of one of the most exciting areas of scientific inquiry - the nature of light. Following on from his bestseller, SCHRODINGER'S CAT, John Gribbin presents the recent dramatic improvements in experimental techniques that have enabled physicists to formulate and test new theories about the nature of light. He describes these theories not in terms of hard-to-imagine entities like spinning subnuclear particles, but in terms of the fate of two small cats, separated at a tender age and carried to opposite ends of the universe. In this way Gribbin introduces the reader to such new developments as quantum cryptography, through which unbreakable codes can be made, and goes on to possible future developments such as the idea that the 'entanglement' of quantum particles could be a way to build a STAR TREK style teleportation machine.

On 24 June 1837, Louis Agassiz stunned the learned members of the Swiss Society of Natural Sciences by addressing them, in his role as President, not with an anticipated lecture on fossil fishes, but with a passionate presentation on the existence of Ice Ages. No one was convinced. He even dragged the reluctant members of the Society up into the mountains to see the evidence for themselves, pointing out the scars on the hard rocks left by glaciation (which some of those present tried to explain away as having been produced by the wheels of passing carriages). Extraordinarily, it would take a further 140 years before the Ice Age theory was fully proved and understood.

In a wonderful synthesis of science, history, and imagination, Gino Segrè, an internationally renowned theoretical physicist, embarks on a wide-ranging exploration of how the fundamental scientific concept of temperature is bound up with the very essence of both life and matter. Why is the internal temperature of most mammals fixed near 98.6°? How do geologists use temperature to track the history of our planet? Why is the quest for absolute zero and its quantum mechanical significance the key to understanding superconductivity? And what can we learn from neutrinos, the subatomic "messages from the sun" that may hold the key to understanding the birth-and death-of our solar system? In answering these and hundreds of other temperature-sensitive questions, Segrè presents an uncanny view of the world around us.

In this book, John Gribbin tells the story of the people who made science and the turbulent times they lived in. As well as famous figures such as Copernicus, Darwin and Einstein, there are also the obscure, the eccentric, even the mad. This diverse cast includes, among others, Andreas Vesalius, landmark 16th-century anatomist and secret grave-robber; the flamboyant Galileo, accused of heresy for his ideas; the obsessive, competitive Newton, who wrote his rivals out of the history books; Gregor Mendel, the Moravian monk who founded modern genetics; and Louis Agassiz, so determined to prove the existence of ice ages that he marched his colleagues up a mountain to show them the evidence.

Quantum theory is so shocking that Einstein could not bring himself to accept it. It is so important that it provides the fundamental underpinning of all modern sciences. Without it, we'd have no nuclear power or nuclear weapons, no TV, no computers, no science of molecular biology, no understanding of DNA, no genetic engineering. *In Search of Schrodinger's Cat* tells the complete story of quantum mechanics, a truth stranger than any fiction. John Gribbin takes us step by step into an ever more bizarre and fascinating place, requiring only that we approach it with an open mind. He introduces the scientists who developed quantum theory. He investigates the atom, radiation, time travel, the birth of the universe, superconductors and life itself. And in a world full of its own delights, mysteries and surprises, he searches for Schrodinger's Cat - a search for quantum reality - as he brings every reader to a clear understanding of the most important area of scientific study today - quantum physics. *In Search of Schrodinger's Cat* is a fascinating and delightful introduction to the strange world of the quantum - an essential element in understanding today's world.

The 20th century gave us two great theories of physics: the general theory of relativity, which describes the behaviour of things on a very large scale, including the entire Universe; and quantum theory, which describes the behaviour of things on a very small scale, the sub-atomic world. The refusal of the Universe to reveal an equation that combines these two great ideas has caused some people to doubt our whole understanding of physics. In this landmark new book, popular science master John Gribbin tells the dramatic story of the quest that has led us to discover the true age of the Universe (13.8 billion years) and the stars (just a little bit younger). This discovery, Gribbin argues, is one of humankind's greatest achievements and shows us that physics is on the right track to finding the 'Theory of Everything'. 13.8 provides an eye-opening look at this cutting-edge area of modern cosmology and physics, and tells the compelling story of what modern science has achieved - and what it can still achieve.

A concise and engaging investigation of six interpretations of quantum physics. Rules of the quantum world seem to say that a cat can be both alive and dead at the same time and a particle can be in two places at once. And that particle is also a wave; everything in the quantum world can be described in terms of waves—or entirely in terms of particles. These interpretations were all established by the end of the 1920s, by Erwin Schrödinger, Werner Heisenberg, Paul Dirac, and others. But no one has yet come up with a common sense explanation of what is going on. In this concise and engaging book, astrophysicist John Gribbin offers an overview of six of the leading interpretations of quantum mechanics. Gribbin calls his account “agnostic,” explaining that none of these interpretations is any better—or any worse—than any of the others. Gribbin presents the Copenhagen Interpretation, promoted by Niels Bohr and named by Heisenberg; the Pilot-Wave Interpretation, developed by Louis de Broglie; the Many Worlds Interpretation (termed “excess baggage” by Gribbin); the Decoherence Interpretation (“incoherent”); the Ensemble “Non-Interpretation”; and the Timeless Transactional Interpretation (which theorized waves going both forward and backward in time). All of these interpretations are crazy, Gribbin warns, and some are more crazy than others—but in the quantum world, being more crazy does not necessarily mean more wrong.

Introduction to Protein Science provides a broad introduction to the contemporary study of proteins in health and disease, suitable for students on biological, biochemical, and biomedical degrees internationally. The book relates the study of proteins to the context of modern high-throughput data streams of genomics and proteomics.

No one is more successful than this author when it comes to making the cutting edge of physics more accessible to a broad lay audience. In *Schrodinger's Kittens*, he took readers to the eerie world of subatomic particles & waves. Now, he explores the most exciting area of research in physics today: string theory. Following a series of major breakthroughs in the 1990s, physicists are putting together a clearer picture of how subatomic particles work. By hypothesizing particles as a single loop of vibrating "string," they are on the brink of discovering a way to explain all of nature's forces in a single theory. Grandly named "superstrings," & incorporating the ideas of "supersymmetry," these models are the prime candidate for the long sought-for "Theory of Everything." Written in clear & accessible language. *The Search for Superstrings, Symmetry, & the Theory of Everything* brings to life the remarkable scientific research that is on the cusp of radically altering our conception of the universe.

FIASCO is the shocking story of one man's education in the jungles of Wall Street. As a young derivatives salesman at Morgan Stanley, Frank Partnoy learned to buy and sell billions of dollars worth of securities that were so complex many traders themselves didn't understand them. In his behind-the-scenes look at the trading floor and the offices of one of the world's top investment firms, Partnoy recounts the macho attitudes and fiercely competitive ploys of his office mates. And he takes us to the annual drunken skeet-shooting competition, FIASCO, where he and his colleagues sharpen the killer instincts they are encouraged to use against their competitors, their clients, and each other. FIASCO is the first book to take on the derivatives trading industry, the most highly charged and risky sector of the stock market. More importantly, it is a blistering indictment of the largely unregulated market in derivatives and serves as a warning to unwary investors about real fiascos, which have cost billions of dollars.

"In this ground-breaking and provocative new book Gribbin argues that we owe our existence to the impact of a 'supercomet' with Venus 600 million years ago. But this is only part of the story, just one of the astronomical and geophysical reasons why Earth is special. For the first time, he makes the link between the whole series of cosmic events that have affected the Earth and given rise to our intelligent civilization - a civilization, Gribbin argues, that is unique within our Milky Way Galaxy. Even if other Earths are common, and life itself may be common, the kind of intelligent, technological civilization that has emerged on Earth occurs only here. If humankind can survive the present environmental crises, the whole of the galaxy may become our home. And if not, our demise may be an event of literally universal significance"--Publisher's description.

The story of two brilliant nineteenth-century scientists who discovered the electromagnetic field, laying the groundwork for the amazing technological and theoretical breakthroughs of the twentieth century. Two of the boldest and most creative scientists of all time were Michael Faraday (1791-1867) and James Clerk Maxwell (1831-1879). This is the story of how these two men - separated in age by forty years - discovered the existence of the electromagnetic field and devised a radically new theory which overturned the strictly mechanical view of the world that had prevailed since Newton's time. The authors, veteran science writers with special expertise in physics and engineering, have created a lively narrative that interweaves rich biographical detail from each man's life with clear explanations of their scientific

accomplishments. Faraday was an autodidact, who overcame class prejudice and a lack of mathematical training to become renowned for his acute powers of experimental observation, technological skills, and prodigious scientific imagination. James Clerk Maxwell was highly regarded as one of the most brilliant mathematical physicists of the age. He made an enormous number of advances in his own right. But when he translated Faraday's ideas into mathematical language, thus creating field theory, this unified framework of electricity, magnetism and light became the basis for much of later, 20th-century physics. Faraday's and Maxwell's collaborative efforts gave rise to many of the technological innovations we take for granted today - from electric power generation to television, and much more. Told with panache, warmth, and clarity, this captivating story of their greatest work - in which each played an equal part - and their inspiring lives will bring new appreciation to these giants of science.

The world around us seems to be a complex place. But, as John Gribbin explains, chaos and complexity obey simple laws - essentially, the same straightforward principles that Isaac Newton discovered more than 300 years ago.

A wonderfully readable account of scientific development over the past 7ve hundred years, focusing on the lives and achievements of individual scientists, by the bestselling author of *In Search of Schrödinger's Cat* In this ambitious new book, John Gribbin tells the stories of the people who have made science, and of the times in which they lived and worked. He begins with Copernicus, during the Renaissance, when science replaced mysticism as a means of explaining the workings of the world, and he continues through the centuries, creating an unbroken genealogy of not only the greatest but also the more obscure names of Western science, a dot-to-dot line linking amateur to genius, and accidental discovery to brilliant deduction. By focusing on the scientists themselves, Gribbin has written an anecdotal narrative enlivened with stories of personal drama, success and failure. A bestselling science writer with an international reputation, Gribbin is among the few authors who could even attempt a work of this magnitude. Praised as "a sequence of witty, information-packed tales" and "a terrific read" by *The Times* upon its recent British publication, *The Scientists* breathes new life into such venerable icons as Galileo, Isaac Newton, Albert Einstein and Linus Pauling, as well as lesser lights whose stories have been undeservedly neglected. Filled with pioneers, visionaries, eccentrics and madmen, this is the history of science as it has never been told before.

A paperback edition of a best-selling tour of the cutthroat world of Wall Street derivatives in the 1990s features a new epilogue and tracks the author's experiences as a successful young Morgan Stanley employee, in an account that traces the period's speculative frenzies and the ways in which they directly contributed to highly publicized losses. Reprint.

'Gribbin takes us through the basics with his customary talent for accessibility and clarity' *Sunday Times* The world around us can be a complex, confusing place. Earthquakes happen without warning, stock markets fluctuate, weather forecasters seldom seem to get it right - even other people continue to baffle us. How do we make sense of it all? In fact, John Gribbin reveals, our seemingly random universe is actually built on simple laws of cause and effect that can explain why, for example, just one vehicle braking can cause a traffic jam; why wild storms result from a slight atmospheric change; even how we evolved from the most basic materials. Like a zen painting, a fractal image or the pattern on a butterfly's wings, simple elements form the bedrock of a sophisticated whole. Synthesizing chaos and complexity theory for the perplexed, *Deep Simplicity* brilliantly illuminates the harmony underlying our existence.

In the ultimate guide to the ultimate mystery--the quantum world--an award-winning scientist and a master of popular science writing explains recent breakthroughs and the wondrous possibilities that lie in the future. Illustrations throughout.

The 1980s witnessed a lemming-like rush into the sea of debt on the part of the American industrial and financial communities, with consequences we are only beginning to appreciate. But the speculative frenzy of the eighties didn't just happen. It was the culmination of a long cycle of slow relaxation of credit practices--the subject of James Grant's brilliant, clear-eyed history of American finance. Two long-running trends converged in the 1980s to create one of our greatest speculative booms: the democratization of credit and the socialization of risk. At the turn of the century, it was almost impossible for the average working person to get a loan. In the 1980s, it was almost impossible to refuse one. As the pace of lending grew, the government undertook to bear more and more of the creditors' risk--a pattern, begun in the Progressive era, which reached full flower in the "conservative" administration of Ronald Reagan. Based on original scholarship as well as firsthand observation, Grant's book puts our recent love affair with debt in an entirely fresh, often chilling, perspective. The result is required--and wickedly entertaining--reading for everyone who wants or needs to understand how the world really works. "A brilliantly eccentric, kaleidoscopic tour of our credit lunacy. . . . A splendid, tooth-gnashing saga that should be savored for its ghoulish humor and passionately debated for its iconoclastic analysis. It is a fitting epitaph to the credit binge of the '80s."--Ron Chernow, *The Wall Street Journal*.

In this candid and witty autobiography, Nobel laureate Herbert A. Simon looks at his distinguished and varied career, continually asking himself whether (and how) what he learned as a scientist helps to explain other aspects of his life. A brilliant polymath in an age of increasing specialization, Simon is one of those rare scholars whose work defines fields of inquiry. Crossing disciplinary lines in half a dozen fields, Simon's story encompasses an explosion in the information sciences, the transformation of psychology by the information-processing paradigm, and the use of computer simulation for modeling the behavior of highly complex systems. Simon's theory of bounded rationality led to a Nobel Prize in economics, and his work on building machines that think—based on the notion that human intelligence is the rule-governed manipulation of symbols—laid conceptual foundations for the new cognitive science. Subsequently, contrasting metaphors of the maze (Simon's view) and of the mind (neural nets) have dominated the artificial intelligence debate. There is also a warm account of his successful marriage and of an unconsummated love affair, letters to his children, columns, a short story, and political and personal intrigue in academe.

Deep Simplicity: Bringing Order to Chaos and Complexity Random House

"John and Mary Gribbin tell the remarkable story of how we came to understand the phenomenon of Ice Ages, focusing on the key personalities obsessed with the search for answers. How frequently do Ice Ages occur? How do astronomical rhythms affect the Earth's climate? Have there always been two polar ice caps? Is it true that tiny changes in the heat balance of the Earth could plunge us back into full Ice Age conditions? With startling new material on how the last major Ice Epoch could have hastened human evolution, *Ice Age* explains why the Earth was once covered in ice - and how that made us human."--BOOK JACKET.

But the sensitive way in which systems respond to those basic laws, combined with feedback, can explain why, for example, just one vehicle braking on a motorway can cause a traffic jam; how a tiny genetic mutation or environmental change may make a species develop in a wholly different way.

Reality as we know it is bound by a set of constants—numbers and values that dictate the strengths of forces like gravity, the speed of light, and the masses of elementary particles. In *The Constants of Nature*, Cambridge Professor and bestselling author John D. Barrow takes us on an exploration of these governing principles. Drawing on physicists such as Einstein and Planck, Barrow illustrates with stunning clarity our dependence on the steadfastness of these principles. But he also suggests that the basic forces may have been radically different during the universe's infancy, and suggests that they may continue a deeply hidden evolution. Perhaps most tantalizingly, Barrow theorizes about the realities that might one day be found in a universe with different parameters than our own.

The Universe: A Biography makes cosmology accessible to everyone. John Gribbin navigates the latest frontiers of scientific discovery to tell us what we really know about the history of the universe. Along the way, he describes how the universe began; what the early universe looked like; how its structure developed; and what emerged to hold it all together. He describes where the elements came from; how stars and galaxies formed; and the story of how life emerged. He even looks to the future: is the history of the universe going to end with a Big Crunch or a Big Rip?

The acclaimed author of *In Search of Schrödinger's Cat* searches for life on other planets. Are we alone in the universe? Surely amidst the immensity of the cosmos there must be other intelligent life out there. Don't be so sure, says John Gribbin, one of today's best popular science writers. In this fascinating and intriguing new book, Gribbin argues that the very existence of intelligent life anywhere in the cosmos is, from an astrophysicist's point of view, a miracle. So why is there life on Earth and (seemingly) nowhere else? What happened to make this planet special? Taking us back some 600 million years, Gribbin lets you experience the series of unique cosmic events that were responsible for our unique form of life within the Milky Way Galaxy. Written by one of our foremost popular science writers, author of the bestselling *In Search of Schrödinger's Cat* Offers a bold answer to the eternal question, "Are we alone in the universe?" Explores how the impact of a "supercomet" with Venus 600 million years ago created our moon, and along with it, the perfect conditions for life on Earth From one of our most talented science writers, this book is a daring, fascinating exploration into the dawning of the universe, cosmic collisions and their consequences, and the uniqueness of life on Earth.

Over the past two decades, no field of scientific inquiry has had a more striking impact across a wide array of disciplines—from biology to physics, computing to meteorology—than that known as chaos and complexity, the study of complex systems. Now astrophysicist John Gribbin draws on his expertise to explore, in prose that communicates not only the wonder but the substance of cutting-edge science, the principles behind chaos and complexity. He reveals the remarkable ways these two revolutionary theories have been applied over the last twenty years to explain all sorts of phenomena—from weather patterns to mass extinctions. Grounding these paradigm-shifting ideas in their historical context, Gribbin also traces their development from Newton to Darwin to Lorenz, Prigogine, and Lovelock, demonstrating how—far from overturning all that has gone before—chaos and complexity are the triumphant extensions of simple scientific laws. Ultimately, Gribbin illustrates how chaos and complexity permeate the universe on every scale, governing the evolution of life and galaxies alike.

We once had to abandon the idea of earth being at the centre of the universe. Now, we need to confront an even more profound possibility: the universe itself might just be one universe among many. *In Search of the Multiverse* takes us on an extraordinary journey, examining the most fundamental questions in science. What are the boundaries of our universe? Can there be different physical laws from the ones we know? Are there in fact other universes? Do we really live in a multiverse? This book is a search – the ultimate search – exploring the frontiers of reality. Ideas that were once science fiction have now come to dominate modern physics. And, as John Gribbin shows, there is increasing evidence that there really is more to the universe than we can see. Gribbin guides us through the different competing theories (there is more than one multiverse!) revealing what they have in common and what we can come to expect. He gives a brilliant tour of the current state of cosmology. John Gribbin is our best, most accessible guide to the big questions of science. And there is no bigger question than our search for the multiverse.

Presents an introduction to astronomy, including the planets, stars, galaxies, and the field of cosmology.

"Delightful, funny, and yet rigorous and intelligent: only Jorge and Daniel can reach this exquisite balance." —Carlo Rovelli, author of *Seven Brief Lessons on Physics* and *Helgoland* You've got questions: about space, time, gravity, and the odds of meeting your older self inside a wormhole. All the answers you need are right here. As a species, we may not agree on much, but one thing brings us all together: a need to know. We all wonder, and deep down we all have the same big questions. Why can't I travel back in time? Where did the universe come from? What's inside a black hole? Can I rearrange the particles in my cat and turn it into a dog? Researcher-turned-cartoonist Jorge Cham and physics professor Daniel Whiteson are experts at explaining science in ways we can all understand, in their books and on their popular podcast, *Daniel and Jorge Explain the Universe*. With their signature blend of humor and oh-now-I-get-it clarity, Jorge and Daniel offer short, accessible, and lighthearted answers to some of the most common, most outrageous, and most profound questions about the universe they've received. This witty, entertaining, and fully illustrated book is an essential troubleshooting guide for the perplexing aspects of reality, big and small, from the invisible particles that make up your body to the identical version of you currently reading this exact sentence in the corner of some other galaxy. If the universe came with an FAQ, this would be it.

John Gribbin, author of *Six Impossible Things*, shortlisted for the Royal Society Insight Investment Science Book Prize, presents a tour of seven fundamental scientific truths that underpin our very existence. These 'pillars of science' also defy common sense. For example, solid things are mostly empty space, so how do they hold together? There appears to be no special 'life force', so how do we distinguish living things from inanimate objects? And why does ice float on water, when most solids don't? You might think that question hardly needs asking, and yet if ice didn't float, life on Earth would never have happened. The answers to all of these questions were sensational in their day, and some still are. Throughout history, science has been able to think the unthinkable – and Gribbin brilliantly shows the surprising secrets on which our understanding of life is based.

A mind-blowing glimpse into the near future, where quantum computing will have world-transforming effects. The quantum computer is no longer the stuff of science fiction. Pioneering physicists are on the brink of unlocking a new quantum universe which provides a better representation of reality than our everyday experiences and common sense ever could. The birth of quantum computers - which, like Schrödinger's famous "dead and alive" cat, rely on entities like electrons, photons, or atoms existing in two states at the same time - is set to turn the computing world on its head. In his fascinating study of this cutting-edge technology, John Gribbin updates his previous views on the nature of

quantum reality, arguing for a universe of many parallel worlds where "everything is real." Looking back to Alan Turing's work on the Enigma machine and the first electronic computer, Gribbin explains how quantum theory developed to make quantum computers work in practice as well as in principle. He takes us beyond the arena of theoretical physics to explore their practical applications - from machines which learn through "intuition" and trial and error to unhackable laptops and smartphones. And he investigates the potential for this extraordinary science to create a world where communication occurs faster than light and teleportation is possible. This is an exciting insider's look at the new frontier of computer science and its revolutionary implications.

This book : "outlines the key concepts forming the core of each major branch of science, and how they were developed ; reviews the achievements of all the major figures in the history of modern science from Galileo onward ; explains the ideas that upset our 'common sense' view of reality, from the weird behaviour of fundamental particles to the vastness of the universe ; explores the cultural consequences of scientific discoveries and ideas ; reveals science for what it really is - a relentless curiosity born out of mystery and wonder." -- back cover.

[Copyright: 57ee0c6c8f66595c9fcb683dd1d3e83b](#)