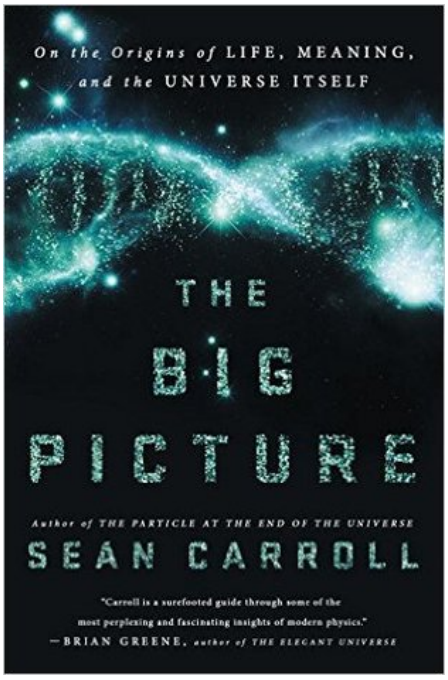

The Big Picture: On the Origins of Life, Meaning, and the Universe Itself

Sean Carroll

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The Big Picture: On the Origins of Life, Meaning, and the Universe Itself Sean Carroll
INSTANT *NEW YORK TIMES* BESTSELLER
"Vivid . . . impressive. . . . Splendidly informative."—*The New York Times*
" Succeeds spectacularly."—*Science*
"A tour de force."—*Salon*

Already internationally acclaimed for his elegant, lucid writing on the most challenging notions in modern physics, Sean Carroll is emerging as one of the greatest humanist thinkers of his generation as he brings his extraordinary intellect to bear not only on Higgs bosons and extra dimensions but now also on our deepest personal questions: Where are we? Who are we? Are our emotions, our beliefs, and our hopes and dreams ultimately meaningless out there in the void? Do human purpose and meaning fit into a scientific worldview?

In short chapters filled with intriguing historical anecdotes, personal asides, and rigorous exposition, readers learn the difference between how the world works at the quantum level, the cosmic level, and the human level—and then how each connects to the other. Carroll's presentation of the principles that have guided the scientific revolution from Darwin and Einstein to the origins of life, consciousness, and the universe is dazzlingly unique.

Carroll shows how an avalanche of discoveries in the past few hundred years has changed our world and what really matters to us. Our lives are dwarfed like never before by the immensity of space and time, but they are redeemed by our capacity to comprehend it and give it meaning.

The Big Picture is an unprecedented scientific worldview, a tour de force that will sit on shelves alongside the works of Stephen Hawking, Carl Sagan, Daniel Dennett, and E. O. Wilson for years to come.

The Big Picture: On the Origins of Life, Meaning, and the Universe Itself Details

Date	:	Published May 10th 2016 by Penguin Group (USA) LLC
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Itself Sean Carroll

From Reader Review The Big Picture: On the Origins of Life, Meaning, and the Universe Itself for online ebook

Book Riot Community says

When I started reading The Big Picture I assumed it would be about cosmology. Sean Carroll is a cosmologist and physicist at the California Institute of Technology, and his previous books dealt with that subject. Carroll's new book is about an even bigger topic – everything. What Carroll attempts to do is give the big picture of our existence, and he does a fine job. He combines science, philosophy, religion, psychology and other subjects, to show why no one explanation works. There can be no general theory of everything. Carroll explains how our understanding of how things functions depends on the domain of what we're describing. So, explanations of the unseen world quantum mechanics do not explain everyday human behavior. This book is for anyone who asks why.

– James Wallace Harris

from The Best Books We Read In October 2016: http://bookriot.com/2016/10/31/riot-r...

Dannii Elle says

I received this on a read to review basis from NetGalley. Thank you to the author, Sean Carroll, and the publisher, Dutton, for the opportunity.

A brief overview of this fascinating non-fiction can be written no more aptly than in the synopsis itself - "In short chapters filled with intriguing historical anecdotes, personal asides, and rigorous exposition, readers learn the difference between how the world works at the quantum level, the cosmic level, and the human level--and then how each connects to the other."

The extensive research and knowledge put into this book is unparalleled to anything I have read before. This could very easily have become a dense and 'stodgy' feeling read, but the light, conversational tone led this to become, instead, a fascinating and understandable insight into the physics underlying the universe, the world and ourselves. The subject matter is dense and complex but it is approached using comprehensible anecdotes, simple analogies and a breaking down of the scientific laws to a layman's level.

I found this was also a wonderful subjective and psychological insight into how human beings assign ourselves an importance, despite the briefness in the longevity of our existence, and attempt to bring order and understanding to the chaotic and incomprehensible laws of the universe.

Atila Iamarino says

Por onde começar? Escolhi o Big Picture por ser um dos livros mais vendidos do ano passado. E foi bem fácil entender o porquê. Este é aquele livro gigante sobre ciência que posso recomendar para qualquer um.

Os capítulos passam por como entendemos o Universo e o que é o tempo, como a ciência entende o mundo, o que é a física quântica e o que ela descreve, o surgimento da vida e de complexidade, o surgimento de mentes e da consciência, para terminar com uma reflexão sobre a vida.

É um livro muito bem escrito, fácil de entender e que abrange muita ciência, do Big Bang aos tempos atuais, da escala das cordas e interações que formam os átomos ao multiverso. É uma obra excelente para quem quer entender sobre ciência, universo ou mesmo como pensamos. Coloco na mesma categoria que o Breve História de Quase Tudo, um livro de ciência geral para todo mundo, de quem não entende nada a cientistas.

Dave Ciskowski says

A disappointing book; despite its potential, I can't recommend it. Carroll's tenet — the idea he calls "poetic naturalism" — is appealing to me and would be worthy of a good exploration. Unfortunately, Carroll spends most of his time exploring the "naturalism" side of his philosophy, which amounts to knocking over cardboard opponents. The early phases of the book (where Carroll is on his most certain scientific ground) read as an interesting tour of the current state of cosmology and the Standard Model, and why they leave no room for non-physical influences. It's no accident that the firmest parts of his argument are where he's essentially focused on the 'naturalism' side of 'poetic naturalism'. I was intensely interested in the later sections, where Carroll tackles more complex phenomena such as consciousness, intelligence, free will, and ethics. Sadly, these chapters are far less illuminating, as he basically spends them in tiresome arguments against dualism — neither philosophically interesting nor rhetorically convincing.

One example, just because it's near to my heart. Carroll spends most of a chapter attacking John Searle's Chinese Room argument. The issue isn't necessarily the argument itself — though Carroll treads no new ground there. The problem is that he spends his time criticizing a view that Searle did not hold (property dualism) and in so doing, attacks the Chinese Room in its weakest and least interesting form. Whether or not Searle is right, the interesting question that he raises — whether a computer program of sufficient complexity would be necessarily conscious — is left unaddressed by Carroll. It's exactly these questions that "poetic naturalism" could have had the most interesting insights to offer; instead, Carroll knocks over yet another straw man on his march to conclude his exercise.

The later sections, dealing with how we can develop ethics and meaning from a purely physical world, are well-written as articulations of his personal ethos, and I appreciated his enthusiasm. Yet I did not find any fresh insight or new perspective here either. Perhaps another reader, struggling with these questions, would take inspiration from them — they truly are movingly written. But I wasn't that reader.

These are difficult questions and I certainly wouldn't fault Carroll for not having answers for them. But he doesn't even fully engage with the questions. A book-length argument for naturalism doesn't say anything useful: those who agree with him won't find much new to consider, and those who disagree won't abandon their faith. If he had more to say for the poetic side of his account — how multiple levels of theory and examination are necessary for explaining the world we inhabit — I'd be much happier with the book. I'd love to have a beer with Carroll and get his thoughts on these more interesting questions; my guess is that he feels on less firm ground here and didn't want to risk a more ambitious discussion. The reader, though, suffers as a result.

Charlene says

After having a countdown for this book, which spanned months, I woke up at 5 am on May 10th and thought, "It's finally here!" I opened my Audible library and it was better than Christmas. In the quiet of the morning, I began to listen to this deeply philosophical book and immediately fell in love with it. It felt like a Poetic Naturalist's version of Christmas- material gifts replaced by the gift of trying to understand the nature of our vast universe and the world in which we live.

Those who have wanted to read Sean Carroll but didn't want to wade through the science will be happy with this book. In the spirit of Alexander von Humboldt, Carroll tucks much of the complex science away in an appendix for those who would like more detail. But, that doesn't mean this book is light on the science. To the contrary, Carroll, as usual, takes some of the most complex issues science has to offer, and packages them in a form that even people with little or no scientific background can understand. In fact, this book in particular is aimed at those who might have little education in the sciences and and even less education about heuristics. It welcomes everyone to join in a thoughtful conversation about understanding what we know about our world and the wider universe. Does it have a purpose? Does its design imply any type of creator? Instead of insulting those who say that it does (I am guilty of this myself), Carroll provided a real way to put our beliefs to the test. He was very willing to consider the views of those who believe in God and provide a detailed method, which is both kind and built on logic, that can help us figure out whether a belief is true.

If the preceding paragraph suggests to you that those with extensive education in the sciences (including cognitive science) will be bored or find nothing new, then I have represented the book poorly. Even people whose undergrad and grad career consisted of many of the following courses will find new ways of thinking about that information and connecting it to the Big Picture.

Samples of related course material:

Intro to Cognitive Science (including Kahneman's heuristics)
Cognitive Neuroscience
Biochem (including chemiosmosis)
Evolution (including environmental modification of genes)
Origin of life research (including Martin, Russell, and Lane's work on bioenergetics and others working on RNA world)
Philosophy of Mind

Carroll opened the door for *everyone* to think about and discuss what evidence we would need for any belief to be validated. Instead of dismissing ideas of belief outright, Carroll employs a very gentle, yet fiercely logical style of problem solving. The result was powerful and reminded me of the deep humility and unfailing logic with which Darwin wrote his many books, including his autobiography.

Prior to this book, if anyone had asked me if I wanted to read yet another book on creationism vs. science or the hard problem of consciousness (involving Chalmers unrealistic and pseudoscientific zombies), the answer would have been a resounding, "NO!" I feel as if too much of my thinking time has been wasted by these concepts that serve only to anchor our progress. I want to push past all of that. I want to never again allow that type of scientific sabotage to ruin the progress I might make in understanding the universe in a real and more complete way than my current view allows. Often reading about the efforts of those who wage war on evidence based knowledge leaves me frustrated, often wishing I could get that time back. That was not the case with this book. The whole time, even though I was reading things I thought I was tired of reading,

my neurons were flooding my brain with wonderful dopamine bursts. Reflexive "Wows" kept reverberating from my brain. The book fits into the category "MINDGASM!"

In a book, which includes such topics as:

how we know what we know
the forces that govern the universe
properties of elements in relation to other elements
quantum mechanics
emergence and complexity
how we gather and evaluate scientific evidence

Carroll, in his usual relatable fashion, seamlessly included discussions about today's relevant issues in society such as transgender rights, marriage equality. I recall reading E.O. Wilson's book Social Conquest Of Earth and feeling somewhat confused about the organization of the book. He kept social issues separate throughout the book and then bombarded the reader with a litany of important social issues. I love both Wilson and his book, but the social issues didn't fit and felt as if they should be in another book. Carroll's humorous (yet serious) approach when discussing such issues makes me feel as if I am reading a 20 something university student with his finger on the pulse of the upcoming generations, while at other times, when he is discussing concepts that take a long time to learn, I feel as if I am reading a book written by a scientifically minded Zarathustra. In a crazy way, this writing style really works.

Parts One, Two, and Three (the first half of the book) were basically an excellent summary of and entire 4 year experience as a major in Cognitive Science. After introducing such concepts as understanding cause and effect, understanding how things move and how momentum is conserved, and understanding how we come to adopt our belief systems, Carroll examined the many heuristics we employ when trying to understand how we know what we know. To figure this out, he introduced a sort of "best of" collection of thinkers. Marrying Cog Sci 101 (with a strong emphasis on Baysian reasoning) with Epistemology and Philosophy 101, he tried to understand what thinkers such as Descartes and Princess Elizabeth of Bohemia, and Kahneman thought about the nature of reality. The main questions scholars have been asking are, "How can I know what I know? How can I know what exists? How can I know if my beliefs reflect reality?" A take home point from Section Two is that people are all entitled to have their own prior beliefs. However, they are not entitled to have their own likelihood. There is an objective likelihood to be discovered, and it takes solid reasoning, and not tightly held belief, to make that discovery. **** see note at end.

While discussing heuristics, Carroll gave a shout out to one of my favorite books -- Mistakes Were Made, but Not by Me. I love that book and am often disappointed that not too many people I have talked to seem to appreciate it in the way I do. I love that it got the recognition it deserved. Many books like it are sort of self-help oriented and veer too far from the science. Many authors fail to question if they are using the very heuristics they are writing about. Still others fail to question the methods to the studies they choose to include, brining down the overall quality of the book. But, Tavris and Aronson did much better than most avoiding these pitfalls. They deserved some recognition, not from the self-help crowd, but rather from a scientists who is celebrated for his keen logic.

In Part 4, Carroll related a humorous story about ending up on a plane, seated next to origin of life researcher Mike Russel. That was a great lead in to explaining Darwinian evolution, cellular formation, emergence, complexity (his complexity research sounds great! I am definitely going to read everything I can get my hand on concerning that), and ATP synthase (my very favorite protein channel!). If you are a bit fuzzy about what Free Energy is, this section will clear that up and relate it to exactly how your very own body works. (What a

delicious section. I was too excited to see what came next. So I did not stop to listen again or take notes on this section. As soon as I am done writing this review, I am going to listen to this entire section again.)

Theodosius Dobzhansky said, “Nothing in Biology Makes Sense Except in the Light of Evolution”. Thanks to scientists such as Sean Carroll, Mike Russell, Jeremy England, and others bridging the gap between living and non living systems, it will soon be said that Nothing in Biology or the larger universe Makes Sense Except in the Light of Thermodynamics. If you want the best possible summary of how thermodynamics fits into the story of living systems (including how those systems likely came into being and how they evolved), then you will love this section.

In Part Five, Carroll took on the philosophy of mind debate. You may have taken courses or read extensively about The Chinese Room, Mary, What it's Like to Be a Bat, Eliminative Materialism, and The Hard Problem. Even if you are extremely familiar with all of this, I would recommend reading Carroll's summary. Wow! I was engaged in a way that surprised me. He breathed new life into these debates. I was a tiny bit sad that he left out Andy Clark's work (especially in relation to Chalmers), but considering this book was more than 17 hours long (Audible), I understand that he didn't have time for everything. It's just that Clark's work (along with the Churchland's work) is what made Philosophy of Mind so great for me.

Carroll ended the book with what I can only say was a beautiful essay I didn't know I needed to read. If you are unfamiliar with the Is vs Ought problem, you can find out in this section what it is and why should you care. If you are well familiar with this question, you will enjoy the discussion provided on Carroll about morality. Deeply satisfying! A+! He ended on a more personal note than any thing I have read by him to date. It was truly a lovely book, from start to finish.

I think Carroll will be remembered along side of Copernicus and Darwin for providing us with gentle but clear evidence that we are not special. Far from being a depressing nihilistic view of the world and universe, Carroll showed his reader (even if you read with your ears) how reality is actually more special than any false belief about being special. Understanding can be the deepest religion of all (idk if Carroll would put it quite like that, but it's my takeaway message).

****I was going to include in this review a bit about Sean Carroll's "planet v black hole belief system," but I posted about it on Facebook and butchered what was an excellent analogy. I can only say that you need to read it for yourself. If you get the analogy, you will forever ask yourself, "Am I being a black hole right now? "Am I following the evidence or am I fooling myself and holding tight to heuristically driven fallacies?" I can see a new viral way of thinking springing from this analogy -- e.g. insults or memes that include the statement, "Stop being such a black hole!"

Mark says

Can meaning and purpose be found and explained within a non-theistic (vs. an atheistic - related, but different) worldview? Sean Carroll argues that not only is it possible, but the only reasonable perspective. He creates a new paradigm, which he calls *poetic naturalism* to explain how he joins science, philosophy, and a naturalistic worldview with one that also allows for wonder, mystery, joy, purpose, and meaning in life.

Poetic naturalism contends that we have different ways of talking about reality depending on scope and

context. We use different vocabularies when we talk about stuff at the quantum level than we do at the level of a complete human organism. We use different vocabularies when we move on to the universe and the cosmos. *Poetic naturalism* borrows the language of poetry to tell different stories at each different level. Each story makes sense and is meaningful within proper contexts. The problem that often occurs in discourse about naturalism, science, worldviews, philosophy, and life is that words used in one domain don't mean the same thing when used in another.

Carroll argues that even though at the atomic level, discussion of meaning and purpose makes no sense, at increasingly more macro levels meaning and purpose become increasingly emergent. We can talk about purpose of simple organisms; we can talk about purpose of more complex ones; and we can finally talk about purpose at the human level. We use the same word, yet at each level the semantics are different.

In this book Carroll provides evidence and argument against any kind of outside force or influence being involved in the universe as we currently observe and know. He provides comprehensive arguments against commonly used theistic arguments in favor of Creationism (of any kind) - this includes the "watchmaker" argument, intelligent design, and more.

This book is for the mainstream public, but I think understanding it is easier if the reader is already familiar with physics, quantum physics, astrophysics, cosmology, higher mathematics, biology, neuroscience, philosophy, and religion.

I think it is important for theists to examine the arguments and reasoning found in this book. They may discover that what they've assumed about arguments for theism aren't nearly as strong as they've thought. Or that non-theists possibly can't have meaning, purpose, ethics, or morals is a myth; and conversely that belief in God is required for ethics and morals. They may also discover that what they've been taught about science and naturalism looks quite a bit different than what it actually looks like within today's scientific theories.

For naturalists Carroll provides avenues for more nuanced dialogue about science and how it shapes their worldview. It elevates storytelling as a more effective means of communication than a mere offering of raw data, facts and theories. He provides common ground in which all can strive to work toward a better world.

(This review based on ARC provided by the publisher through NetGalley.)

Whitney Milam says

I finally have a term to sum up my own personal philosophy toward life (which was certainly deepened and expanded by reading this book): poetic naturalism.

Manny says

[A cloud in Heaven. PLATO, LUCRETIUS, HUME, LAPLACE, DARWIN, THE REV BAYES and sundry others]

PLATO: Meeting to order. Manny has asked us to review Sean Carroll's new book. I trust you've all read it?

LUCRETIUS: Say, how come we're writing this for him? What's going on, Plato?

PLATO: I owe Manny a little favor. Fellow-seekers after wisdom, we have eternity ahead of us. This won't take more than an aeon or two. Who's first?

LUCRETIUS: Okay, I didn't like it much.

PLATO: Would you care to elaborate, dear Lucretius?

LUCRETIUS: Well, it's a cheap rip-off of *De Rerum Natura*.

HUME: Modest as ever, I see.

LUCRETIUS: Look, he's just updating my formula! Fear not the Gods, fear not death, there is nothing but atoms and void--

LAPLACE: Quantum fields.

LUCRETIUS: Whatever. He's done a good job on the philosophy, I grant you that. But come on guys, he calls it "poetic naturalism" and where's the poetry in his book?

LAPLACE: Where's the naturalism in yours?

HUME: Touché!

LUCRETIUS: Now Pierre-Simon, you know that's not fair. I was writing in the first century B.C.

LAPLACE: Well, you could have read Aristarchus. Or at least Hipparchus. Sean's naturalism is state of the art.

[General murmurs of approval]

PLATO: With all due respect, brother Lucretius, I think Pierre-Simon makes a fair point. If one wishes to defend naturalism, an understanding of nature is required. It is evident that Sean understands these -- ah -- quantum fields very well. And he has a gift for explaining them.

LUCRETIUS: But the hexameters--

PLATO: Sean maybe lacks a feeling for the poetics of words. But he sees the poetics of geometry.

LAPLACE: I enjoyed his geometric demonstration that there can be no occult forces.

PLATO: Yes, his use of the -- what was it called? --

LAPLACE: Feynman diagram.

PLATO: That was it. By turning the Feynman diagram through a right-angle, we see that all forces must already have revealed themselves. Very elegant. I must remember to show it to Eudoxus. Now, who else has comments?

THE REV BAYES: It is unworthy of me to say this, but I was touched that he believed more in my little rule than in God.

LAPLACE: You did well there, Tom.

THE REV BAYES: Perhaps too well. I fear people like Sean may be disappointed when they find out that--

ALL: Shhh!

THE REV BAYES: I'm sorry, I forgot we were still live. Charles, you look like you want to say something?

DARWIN: Well, I was also flattered that he took me so seriously. But remember, I always left open the question of how life originated. That "warm little pond"--

HUME: It's true, I did feel at times that Sean's protestations of rigorous scepticism were not entirely justified. I liked the kind things he said about me too. Though when he told us he was certain that science would soon understand the emergence of life, it almost sounded like--

THE REV BAYES: Faith? There's nothing wrong with that, you know.

HUME: Yes, but he says science *isn't* faith. I'd have felt reassured if he'd quoted Iris Fry's book. There's a woman after my own heart. But she's not even mentioned.

WEYL: And the same story with the universe's low initial entropy. I wasn't afraid to compare it to a miracle in *my* book. But despite the fact that Sean constantly refers to the Past Condition, there's hardly a word about *why* the world might have started in this extraordinary state.

PLATO: Gentlemen, gentlemen, please! Remember, it's easy for us to nitpick. Sean's just mortal.

DARWIN: True. Well, he's better than Richard Dawkins.

VOLTAIRE: And Christopher Hitchens.

WEYL: And Victor Stenger.

THE REV BAYES: Not to mention A.C. Grayling.

[Elaborate facepalm from VOLTAIRE]

PLATO: So, all in all, we don't think he's so bad.

LUCRETIUS: No, no, his heart's in the right place. As Pierre-Simon said, he does a good job of explaining the atoms and void.

LAPLACE: Quantum fields.

LUCRETIUS: Whatever. I still can't forgive him for taking out my hexameters. But maybe that's just me.

PLATO: Thank you Lucretius. Then, I hope that--

HUME: Wait! If Sean's correct about the finality of death, then what are we all doing here?

[A moment of general consternation]

WITTGENSTEIN: Relax, everyone. We're only a figure of speech.

PLATO: Ludwig, I don't know what we'd do without you. So, we're giving him a pass? All those in favor--

EVERYONE EXCEPT HUME: Aye. Aye. Aye

HUME: With the caveats already mentioned.

PLATO: Duly noted, David. Now thank you again, gentlemen, you've all been very kind. The first round of ambrosia is on me.

Max says

Physicist Sean Carroll goes well beyond the ordinary bounds of his discipline in this wide ranging exposition. He begins with ontology, the fundamental nature of everything, and ends with how humans can derive meaning living in a world that is not transcendent. Along the way we get explanations of quantum field theory, quantum mechanics, entropy, Bayes Theorem, abiogenesis, evolution and consciousness. Much of the material does not represent new thinking, but one discussion stood out to me.

In his excellent book, *From Eternity to Here*, Carroll explored the relationship between entropy and time in detail. Carroll shares his expertise in entropy in this volume. How does one explain the emergence of complex structures (planets, people, etc.) in a universe going from low to high entropy? He points out that these are vehicles for creating high entropy. They convert free (useful) energy to disordered (waste) energy. Whether through photosynthesis, fermentation or cellular respiration, living organisms are converting free energy from the sun to disordered energy in the ATP to ADP cycle they use for internal energy. As one of Carroll's associates put it, "The purpose of life is to hydrogenate carbon." This idea of life as a process tied to the universe's direction and fate through entropy was new to me. As Nobel Prize winner Albert Szent-Gyorgyi put it, "life is nothing but an electron looking for a place to rest". Life becomes a solution to the problem of liberating free energy, something the universe is hell-bent to do. Needless to say there are other ways to look at life.

Carroll proposes what he calls poetic naturalism, a scientific view of the world that is open to describing it on many levels at the same time. Thus we have the physicist's view of particles, forces and fields, but equally valid are operational views of emergent states. Human beings and human behavior are emergent states from the underlying physics. Biology and psychology provide objective views of emergent states while morality and esthetics provide subjective views. The fundamental reality of physics is not the reality we experience. Our conscious decision making and human relationships are best evaluated in their own terms. Every theory has its own domain of applicability. Thus mixing, for example, psychology and quantum mechanics in the same description is likely to lead to gobbledygook.

Throughout Carroll defends his views from the common attacks of religionists, creationists and others with supernatural beliefs. Unfortunately, these people are unlikely to read his book or be convinced by his

arguments. For those of us that accept science and nature as it is, this is space Carroll could have used for something more productive. For example, Carroll points to the conservation of momentum to explain that the universe does not need a mover. It operates on its own. I doubt this science based logic will change any minds.

Carroll covers a lot of ground presenting his poetic naturalist vision. He takes us from his home ground of physics to biology and even morality. I found little to disagree with but also little new with some notable exceptions such as the relationship between entropy and life. I am struck by the need of some brilliant people like Carroll (Richard Dawkins also comes to mind) to defend so hard against inane beliefs. It seems like a hopeless task, but it is understandable given the relentless attacks on science in America today. Carroll also clearly felt the need to show that one could have values, embrace morality and live a meaningful life without belief in the supernatural. I applaud him in that effort.

David says

This is a wonderful book about the meaning of our universe, and of life. Sean Carroll is an active theoretical physicist, and he brings some fresh new ideas to philosophy. He coins a new term, *Poetic Naturalism*. It stems from a quote by Muriel Rukeyser,

> The universe is made of stories, not atoms.

While naturalism is the idea that only natural laws and forces (not supernatural or spiritual) operate in the world, poetic naturalism says that the way we find meaning to life does not naturally emerge from a purely scientific approach. Poetic naturalism encourages extending discussions into what is right and wrong. It integrates scientific reasoning methods into our purpose-seeking and meaning-making, with emphasis on Bayesian techniques.

In 2003, a Dutch pediatric nurse was sentenced to life imprisonment for the murder of four children under her care. The case became a media sensation because, as it turned out, the case rested on the misuse of statistical reasoning. Infant mortality had actually been higher before she started working at the facility. The real cause of her conviction was psychological: People believe that infant deaths could not be random; someone must be to blame. Leibniz coined the *Principle of Sufficient Reason*: "For any true fact, there is a reason why it is so, and why something else is not so instead."

But this Principle of Sufficient Reason is not necessarily true. A cancer survivor sells empathy cards that read, "Please let me be the first to punch the next person who tells you that everything happens for a reason." And, by the way, I fully support the thought behind these cards!

Some things have reasons, while others do not. For example, the question, "Why is there an accordion in my bathtub" has a reason. But, "Why is a proton almost 2000 times more massive than an electron might not have a reason or an answer.

I rarely hear the true description of the big bang, but Sean Carroll writes that the big bang was a moment in time, *not* a location in space. It was not an explosion of matter into an empty void. It was the beginning of the entire universe, with matter smoothly distributed throughout space, all at once. The big bang really marks the end of our theoretical understanding. We understand what happened after it, but it is a label for a moment in time that we don't currently understand.

On Earth, there is an up and down. In space, all directions are equal. In the everyday world, time has a definite direction. But really, both directions in time are equal. It is just that we live in the aftermath of the big bang. Physical motions are reversible. Of course eggs break and never unbreak. The real question is why eggs were unbroken in the past. There is an interesting chapter on why we remember the past and not the future (very relevant to the recent movie, "Arrival"), that is why the arrow of time points toward the future. It is because of the increase in entropy since the big bang, and the second law of thermodynamics. There is a difference between reversible laws of physics and the concept of cause and effect. Laws of physics predict what will happen. They do not, however, dictate a cause as *responsible* for later events. Events are simply arranged in a certain order. No particular event is a cause.

Sean Carroll writes that it is okay to doubt everything. He writes about "planets of belief", which is a wonderful metaphor. Science does not presume naturalism. Science concludes that naturalism is the the best available picture of the world.

Sean Carroll wrote that no scientist working on the origin of life points to a particular process and says, "Here we need some supernatural intervention." And, some people say that evolution occurs too slowly for an experiment to observe. However, David Bartel and Jack Szostak performed an interesting experiment in 1993. They started with a random RNA molecule consisting of trillions of molecules in a random sequence of nucleotides. They picked out a fraction of them hat held higher rates of catalysis, and made copies of them. Random mutations occurred during copying. After ten iterations, the last pool of molecules was 3 million times better at catalyzing reactions than the original sample.

The key to life is the set of instructions for chemical reactions that gets copied. Mutations in the instructions allows life to evolve with natural selection. In an experiment in 1988, Richard Lenski grew E. coli bacteria in flasks, along with specific nutrients. Every day he managed six generations of the bacteria. Over time, over thousands of generations, the bacteria evolved to better use the nutrients in the flasks.

Michael Behe, a critic of natural selection, is an advocate of intelligent design. He introduced the concept of "irreducible complexity". And he used the example of a mousetrap. Every part of a mousetrap is essential; if any part is missing, it cannot work. However, Carroll points out that actual mousetraps were not designed overnight, but their design evolved over many years.

A very interesting part of the book discusses the so-called "Fine-Tuning" argument for theism. The argument states that since many of the fundamental physical constants seem to be finely tuned for the development for galaxies, stars, planets, and chemistry that can support life, there must be a creator who "designed" these constants for this purpose. Sean Carroll admits that fine-tuning is the best argument for God's existence. However, it is still not a very good argument. It uses what Carroll calls "old evidence." It uses evidence that life exists, that we know already is true. The argument is not predictive.

Carroll uses Bayesian reasoning to sort out how much credence one should give to naturalism versus theism, given that life requires the chemical reactions we observe in nature to occur. His argument against theism is that many aspects of nature are unnecessary for life. Two heavier families of elementary particles are not needed for life. All the billions of galaxies are unnecessary. Theism predicts that they should not exist.

Carroll has an interesting approach to understanding whether we have free will. He describes how the so-called paradox of free will is really just an incompatibility between the languages of quantum mechanics (atoms and physical laws) and the human-scale world.

When Carroll sums up his discussions, he writes that the majority of philosophers and scientists are

naturalists today. But in the public sphere, religion and spirituality are most prominent. Our values need to catch up with science.

I enjoyed this book so much! It is beautifully written, and well thought-out. Sean Carroll has a lot of new, interesting philosophical and scientific arguments, and makes many analogies and metaphors that help to explain his reasoning. He boils down a lot of the uncritical thinking of the past to the incorrect application of Bayesian reasoning, or no application at all. To my knowledge, this is a new idea; the application of Bayesian reasoning to philosophy should be very prominent in the future.

Gendou says

Carroll introduces a philosophical idea he calls "poetic naturalism" in which the ontology includes objects which are useful in talking about the world at a given scale or levels of detail. For example, we can talk about people when it's useful to do so, and not worry that people are just made up of atoms and without getting distracted by questions like which is the last atom that's part of "me" on the tip of my finger.

The book takes the reader from the beginning of science with Newton's laws of motion up to modern day quantum field theory. This is structured like a survey of physics so as not to let any novice readers get lost. He does a great job of explaining why psychic powers can't be real, why "qualia" and "philosophical zombies" are dumb, etc. He introduces a cool analogy of a "planet of belief" which represents all the things a person believes. Every person has a different "planet of belief", and they can be stable or unstable, etc. He smacks down the idea that science, like religion, requires "faith". He tackles the hard and soft problems of consciousness. He says the soft problem is really hard, and the hard problem is a misunderstanding.

There's a whole lot of talk about god in this book. I'm not sure why. He does say its important because so many people believe in god. The topic is approached with a lot of caution which seems to me an attempt to avoid turning away theists. That's nice, but I felt like he was treating religious ideas with kid gloves and that's not too fun for me to read. It's also boring. I want to hear that space stuff!

Here are some claims in the book which I consider mistakes.

* He claims "there's nothing about quantum mechanics that necessarily invalidates determinism." Um, what about the part where observations are random?! He invokes the MWI and says the ensemble (multiverse) is deterministic. But this doesn't work because you don't do quantum mechanics using the ensemble. You use the same maths using MWI to make the same non-deterministic predictions about what's likely to happen when you make a measurement. A theory is deterministic, by my reading, if there's an unique prediction when evolution forwards in time given fully specified initial conditions. This is true for Newtonian mechanics, and untrue for Quantum Mechanics. If you look at MWI as providing an unique solution evolving forwards in time, you do so at the cost of all predictive power, because we have no way to tell which path down the infinity of branching universes our reality has taken.

* He claims there's nothing in the practice of science that excludes supernatural explanations from the start. Actually, there is. The word "supernatural" generally means a force beyond scientific understanding or the laws of nature. So it's unscientific by definition! But even if we grant the most charitable definition of "supernatural" as being merely inconsistent with known laws of physics, we still have a problem. Scientific theories must be falsifiable. A supernatural claim is one of an exception which has been found to the laws of physics. If this exception is explained by some new hypothesis, we must test that hypothesis. If found true,

this new hypothesis is added into what we mean by "the laws of physics". So a supernatural claim, when unsupported, shouldn't be believed at all, and is rightly rejected by anyone practicing the process called science. And as support for the claim's truth becomes available, it *must* become consistent with the other laws of science. This process can be gradual or rapid, depending on the nature of the evidence, but at no time is any natural explanation "supernatural", and at no point is any "supernatural" explanation necessary much less allowed in scientific discourse!

* He claims the universe could be just a bit larger than what we observe. His point here is that we should remain skeptical about unknowns, and not assume the way the universe looks here matches how it looks elsewhere, or even assume there is an elsewhere! This is subtly incorrect. We actually do have some knowledge about that which lies outside our observable universe! If spacetime were curved such that the size of the universe were finite and on the order of the observable universe, we'd expect an enormously positive value for the curvature of the universe. Which we don't see. Also, if the universe relatively close to (but outside) the horizon of our observable universe were significantly anisotropic, we'd notice the impact of this anisotropy on objects close to (but inside) the horizon. The isotropy of the observable universe is very precisely known. So, he's made an overly naive claim because it ignores important lines of evidence about what lies outside the horizon of our observable universe, where that evidence can be gathered from right here within the horizon.

Peter Mcloughlin says

I probably would have given this a five star rating but I am very familiar with Dr. Carroll from Youtube and the Great courses and his other books. I like the book a lot but I have seen this stuff before in other places. The only reason I am withholding the five is that I wanted to see something new. I would recommend this book who doesn't know Dr. Carroll from the interwebs and I think he is a good writer and I like his grand work here but I think i like his earlier works better. Still I like this synthesis of science and philosophy a lot and I think he gets his picture right.

February 7, 2017,
Upon doing a much more careful listening on Audible I have gotten a lot better appreciation for this book and Carroll's understanding of poetic naturalism. I can sign on to 99% of what Carroll endorses in terms of the science and philosophy of the book. I might fight him on his interpretation of consciousness and the status of philosophical zombies but as for the rest of his vision of poetic naturalism I find it satisfying and beautiful and more importantly probably the closest to the truth. Very enjoyable on a close reading.

Here is Carroll talking about his book at Google. https://www.youtube.com/watch?v=x26a-...

Blair says

Poetic Naturalism: Not a Good Way of Talking

The “Big Picture” is an attempt by a physicist to explain our universe, up to and including culture. It begins with naturalism, the concept that there is a single, objective reality that follows a set of laws. We can discover those laws by observing that reality using scientific method. The author extends that (or dilutes it) to something he calls “Poetic Naturalism”. This means, in his words:

1) There are many ways of talking about the world.
2) All good ways must be consistent with each other and with the world.
3) Our purposes in the moment determine the best way of talking.

As I explore this book, I will try to explain why it is not is a very good way of talking about science. I also question what it has to do with poetry.

Emergence: More Than a Just Another Way of Talking

How can all the complexity that makes up life arise from only a few fundamental particles or forces? This requires the concept of emergence, meaning that complex systems have properties not found in their underlying components. In my opinion this is one of the most fundamental ideas in science, which is often ignored or only mentioned in passing. At least this book considers it in some detail.

The example of emergence he uses is air. At the microscopic level it is composed of individual molecules. But we can think of it as a fluid, with properties such as temperature that emerge from the underlying chaos of molecules flying around. But this example does not really support his conception that levels of emergence are completely separate. He tells us,

"Within their respective domains of applicability, each theory is autonomous. Organisms can be alive, even if their constituent atoms are not. Animals can be conscious even if their cells are not."

The vital concept missing here is a *bridging theory* that links the different levels of emergence. In the air example the bridge is clear: the temperature of the fluid is the average speed of the individual molecules. There are bridges from quantum mechanics to chemistry to biology to neurology. On the other hand, the bridge to being alive or conscious is not so clear. This is the mystery I would love someone who knows that they are talking about to explore. I am still waiting. It seems this author would rather indulge in vague language than build bridges.

"So the fluid and molecular description are two different ways of talking about air."

While trivially true, it obscures the reason why the descriptions need to be different. The real problem begins with the following idea that is repeated throughout the book:

"There is only the quantum wave function. Everything else is a convenient way of talking."

I take this to mean that any science about emergent properties, meaning anything other than physics, is second rate, just a different way of talking about what the fundamental quantum wave functions do. It is curious that the term reductionism is mentioned by name only once in this book, where he appears to dismiss it out of hand. Yet how else can one interpret the following?

"Understanding what quantum fields and particles are and how they interact with each one another is a crucial part of comprehending what it means to be human."

This flatly contradicts what he has just told us about the meaning of emergent properties. We do not need to know anything about fields or atoms to understand humans. Unfortunately, such contradictions are characteristic of this book.

The Universe and Beyond

“So the big bang does not actually mark the beginning of our universe; it marks the end of our theoretical understanding.”

What a beautiful way to express the limits of what science can explain! If only he would keep that in mind. Since we don’t know how our universe began, what does it mean to conjure up other universes?

I think of the multiverse as a kind of cosmic attic – a place where we put the stuff we don’t know what to do with. Why do particles end up in specific places when they come from a wave that is everywhere? Lets invent a new universe for every place they could appear. Is it a problem that string theory makes a gazillion contradictory predictions? Not if we make each one of them true in a different universe. It couldn’t be a problem with the theory itself. We are told that when you apply the uncertainty principle to the theory of the early rapid expansion of the universe, you get “eternal inflation” and an infinite universe. Could this be a sign that the theory is broken? Not when it gives us the logical equivalent to a multiverse - what a great place to put all the string theory universes! Never mind that cosmic inflation was developed from general relativity rather than string theory.

Perhaps the reader should be informed that these are three independent types of hypothetical multiverse, not multiple lines of evidence supporting a single multiverse theory. Oh well, I suppose all the multiverses let us be pleasantly diverse and inclusive with all our incomplete theories.

Disorderly Thinking About Time

“It is the tendency for entropy to increase that is responsible for time’s arrow.”

The second law of thermodynamics states that any system will tend to become more disordered (or have higher *entropy*) unless external work is done on it. There is another view that this “law”, rather than being fundamental, amounts to a tautology: the most likely future path of a system is the path that is most probable. Perhaps entropy is simply an emergent property of discrete objects appearing in the universe. Just as temperature emerges from the speed of the air molecules of a gas, entropy emerges from their distribution.

If entropy drives the emergence of time, one might expect that time flows at different rates depending on the local entropy, which we do not observe. Another view is that if general relativity is valid, space and time are intimately connected, and an expanding universe means that space-time itself is expanding. This predicts that new time will be created at the same rate everywhere in space.

Instead we are given a strange theory of how increasing entropy somehow leads to the development of complexity, apparently derived from observing cream poured into coffee. [I am not making this up.] But remember the part about external work reversing entropy? That work is done by gravity. However universe started, after the emergence of matter led to hydrogen atoms scattered around in a highly disordered state. Gravity pulled the atoms together to form stars, and eventually planets that can support life.

Gravity is the fundamental anti-entropy force in the universe that makes stars, planets and life possible. How could he leave this out?

Scepticism and Authority

Scepticism is the fundamental attitude required for scientific thinking. It does not mean to conveniently reject what you disagree with. It means question everything. There is no unquestioned authority, but there is relevant expertise that should be respected.

In the above paragraphs this amateur has questioned the authority of an accomplished expert in quantum physics. I have no right to an opinion in that subject. However, it is legitimate to observe that other equally good experts have differing views on these questions. While I have no right to decide which is true, I must conclude that these are still open questions, more open than this book suggests. There are a lot of open questions in science.

I think it is a common problem that scientists are used to advocating their viewpoints to other scientists who already understand the range of scientific opinion. When writing for the general public, they often forget the need to explain the competing viewpoints and the degree of scientific consensus about them. But here, it seems he is leaving out other viewpoints entirely.

A Bad Premonition: The End of Psychic Powers

His treatment of psychic powers is so heavy-handed that it resembles what one finds in pseudoscience. What do I mean by that?

A standard pseudoscience trick is to misrepresent the theory under attack. For example, the theory of evolution presented by Creationists bears little resemblance to the actual theory. Here he constantly refers to psychic powers as spoon bending. As far as I know, there is only one person claiming to be able to bend spoons with his mind. Contrary to this straw man, the usual claim of psychics is that information can flow from one person to another over great distances. Information is much lighter than spoons.

There is another pseudoscience technique that I call *immunization*. Spell out the fallacy you are about to employ, claim that you understand all about it and of course you would not do such a thing. Then liberally employ the trick. Now watch it in action:

"What we know about the laws of physics is sufficient to rule out the possibility of true psychic powers. That is a very strong claim. And more that a little bit dangerous: the trash heap of history is populated by scientists claiming to know more than they really do, or predicting that they will know almost everything any day now."

He then gives a number of historical examples of scientists doing exactly that. But,

"My claim is different. I am claiming we know some things, and those things are enough to rule out some other things – including bending spoons with the power of your mind."

Again, rather than bending spoons, psychics claim they are transmitting or receiving information. I do not see how a theory that claims its fields permeate the entire universe can rule this out. If quantum time really is a superposition of all moments, as he tells us, then even clairvoyance can look somewhat within the realm of possibility.

I do not claim to understand his technical explanation about why quantum field theory rules out other forces. I rather doubt that it can rule out life after death, as he claims. No theory can rule out what is outside that theory. That amounts to a claim of clairvoyance.

The reason to be sceptical about psychic powers is that they are difficult to demonstrate in a repeatable experiment. If we could reliably replicate psychic spoon bending, we would then have to modify quantum field theory. That is how science works – evidence first, theory follows.

Who Am I? Or, What Could I Possibly Be Thinking?

We just saw an example of scientific overreach – making a statement with a certainty that cannot be justified. Now we suddenly encounter the opposite, where scientific method gets tossed out the window when it comes to human beings. A remarkable (not in a good way) chapter titled "Who Am I?" addresses the currently popular transgender issue.

"For many people, the concepts of 'male' and 'female' are deeply rooted in the fabric of the world. Poetic naturalism sees things differently. Categories such as "male" and "female" are human inventions – stories we tell because it helps us make sense of our world. The basic stuff of reality is a quantum wave function. Everything else is an overlay, a vocabulary created by us for particular purposes. Therefore, if a person has two X chromosomes and identifies as male, what of it?"

A quantum wave function is also a "human invention". Categories such as male and female are "human inventions" that encapsulate our best description of how reproduction in all complex life is fundamentally different from that of bacteria. In science, words have specific meanings. If a person has two X chromosomes, she is by definition genetically female. If you want to talk about the relationship between gender and behaviour, then find the appropriate language without changing the meaning of existing words.

I will quote the next few paragraphs in full so you can see how he mixes subjective and objective thinking for yourself:

"This can sound reminiscent of the old postmodern slogan that reality is socially constructed. [Yes, it certainly does.] *There is a sense in which that is true. What is socially constructed are the ways we talk about the world, and if a particular way of talking involves concepts that a useful and fit the world quite accurately, it is fair to refer to those concepts as 'real'. But we cannot forget that there is a single world underlying it all, and there is no sense in which the underlying world is socially constructed. It simply is, and we take on the task of discovering it, and inventing vocabularies with which to describe it."*

"People who think that transgenderism is a violation of the natural order sometimes like to use a slippery slope argument: If gender and sexuality are up for grabs, what about our basic identify as human beings? Is our species socially constructed?"

[A better term for "slippery slope" is false dichotomy. On one side there is an arbitrary and rigid definition of what gender roles should be, and on the other the idea that gender is an arbitrary construction and we can be whatever we want. But now he slides us all the way down that slippery slope.]

"There is, indeed, a condition known as 'species dysphoria'. It is analogous to gender dysphoria but is characterized by a conviction that the subject belongs to a different species. Someone might think that, despite their nominal human form, they are actually a cat or a horse. Others go further, identifying with species that do not actually exist, like dragons or elves."

"So poetic naturalism does not automatically endorse or condemn someone who thinks they are a dragon, or for that matter someone who thinks they are male or female. Rather, it helps us understand what questions we should ask: What vocabulary gives us the most insight into how this person is thinking and feeling? What helps us understand how they can be happy and healthy? What is the most useful way of conceptualizing this situation? We can certainly imagine thinking through these questions in good faith, and at the end concluding with 'Sorry, Kevin. You are not a unicorn.' "

[Then why not, “Sorry, Kevin, your Y chromosome means you are not a woman.”]

“The real lives of people whose self-conceptions do not match those that society would like them to have can be extremely challenging, and their obstacles are highly personal. No amount of academic theorising is going to solve those problems with a single gesture. But if insist on talking about such situations on the bases of outdated ontologies, chances are high that we will end up doing more harm than good.”

Yes, actions have consequences. We should indeed be sceptical about “outdated ontologies” while remembering that traditional morality is the product of centuries of social evolution and may contain some truths based on long experience. We should therefore be even more sceptical about modern, constructed ontologies that are not based on evidence. They also have consequences and can do harm.

I suppose his writing might seem to be balanced and reasonable. I disagree. I think it is a false balance, slipping in ideas that are hostile to the spirit of science. He chooses to use the loaded term “social construction” which really means an arbitrary arrangement, usually imposed by the ruling elite to maintain their power over society. It is an explicit claim that the only reality is about relationships of power. This is the philosophy of subjectivism – the idea that we can believe whatever we want to believe to achieve our social goals. While he insists there is an underlying reality, one gets the impression there is no way to address emergent reality scientifically, so all we can do is “construct” ways of talking about it. The reader is left to cross the thin line to the next step, to construct any reality that conforms to their social world view.

What Happened to Scientific Method?

Scientific method is not a specific technique; it is a way of thinking that can be applied to any aspect of reality. It means challenging everything based on the best evidence available, recognizing uncertainty, and knowing when the evidence is insufficient to draw firm conclusions. Humility is (or should be) at its core. Unfortunately, scientists do not always live up to this standard. At least, when they do not, there is an objective way to challenge them. There is no way to challenge a subjectivist, as any opinion is arbitrarily constructed.

Human beings are not an arbitrary construction, or a blank slate. We have evolved over time to adapt to a changing environment. Our distinctive feature is our ability to cooperate, to behave as a social organism. Morality is how individuals modify their behaviour to make social cooperation possible. It has a genetic base with a culturally learned overlay. For those of us for whom evolutionary theory is not just another way of talking, this means there is an objective basis for morality that can be understood using scientific method.

That does not mean science can give us a complete and authoritative theory of morality that can be tested in a laboratory. It means we should question all moral concepts, including modern ones, and try to understand their consequences on the basis of evidence as much as possible. Using critical thinking rather than believing what is socially convenient means avoiding the following:

“Deciding how to be good is not like solving a math puzzle, or discovering a new fossil. It is like going out to dinner with a group of friends. We think about what we want for our individual selves, talk to others about their desires and how we can work together, and reason about how to make it happen.”

Dinner with like-minded friends is a recipe for groupthink. I suppose he picked up his moral relativism from his academic dinner mates.

I Have No Need For This Way of Talking

Let me mention one last logical fallacy: *transfer of authority*. An expert in physics is not necessarily an expert in philosophy or morality. In this case I often felt I was reading a guy who has read the same books I have. But he failed to pick up the message that there is no room for subjectivism in science. It is as if he has made a deal with the devil to let him keep the integrity of physics, but all the other emergent sciences (or "different ways of talking") get thrown under the relativist bus.

Ideas and language have consequences. For example, if biology is just a way of talking, the benefits of immunization are simply a social construction. If you do not like this kind of thinking, then do not use the language that leads there. There is another word for the constructionist fallacy:

"Alternative Facts"

The other side has learned to play the game. After all, it is just another way of talking.

Although there is much of value here, I find it difficult to recommend a book that sells out the very integrity of science. He is a good writer, and I would happily read a book that sticks to his field of expertise. However, I will take my naturalism without the poor excuse for poetry, thank you very much.

Brian Clegg says

Most popular science books either focus in on a specific bit of science, or explore the work of a particular scientist. However, every now and then, authors get the urge to go large - to take on life, the universe and everything. It's what you might call the science writer's midlife crisis - and this title typifies the genre.

Of itself, this isn't a bad idea, though it can be a struggle to decide how to organise such a vast subject matter, and the 'big book' syndrome frequently rears its ugly head. Because this is a big topic, either the publisher or the author often feels it has to be a big book. This translates into a painfully long book, something this certainly is, at over 400 pages. The result is page after page of waffle, which in a subject that naturally inclines the author to philosophy can be more than a little deadening. So, for instance, although Sean Carroll does actually put quite a lot into his opening section, it can feel like he's spent 80 pages saying 'things do or don't have a cause, depending on what they are and what you call a cause.' And there's only so much you can take of that kind of thing.

At the book's heart is the concept of poetic naturalism, which Carroll presents as the best scientific approach to universal topics. This amounts to having a clear naturalist approach (nothing is supernatural, everything can in principle be explained by reductionist means), but building on it the storytelling aspect of our understanding that takes us beyond the fundamentals like quantum theory to add on emergent aspects reflecting the world as we understand and experience it. The poetic naturalist knows that it's all particles and fields underneath, but accepts that we need the higher level stories to relate to the universe. Carroll covers this at great length in his six sections: Cosmos, Understanding, Essence, Complexity, Thinking and Caring.

At page 159 we finally get away from philosophical hand waving, but given that, so far, Carroll has been hammering out each point at great length it's unfortunate that when he is on more familiar ground, he leaps into assumptions about what his readers understand. So we are told, for instance, that an electron in a hydrogen atom only gives off 'certain discrete wavelengths'. It's a shame that, while philosophical jargon was given pages of explanation, a word like 'discrete' which isn't commonly used the way physicists employ it, isn't given a brief explanation.

When get onto the serious science bit, after acres of pages telling us about the difficulty of being certain of everything, it’s a wave of the magic wand and physics has all the answers (admittedly to a small subset of questions). It’s not that there’s anything wrong with the physics presented here, but the way it is described there seems a danger of falling into the trap Carroll himself identifies of declaring that nothing much new will emerge as we pretty well know it all. And after all the philosophical justifications and exploration, it feels unsatisfactory to be presented with the physics on a ‘this is how it is, and you have to believe it because I say so’ basis. This comes across particularly strongly in the description of crossing symmetry. The lack of explanation and justification here is disappointingly different from Carroll’s lucidly explanatory From Eternity to Here.

The good news is that in the next section (Complexity) things finally get both interesting and better explained. As we move into biology, Carroll continues to keep the writing interesting and delivers significantly more than he has to date. Unfortunately, this doesn't last and we head back to the philosophising and logic-chopping as Carroll makes one of several attempts to provide a logical consideration of the existence or non-existence of God, saying that the fine tuning of the universe is probably the best argument for theism, but it proves to be a weak one. There's something dated about attempts to make logical and/or Bayesian arguments for or against a deity and it just doesn't do a lot for the reader. This is followed by a long, occasionally interesting, philosophical discussion of the nature of consciousness.

Towards the end of the book, interest is re-kindled with some thoughtful material on ethics and we finish with an absolutely lovely chapter, where Carroll relates his move from his early Christian beliefs to a naturalist viewpoint. This is the best writing in the whole book - simple yet personal, and far more effective as a flag carrier for atheism than any of Dawkins' raging.

Overall it's an odd book and one that has way too much philosophising and meandering for me to have enjoyed it. Interesting nonetheless.

Katie says

I bought this at an airport bookstore, mostly because I admired the audacity of someone who would write a book about *life, meaning, and the universe* and slap it all on the cover.

I'm pretty much the audience for this book. I like science but have zero formal training in it; I like books that are overly ambitious in their scope. I also went into this book (without realizing it) already having essentially the same philosophical and religious views as the author. That made for a somewhat satisfying read, if never a particularly challenging one.

Carroll is a decent writer - nothing spectacular, but always clear and approachable. He's one of the rare science writers I've come across that shows a regular respect for historical thinkers who were clever but also wrong. He's also quite good at deploying analogies to explain difficult concepts (I especially liked this discussion of time and entropy).

That said, I'd imagine this book is a bit of mixed bag for actual, trained scientists. It's relatively light on hard science and if you're not already on board with Hugh Everett's multi-world explanation of quantum mechanics, this is certainly not going to convince you. But that's okay. That's not really what this book is trying to do. It's fitting that the books' last chapter is called "Existential Therapy" - Carroll's book is really designed as a philosophical statement, as a gentle "it'll all be okay" to people who look at quantum

mechanics with existential dread. I was already pretty much on board before I started reading it, so I can't say how effective it'd be at convincing non-believers. But it's still an interesting, engaging book, filled with clever analogies and a broader, humanistic view of the world.
