



The Beginning of Infinity: Explanations That Transform the World

David Deutsch

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The *New York Times* bestseller: A provocative, imaginative exploration of the nature and progress of knowledge

In this groundbreaking book, award-winning physicist David Deutsch argues that explanations have a fundamental place in the universe—and that improving them is the basic regulating principle of all successful human endeavor. Taking us on a journey through every fundamental field of science, as well as the history of civilization, art, moral values, and the theory of political institutions, Deutsch tracks how we form new explanations and drop bad ones, explaining the conditions under which progress—which he argues is potentially boundless—can and cannot happen. Hugely ambitious and highly original, *The Beginning of Infinity* explores and establishes deep connections between the laws of nature, the human condition, knowledge, and the possibility for progress.

The Beginning of Infinity: Explanations That Transform the World Details

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David Deutsch**

From Reader Review *The Beginning of Infinity: Explanations That Transform the World* for online ebook

Andy says

I am not sure that another book has influenced my thinking quite as much as *The Beginning of Infinity*.

As I read through Deutsch's many provocative assertions, I often reacted with instinctive scorn and disbelief. But with only a few exceptions, I found myself within a few pages not only persuaded but convinced of the utter obviousness of his ideas.

The specific assertions in this book are important not because of the claims they make relevant to that field, but because they are *meta-assertions* which empower every field, even when we have no idea what's coming.

Ed van der Winden says

I cannot stress the importance of this book enough. This book is about the power and potential of explanations and therefore also of our potential as a species, as the people who are able to create these explanations. Deutsch's book is an incredibly lucid and powerful explanation in itself and I will even go as far as to conclude that with this book Deutsch has become the most important philosopher of our time! Do yourself a favor and read this book! Deutsch's book is not technical and understandable by anyone with a decent brain. That includes you, otherwise you would not be reading this review. The book's arguments are as rational as they are optimistic (in every sense of the word, including the definition in the book itself). This is the kind of thinking that empowers us both as individuals and as a species. MARVELLOUS!

Nick Black says

fascinating, but not everything i was hoping for. i'm surprised to see this book being used as one of the required texts for scott aaronson's 6.893 Philosophy and Theoretical Computer Science this fall, a course which i would happily give up either testicle to attend. seriously, stop reading whatever crap you're reading and go through that reading list. it's a *who's who* of everything that matters.

picked it up today. can't wait.

Dr. Deutsch wrote one hell of a PhD dissertation back in the day; I look forward to reading his book.

<http://www.scottaaronson.com/blog/?p=690>

rmn says

Who knew that the beginning of infinity was also the start of boring, I mean really, what a crappy way to have to spend infinity.

Anyway, this book is dryly written (despite what the back of the book jacket says) and confusingly uneven with some parts being informative and some being so incomprehensible that they would likely put somnambulists to sleep.

As far as I can tell, the author has a valid thesis which is that human intelligence can solve any problems we face as long as people remain open minded about their thought processes and put seeking truth ahead of everything else. This thirst for knowledge started or gained steam with the great awakening of the Renaissance and has grown exponentially since then. Only by keeping an open society and continuing to build upon past research and looking for best answers will humanity continue to develop and strive for this infinity of knowledge (hence we are at or near the beginning of infinity).

If that sounds interesting, add about 300 pages, 3 fewer jokes, some quantum mechanics including a discussion of the Many Worlds hypothesis, and an author with a bigger ego than the US national debt, and you have the *Beginning of Infinty*. That said, there are some interesting concepts in the book so don't let me dissuade you if it is on your to read list as there is a really thoughtful and interesting book here, it just needs a more skilled writer.

Gary says

I finished this book a month ago and at first I wasn't sure what I thought of it. But a month has gone by and I still think about it. In fact I think about it a lot.

Some other reviewer mentioned that his favorite word was "parochial" which made me laugh because it does seem to be true. And I finally had to look it up in the dictionary because he only gave a one sentence definition of "parochial" that I thought was lacking. And by that I mean I didn't understand it. I looked it up online. I wish I had done it more towards the beginning of the book instead of the end. I was wishfully thinking that I would understand it from context. Oh well.

There are entire chapters that seem a little pointless, some kind of rambling, and the multiverse chapter I gave up on half way through and skipped to the next chapter.

The first two or three chapters though... wow. The first two chapters were amazing. I will be re-reading them again until it really sinks in. The question of "how do we know what we know?" is tackled, in the sense of he ran at it full speed, tackled it, slammed into the ground and pummeled it. It was first rate stuff.

One part that stuck with me was the two plaques. "Problems are inevitable" and "all problems are soluble" has stuck with me. Setting arbitrary limits to the potential of human knowledge also really struck a chord with me. In fact over the last month I've found myself repeating ideas that I picked up in this book during conversations. I yelled "Don't set arbitrary limits to human knowledge!" over a beer at a bar the other night. It was all a bit pretentious. I might as well have been wearing a beret.

The parts at the end of the chapter, especially the "Meanings of infinity encountered in this chapter" and his definitions were kind of silly. At least it felt silly to me. In fact lots of it felt silly. And yet, I gave it five stars, because I haven't read a book in a long time that has stuck with me like this one has.

It is big, but not expensive. It is at times annoying, but so what. Actually that reminds me. Some reviews

or because it is best that we fail, but always because we didn't know enough, in time. but optimism is also a stance towards the future, because nearly all failures, and nearly all successes, are yet to come.

Highly recommended.

Diarmid says

David Deutsch is a Fellow of the Royal Society and an expert on the quantum theory of computation based at Oxford University. Physics and an understanding of the laws of physics are at the core of this book, but it is just as much a work of philosophy, dealing as it does with progress and human society. Deutsch's contention is that the laws of reality can be known and will provide endless opportunity for investigation and the expansion of knowledge, that the principles of the scientific method established since the Enlightenment allow us to discover the laws of reality, and that there is no limit to human progress. Deutsch makes his argument brilliantly, and there is a great deal of speculation about optimism, memes, and the nature of intellectual progress that provides a new perspective on our society and where it might go, but the book as a whole is strangely unsatisfying.

It is difficult to find fault with the arguments in the book, but it feels like Deutsch's view is ultimately lacking, that it looks at only one aspect of human progress and underplays others. For example, Deutsch references Jared Diamond's brilliant 'Guns, Germs and Steel' in its examination of why indigenous societies in America were defeated and destroyed by European colonialism. Diamond's argument is based on resources and their effect of human development, which slowed and limited development in the Americas and allowed Europe to progress faster. Deutsch argues that a lack of resources does not present a barrier to human progress, as Enlightenment thinking will allow any lack of resources to be overcome or avoided, and will in fact change how resources are defined. The civilisations now in America have the same resources as the indigenous civilisations, but are vastly wealthier and more advanced because they use resources differently. The problem is that Deutsch claims that all pre-Enlightenment societies suffered from the same limitations, yet European societies were able to overtake and overwhelm indigenous societies. Medieval Spain was profoundly unscientific and riddled with the sort of ideas that Deutsch identifies as a barrier to progress, but was able to overwhelm the Incan empire and the other civilisations of the Americas. Deutsch argues that progress is based on a certain way of thinking, and that societies without that way of thinking are static and incapable of progress, yet that argument seems to be unable to address why pre-Enlightenment Europe managed to advance and overtake other areas of the world.

On the other side of the coin, Deutsch argues that a society which uses Enlightenment thinking is capable of unstoppable and infinite growth. He does identify instances of other societies that have developed the same way of thinking, most obviously classical Athens, but he never really explains why these societies did not carry on progressing while arguing that our society will. In the end, no matter how brilliant Deutsch's argument it feels too simplistic to explain the complexities of human progress and the reasons why societies rise and fall, and thus inadequate to predict how our society will progress and how we will overcome the problems and threats that face us over the next decades. Deutsch's views on progress are fascinating and his views on optimism refreshing, but his argument as a whole feels ultimately slightly ephemeral and sophist, beautiful but not wholly practical.

Anastasia Hobbet says

David Deutsch is brilliant, iconoclastic, and so sure of himself that it takes my breath away. No political correctness here! And no homage to that creaky old ideal of writing within your own speciality. But then he's a cosmologist, so what's not within his specialty?! Accordingly, this book is about absolutely everything. It includes critiques of contemporary science fiction, conversations between Socrates and his adherents, trips into intergalactic space, and a thorough discussion about the pros and cons of representative government--globally. You'll also spend some instructive time on Easter Island, where Deutsch manhandles the artistic reputation of the former residents. Nothing is sacred to Deutsch--least of all religion--except for the concept of human ingenuity. He sees the humankind as immortal--because we're thinkers and doers. We read and write and pass on critical, evolving knowledge from generation to generation. Our intelligence has what he calls 'reach,' and he sees us, eventually, as emigrants to other worlds: We will make the Enlightenment universal.

Mind-bending and wholly surprising from chapter to chapter. I will read this again soon.

Gendou says

Summary: Lose, philosophical rambling, plus an insightful take on Many Worlds.

Author's favorite word: *parochial*

I'm trying to be more positive in my reviews. Here are the good parts:

- * Plausible story of the evolution of the technology of numerals.
- * Refutation of anthropic reasoning for being a bad explanation.
- * Introduction to infinite set theory using the idea of Infinity Hotel.
- * Refutation of the Precautionary Principle for being pessimism.
- * A clever, made-up tale of Socrates and Hermes on epistemology.
- * Intro to Philosophy of empiricism, instrumentalism, realism, etc.
- * Some nice anecdotes on the history and importance of the Enlightenment.
- * Nice definition of a "good" theory: one that breaks if you change it.
- * Definition of fungibility and its application in economics and physics.
- * An novel description of Many Worlds which emphasizes fungibility.

Now, on to my gripes.

Gripe #1: Many Worlds

That last "good part" is actually an interesting and unique insight! In this interpretation of quantum mechanics, universes branch and merge. Branching is seen as an effect on one of an infinite number of fungible universes. This is equivalent to entanglement. Merging produces a number of possible histories, all of which are real. This is equivalent to measurement. Too bad only one half of one chapter was dedicated to exploring it! Notice that this does NOT solve the measurement problem. It is equivalent to the Copenhagen Interpretation in all predictions. The only novelty is in the explanation, which is all the author claims. So, it's fun to think about! But it does not refute the Copenhagen interpretation, as the author claims. He also dismisses the Copenhagen interpretation as bad philosophy. He calls it "instrumentalism, anthropocentrism, studied ambiguity". Ouch!s None of these accusations are valid, and are really quite insulting to the

mainstream.

Gripe #2: No force of gravity in GR

The existence of a force of gravity is, astonishingly, denied by General Relativity. Actually, the *classical* force of gravity *emerges* from the curvature of spacetime. But instead of using these *correct* words, he assaults the sensible reader with hyperbole. Later on emergence is discussed, but too little too late.

Gripe #3: Occam's Razor

Occam's Razor is labeled as a "misconception" and rejected as a poor technique. But the "Occam's Razor" described by the author is not the one practiced in reality. According to the author, it isn't simplicity that makes for a good explanation. It is how hard the explanation is to verify. This does NOT account for the situation where two explanations are equally hard to verify! Only when this is the case does Occam's Razor come into play.

Gripe #4: Transmutation

The author doggedly refers to thermonuclear fusion as "transmutation". He also brings it up several times in early chapters as a non sequitur. That was really weird...

Gripe #5: Quantum Jumps

The author argues there are no such thing as quantum jumps, only smooth transition. This claim is not justified by evidence or theory. Atomic electron transitions or "quantum jumps" are an unmistakable part of quantum theory.

Gripe #5: Star Trek Transporter

The author gets us thinking about multiple universes with an anecdote from science fiction. Then, instead of moving on to talk about the real world, he keeps up the charade. Never does he actually justify any of his argument by comparing it to experiment. The whole chapter is veiled in a cloak of fiction, so as to defend against criticism. Once the veil is dropped, he's back to your basic Many Worlds interpretation, nothing more. So, why all the wasted time in fantasy land? I don't get it.

Gripe #6: Bohmian Mechanics

The author dismisses Bohmian Mechanics as nothing more than a flavor of Many Worlds. This is blatantly incorrect. Bohmian Mechanics is a non-local theory, where as locality is preserved in Many Worlds.

Gripe #7: Instrumentalism

The most brutalized viewpoint in the book is instrumentalism. He calls it a "bad philosophy of science" because it doesn't require explanation. Of course, this is false, because explanations are part of the *instrument*. The author uses the jibe "shut up and calculate", but that is bad instrumentalism! The good instrumentalist avoids the real vs. anti-real debate altogether. It seems that the author is objecting instrumentalism as an excuse for bad explanations. I agree that it is often used as an excuse, but that doesn't make it bad philosophy.

Gripe #8: Plasma

The author claims that most matter in the universe is the plasma found in stars. Actually, most of the matter in the universe is found in the intergalactic medium. This is also a plasma, but isn't (yet) part of a star!

Gripe #9: Reach of General Relativity

The author makes a big deal about the "reach" of a theory. He defines reach as the range of energies, distances, times, etc. where the theory works. General Relativity has a grand reach, but he claims its reach to

be infinite. This is not true, because at the big bang and event horizon of black holes, it fails.

Gripe #10: Infinite Progress

The main thesis of the book is that progress is infinite. This is justified using an inductive argument: Since science has continued to produce new, better theories with greater reach, it will continue to do so indefinitely. But in the first chapter, the author claims inductivism to be bad philosophy, contradicting the argument for the book's thesis.

I agree with the author that we won't reach the end of science any time soon, if ever. But the whole point of the book is that the process necessarily is infinite, and I disagree. For one thing, all species have a finite lifetime, providing a necessary end to progress.

Blair says

This book is about rational optimism. For the past few hundred years in the West, science and logical thinking have been changing things for the better. The author believes we are just beginning an era of continual progress that has no bound.

His key idea is that science is defined by seeking explanations for the universal laws that govern reality. Explanations go beyond simply describing what we observe, or “instrumentalism”. A good explanation has “reach” – it explains not only what we see, but continues to work in situations we never anticipated. For example, Newton’s laws of motion explain both a falling object on Earth, and the orbits of the planets.

A poor explanation, such as “God did it”, could explain anything, and therefore explains nothing. Even if God exists, this statement does not explain how he did it, which is what is relevant for science. What Deutsch calls bad philosophy is not only a poor explanation, but it also sets up a system that is immune from criticism (such as “God’s will cannot be questioned”). This prevents anyone from challenging the philosophy.

The source of our theories is conjecture, which are then subjected to criticism. All theories are wrong, or at least incomplete. Criticism permits better explanations to emerge. This kind of error correction is critical to making any system work. Deutsch states that the prime moral imperative is to never suppress the means of criticism and error correction.

Deutsch examines William Paley’s argument in 1802 that life must have been designed. He shows this argument is profound, limited only what was not known at the time.

What is the difference between a stone and a watch? Paley may have thought the stone was created as is, while today we know that it has been through a complex process driven by the formation of the earth and plate tectonics. But that makes no difference. The watch was clearly not assembled by plate tectonics or any other natural process. If any small change is made to it, it ceases to function as before, while if the stone is broken in pieces, you have more stones. The design process for the watch involves stepwise refinement with the correction of errors that result in a functioning watch. The stone also went through a refinement process, but the fundamental difference is there was no error correction feedback. The watch cannot be properly understood without knowing its purpose. And if there is purpose, there must be intent, and therefore a designer.

A mouse has all the same attributes as a watch, so it was quite reasonable to conclude that it must be

designed as well, therefore has a designer. And he is right. However, we now know the purpose of the mouse: to replicate its genes. The designer of the mouse is not a person; it is the stepwise process known as natural selection, with a system of error correction that removes mouse designs that fail to reproduce their genes.

These ideas are clearly central to the book, as can be seen by the watch the author is examining on the front cover. The watch and a good scientific explanation share the fact that small changes made to either will break them. Bad explanations and stones can be changed significantly, and they still function as they did before.

The author explores the concept of a universal system, which means a small digital system that can be used to create new things without itself being modified. Digital systems are required because they have built in error correction. Variations are rounded to the nearest decimal digit, whereas in analog systems the errors can accumulate. An example is the alphabet, which can generate any new word using the same letters, or ten digits that can generate any possible number. Language itself is a digital system. While we can make an infinite number of sounds, of which only a subset are used for our words. The first universal digital system was the genetic code, which somehow evolved from the original chemicals on the Earth. All of these systems had non-universal origins, and what he calls the “jump to universality” was a final stepwise refinement that had much more power than simply solving the intended problem. For example, for the first few billion years the DNA system only created bacteria. Much later we got multi-celled organisms, and in 1994 the first DNA computer was made, a possibility inherent in the original design of DNA.

The author’s field of expertise is quantum mechanics. He points out that while the equations of Heisenberg and Schrodinger describe the behavior of subatomic particles, there is no single explanation in words, or interpretation, that is universally accepted. He strongly objects to the majority Copenhagen interpretation that claims quantum mechanics cannot be understood, deriding it as “shut up and calculate”. He points out that “This combination of vagueness, immunity from criticism, and the prestige and perceived authority of fundamental physics opened the door to countless system of pseudo-science and quackery supposedly based on quantum theory.” His favored interpretation is many worlds, or the multiverse.

Deutsch develops an interesting argument against sustainability on “Spaceship Earth.” He points out that the biosphere is actually hostile to human life – just try living in a natural environment with no artificial help and see how long you last. Life is actually sustained by our knowledge of how to manipulate that hostile environment.

Sustainable has two conflicting meanings. One is to keep us alive, surely a good thing. The other meaning is to keep things the same. But static societies fail when unexpected changes occur, as they always do. Our survival depends upon the ability to adapt to change, which means the current mode of production should not be sustained. Hence the praise for unsustainability.

Paul Ehrlich was the ultimate resource pessimist. His fallacy is to compare the known inventory of present resources, extrapolated into the future, with the unknown possibility of finding new resources, or technical innovation that reduces the need for them. The predictions of this kind of pessimist tend to be very wrong.

After blasting environmentalists like Paul Ehrlich, he then addresses climate change. I was expecting him to dismiss the issue, but I forgot he warned against blind optimism, and realizes that problems are inevitable.

He clearly spells out the reality of climate change in line with the great majority of scientists. He also points out that predictions of economic consequences fail to take account of future innovation. He even uses the word “disaster”, but to him it equally means possible climate impacts, and the impact stopping progress to

reduce carbon dioxide emissions. He says that solutions that disable our ability to grow and innovate will not work. Prevention and delaying tactics are useful, but can be no more than a minor part of a viable strategy for the future. We need a large and vibrant research community, interested in explanation and problem solving. We need the wealth to fund it, and the technological capacity to implement what it discovers.

Deutsch defines wealth as the repertoire of physical transformations that one is capable of causing. I would like to point out that wealth spent on personal consumption while starving scientific research for needed funds will not contribute to the solution. In general, the problem with relying on scientific method to solve our problems is that we humans did not evolve to think that way. It takes great effort and training to think scientifically, and even scientists often forget it the moment they step out of their labs.

This book is full of challenging ideas. Some chapters are clearly written, while others were beyond my comprehension. Maybe if I read them a few more times I will get the point. However, my understanding of science has changed because of this book, and that is the highest praise I can think of.

Steven Williams says

In this book the author David Deutsch argues that there is no or can be no end to how far we can, or other sentient creatures, can go in furthering our explanations of the universe. This is our knowledge will continue to grow with out bounds. He explains why explanations are the key element in our gaining knowledge, and not the standard true justified belief of epistemology. He attempts to show how induction and empiricism fail to describe our knowledge acquisition. He believes science is practiced in the Popperian way of conjecture and critique. This is we first come up with an explanation and then we try to attempt to see if it holds up. And, this is the way we all gain knowledge, not just scientific knowledge. He believes that we create knowledge, and this is what separates us from other animals. He also looks forward to an optimistic future of continued problem solving. He has a chapter on Hilbert's infinite hotel, the quantum multiverse, which he concludes is the only explanation of quantum goings-ons that currently works. He has several chapters on cultural evolution and the role of memes and creativity. His second to last chapter attacks sustainability, and why we should not be attracted to obtain it because it restricts ongoing knowledge acquisition. He believes we should seek unsustainable solutions because sustainability is stagnation, and in the end will fail, so are only choice is to continue to create newer and newer knowledge that will solve whatever current problems need addressing. In his final chapter he claims why we are only at the beginning of an infinity of knowledge. We are at the beginning because the enlightenment and scientific age is only two hundred years old, and a brighter and brighter future is ahead for humankind. And, there is no end to the knowledge we will obtain; that there will always be new knowledge to obtain.

Here are some comments based on specific pieces of the text. Kindle locations are in brackets []

[220] David Deutsch states: "The misconception that knowledge needs authority to be genuine or reliable dates back to antiquity, and it still prevails. To this day most courses in the philosophy of knowledge teach that knowledge is some form of *justified, true, belief*, where 'justified' means designated as true (or at least 'probable') by reference to some authoritative source or touchstone of knowledge." (author's italics) First, justification involves more than knowledge from some authority. It can be any form of evidence. He also leaves out true (i.e. aligns with the universe). It goes belief needs to be justified, and these beliefs only count as knowledge if the belief is actually true. In other words we must have some form of evidence, and it must be coherent with our other beliefs. In his terms we need an explanation in order to acquire a belief. But, for it to be considered knowledge under the standard form it also has to be true, not what some authority states as

true. But, we often have to rely on secondhand knowledge. There is very little that we know from firsthand knowledge. Our knowledge may even require higher degrees of handedness.

[1920] “Holists also often share with reductionists the mistaken belief that science *can only* (or should only) be reductive, and therefore they oppose much of science.” (author’s italics) I share Deutsch’s view on holists, but I call myself a reductionist because I hold out that science might indeed be successful in providing a complete reduction of science. He should also not argue against this belief because we have nothing to show it cannot be done with his optimism about what we can know. Having said this I also agree with him that different levels of explanation are possible. When we ask someone why they forgot to take out the trash, we do not want a reductive answer down to particles and forces.

[3576] “Such an event [a gamma-ray blast in our galactic vicinity] is thousands of times rarer than an asteroid collision, but when it does finally happen we shall have no defense against it without a great deal more scientific knowledge and an enormous increase in our *wealth*.” (my italics) Wealth is one key ingredient that many (maybe all I have read) futurists ignore.

[3713] “Yet there have been a few individuals who see obstacles as problems, and see problems as soluble.” I am mostly an optimist in my own life, where I do see problems as soluble. However, I do not hold out much hope that the world can solve all of its problems through science. Not that science may not be useful, but person to person issues, such as that involving religious disagreement do not seem likely to be solved anytime soon, no matter what science might discover. Having said this I do not hold it impossible. After all who would have thought the enlightenment (which Deutsch thinks is so central in our advancement) would have occurred and would have had such an impact that it has had.

[4351] In an imaginary dialogue Plato says in part: “Because they don’t want their kids to dare to question anything, so that they won’t ever think of changing anything.” Sounds like today’s fundamentalists, which Deutsch may have been having a dig at here.

[5566] “If a drug passes that test [saying they are happier], the issue of whether it really makes the patients happier, or merely altering their personality to have lower standards or something of the sort, is inaccessible to science until such time as there is a testable explanatory theory of what happiness is.” While I have issues with happiness studies too, does he really think people are so clueless when it comes to their own happiness.

[6046] “They [voters] are choosing which experiments are to be attempted next, and (principally) which are to be abandoned because there is no longer a good explanation for why they are the best. The politicians, and their policies, are those experiments.” I began to wonder at this point if his explanation seeking was not just good old pragmatism and truth seeking here.

[6082] “That gives all parties the incentives to find better explanations, or at least to convince more people of their existing ones, for if they fail they will be relegated to powerlessness at the next election.” I wish he would have provided some real voting examples to illustrate his political philosophy.

[6469] “Arguments by analogy are fallacies. Almost any analogy between any two things contains a grain of truth, but one cannot tell what that is until one has an independent explanation for what is analogous to what, and why.” This was said in response to Marx’s use of biological evolution. However, the same could be lodged against meme theory, which Deutsch defends.

Here is some more commentary on the book not link to any specific piece of text:

(1) Deutsch's major focus is to explain science and all knowledge acquisition as finding the best explanation. Under Karl Popper's influence he sees that these explanations need to be testable. They need to be able to be discarded when they no longer provide the best explanation we can devise. And, they need to be narrow enough that to shade off to the side a little bit destroys it, and it needs to have reach—able to explain more than previous explanations. His reliance on Popper is problematic. For a good critical examination of Popper's philosophy of science see Susan Haack's *Putting Philosophy to Work*.

(2) He argues against knowledge's criteria—what counts as knowledge—as justified true belief. His main qualm is the use of evidence to justify an evidence claim. However, evidence is just one component to justification. The other is coherency—does it contradict other knowledge (i.e. how well does it fit in with other things we know already). See Haack's *Evidence and Inquiry* for a good attempt to nail down what makes up or gives us knowledge. He seems to ignore the truth component. No matter how justified we are about our beliefs they have to jive with reality (this maybe all his testability comes to). He is correct that given this definition of what knowledge is that it is not unproblematic.

(3) He also believes in conjunction with his focus on explanations that we have the capability to solve all problems we may encounter. And, this capability has no limit. He severely criticizes that there are limits to our growth as a human species. He bases this primarily on the fact that such predictions have all been wrong in the past (e.g. energy and resource depletion, environmental destruction). And, now possibly climate change (although, not as from the fashionable conservative debunkers). He calls the limits to growth sustainability arguments. His solution is not to purposely stop our growth, but to be optimistic that more solutions will be found in the future. The fact that such environmental predictions have failed in the past, does not necessarily imply that they will continue to fail, but neither does it show that these limits can ultimately be overcome.

(4) He believes that the many-worlds interpretation of quantum physics is the currently the only option to explain quantum effects. This is that all possible outcomes occur; it is just that each one occurs in a different universe. At the same time he is critical of multiverse theories. In my mind neither version has the necessary experimental backup to show that either of them are true. But, because of his reliance on explanations carrying the load in science he believes the many-worlds interpretation is the best one we have at the moment.

(5) I am not a fan of meme theory as he appears to be. The analogy with the gene as the unit of genetic inheritance is not as tight as it would need to be to make the meme's use anything more than metaphor. Does this make the meme concept worthless? I do not believe so; it is just that caution is needed until such time, if any, we have a bona fide theory of memes. See *The Electric Meme* by Robert Aunger for a good book on producing such a theory—its pluses and minuses.

(6) Finally, he is a big proponent of quantum computing. However, I have a knowledgeable goodreads' friend that thinks it is not the computing panacea for computational complexity that it is most often portrayed as in popular science works if I understood him right.

I found the book to be interesting. However, at times it seemed to drag under the weight of repetition. While I have my qualms about all of his views displayed in the book, I would agree that pessimism about our future capabilities to continue to grow as knowledge is more or less misplaced. And, while I would temper his optimism toward solving all of our problems now and in the future, there is not any good reason to throw up our hands and surrender. Solutions may indeed be found; there is no necessary impossibility to solving all our problems with an advance in our knowledge.

This would be a good book for those interested in a sort of nonstandard view on philosophy of science. If you do not like or have the capacity to entertain different views on what science is, where it leads to, and its ability as a problem solver, than I would not suggest this book.
