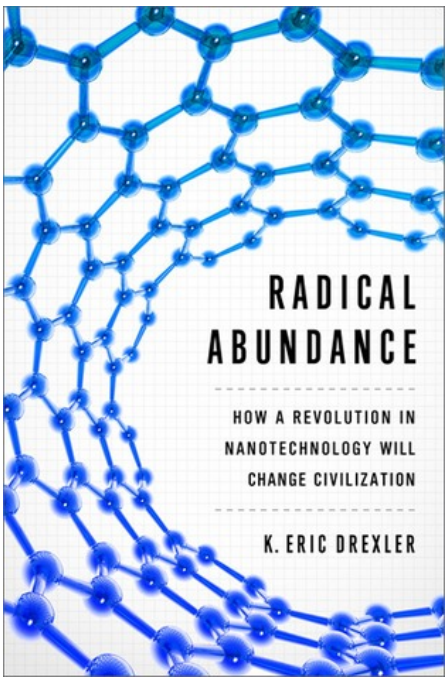

Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization

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Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization K. Eric Drexler K. Eric Drexler is the founding father of nanotechnology—the science of engineering on a molecular level. In *Radical Abundance*, he shows how rapid scientific progress is about to change our world. Thanks to atomically precise manufacturing, we will soon have the power to produce radically more of what people want, and at a lower cost. The result will shake the very foundations of our economy and environment.

Already, scientists have constructed prototypes for circuit boards built of millions of precisely arranged atoms. The advent of this kind of atomic precision promises to change the way we make things—cleanly, inexpensively, and on a global scale. It allows us to imagine a world where solar arrays cost no more than cardboard and aluminum foil, and laptops cost about the same.

A provocative tour of cutting edge science and its implications by the field's founder and master, Radical Abundance offers a mind-expanding vision of a world hurtling toward an unexpected future.

Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization Details

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From Reader Review Radical Abundance: How a Revolution in Nanotechnology Will Change Civilization for online ebook

Pierre says

The deterministic and dry counterpart to the stochastic and wet Creation https://www.goodreads.com/book/show/1.... Convince yourself this is no crank by looking at his original dissertation http://e-drexler.com/d/06/00/Nanosyst.... For a shorter read without the history and politics (which are also important) and philosophy (which is an interesting distraction to a limited audience) see http://en.wikipedia.org/wiki/Molecula...
I'm glad I found this book because it led me to read these other sources.

Not 5 stars because of style and verbosity. Next time I hope Drexler collaborates with a science writer. I only had patience with the epistemological rhapsody on engineering compared to science because I am separately interested in the topic.

Jonathan Jeckell says

A surprising portion of this book was not actually about the technology behind nanotechnology…oops, sorry, Atomically Precise Manufacturing (APM). The author begins by explaining how he became interested with the topic, and explained how research got ironically got completely derailed by the hype that surrounded nanotechnology in the 1990s in addition to explaining the technology and its feasibility. Unrealistic expectations, researchers jumping on the bandwagon with unrelated research to obtain funding for their programs, and weird hysteria about “grey goo” taking over the world all made nanotechnology seem like a fad. So he goes to great pains to call what he is proposing “atomically precise manufacturing” and showing how it differs from previous hype. For example, some forms of atomically precise manufacturing are already with us in biochemistry, the pharmaceutical industry, and other places. He makes a fantastic case that this technology is feasible and will make really useful things.

He also gives one of the most lucid descriptions of the differences between scientists and engineers, and how these two groups overlap, that I have ever heard. But he also makes a valiant, but naïve attempt to discuss the societal impact of APM and the sudden shift of economies and politics in an era of “radical abundance.” He describes the tectonic shifts in employment and investment, the dislocations of many existing professions, etc. So far, so good. I can even accept his claim that many raw materials will be less important (oil, iron, etc.) because APM can synthesize better alternatives (such as ultra-strong composites in lieu of steel and super cheap photovoltaic solar in lieu of oil). Ok, maybe. But then he described the national security implications of all of this. He evidently overestimates the importance of resources as a cause for war and grossly underestimates other reasons, such as ideology.

He also described the importance of international scientific collaboration in developing nano, er APM because of the severe risks of paranoia, dangerous arms races and misunderstandings. Because APM accelerates design cycle times and can make dangerous things very quickly, one nation could never be sure that another wouldn’t develop overwhelming capabilities overnight. Perhaps that is true, but if it is, that is precisely why at least *one* nation would do just that. This is a classic Prisoners’ Dilemma from game theory. Everyone that cooperates gains, but anyone who defects and screws everyone else over hits the jackpot. His policy recommendations were also aggravating. He says because someone *might* make

something dangerous with APM, that it should be tightly regulated by the government. That virtually assures that research will be kept out of reach of anyone outside giant laboratories who will entrench their organization's power. It will also assure that no fresh thinking enters the field and it will converge into a groupthink love fest. This would be a horrible mistake that would deter real innovation. This advice is kind of odd and contrasts with the praise he heaped on open source and public programs like FoldIt, where people can fold proteins for fun on their computer, but the results produce real scientific benefit. How about a game based on his APM design software where anyone can design a nano-device for fun, like Kerbal Space Program? The products people make could be put into a big open source library of stuff people made and sifted through by anyone interested for things that might actually be useful. It would be like having a genetic algorithm generate all kinds of options to see if it makes something useful, but scores of people would be trying to do that intentionally.
I really enjoyed (most of) the book and look forward to seeing the benefits this can bring to the world, but it was marred by timid advice I hope gets ignored on restricting access to the technology, and I would like to see someone think through the really serious national security implications to prevent his darkest predictions from coming true.

Fain says

A breathless love letter to nanotechnology and "atomically precise manufacturing" that no one asked to read. It has astonishingly little content; the author repeats himself for three hundred pages and seems very pleased with himself for doing so.

K-dizzle says

This book is a very good broad overview of APM technology and what it will be able to do one day in the future. However, it offers very little in terms of specific developments, emerging areas or topics that need more research in order to make radical abundance a reality. Saying that, I did love the way the author describes the difference between engineering and research, and will be using that same analogies when I teach my students.

Mal Warwick says

Once upon a time a nutty scientist gave a talk called "There's Plenty of Room at the Bottom."

The scientist was the wacky and wonderfully entertaining Nobel Laureate Richard Feynman, the guy who solved the mystery of the Challenger disaster. It was 1959, and he was not referring to organization charts but, rather, to the bottom of the physical measurement scale. He was referring to atoms and molecules measured in nanometers.

As a student, Eric Drexler took up Feynman's challenge. He's the man who crafted the term "nanotechnology" and set off a race for its realization. In Radical Abundance, he sets the record straight on this much-misunderstood field and paints a picture of a possible (not certain) future of plenty for the human race.

It’s important to note at the outset that, despite the implied inevitability of the book’s subtitle, Drexler is not in a class with the boosters of a glorious future such as Ray Kurzweil and Peter Diamandis. (I previously reviewed Diamandis’ Abundance: The Future Is Better Than You Think.) Drexler is more level-headed than that. He recognizes the immensity of the challenges facing homo sapiens in the twenty-first century, from the self-inflicted travesty of global climate change, to the danger of massive unemployment once manufacturing is completely automated, to the sheer perversity of human nature in organized settings.

A future of unlimited possibility

At his most expansive, Drexler describes a revolutionary new nanotechnology manufacturing paradigm that could produce such items as ultra-efficient solar energy generators, ultra-safe, zero-emission automobiles, and, presumably, perfectly insulated dwellings with innumerable electronic capabilities — all from simple raw materials such as air, sand, and water.

“Imagine a world,” Drexler writes, “where the gadgets and goods that run our society are produced not in a far-flung supply chain of industrial facilities, but in compact, even desktop-scale, machines. Imagine replacing an enormous automobile factory and all of its multi-million dollar equipment with a garage-size facility that can assemble cars from inexpensive, microscopic parts, with production times measured in minutes. Then imagine that the technologies that can make these visions real are emerging — under many names, behind the scenes, with a long road yet ahead, yet moving surprisingly fast.”

An unfortunate detour along the way

As the author explains at length (and in more than one place, resulting in some duplication), his vision of nanotechnology — enunciated in a scholarly paper at MIT in 1981 and in a widely read book for the public, Engines of Creation, five years later — was a call for Atomically Precise Manufacturing (APM). In Drexler’s concept, scientists and engineers a few decades down the road would perfect the techniques of assembling atoms and molecules into minuscule machines capable of crafting slightly larger machines, which would in turn create even larger machines. After numerous generations of ever-more capable machines, the system would turn out all manner of useful items. And the whole manufacturing system would be housed in the equivalent of a box just slightly larger than the products it was designed to manufacture.

Sadly, Drexler’s compelling vision was bowdlerized soon after the publication of Engines of Creation by both journalists who rhapsodized about such things as tiny robots that would rush to a blood clot and demolish it before damage could be done, and science fiction writers who, of course, went much further. You may recall reading about nanobots run wild and becoming “gray goo” that would consume everything in their path, including their creators. Though Drexler protested loudly that this was nonsense, the most colorful of these creations took hold in the public imagination and helped suppress the funding necessary for R&D to bring his vision to fruition.

Even worse happened in 2000 during the transition from the Clinton Administration to that of George W. Bush. Earlier that year, Wired magazine published an article by Bill Joy — a cofounder of Sun Microsystems and one of the country’s most celebrated technologists — warning about the dangers inherent in nanotechnology, genetic engineering, and the creation of sentient robots. Joy’s disquiet was summed up in a single sentence: “robots, engineered organisms, and nanobots share a dangerous amplifying factor: They can self-replicate.” In effect, Joy had fallen prey to the “gray goo” fallacy. And apparently his fear projected onto the managers of a bill recently passed by Congress to allocate a billion dollars to nanotechnology research: instead of just taking the money and running with it, the custodians of the program rewrote the terms of the grant (after Congress had defined them) so as to rule out any mention of atoms or molecules and instead to

redefine nanotechnology as a field dealing with anything really, really small (i.e., measured in nanometers). As a consequence, the field bifurcated into two streams, with the public drowning in all the confusion that came about.

A book for scientists, engineers, and their fans

Radical Abundance covers a lot of territory, from Drexler’s personal intellectual history to the history of technology to the difference between science and engineering as well as his vision of future plenty. However, much of the book requires more than a rudimentary understanding of science. Rather than characterize its audience as the general public, it’s probably fairer to say that those who would gain the most from the book are scientists, engineers, and people who can engage in conversations with them without becoming befuddled. In other words, the book is challenging at times for a reader such as me: my last organized brush with science was half a century ago in college, and what I learned then (little of which I remember) bears little resemblance to science today, anyway. Nonetheless, the prophetic message in Radical Abundance — and the numerous warning signs posted throughout the book — make this invaluable reading for anyone concerned about humanity’s prospects for the future.

Jamie Archer says

The father of nanotechnology follows up his seminal book and shows how we're not far away from a manufacturing revolution that will change our lives forever. Forget artificial intelligence Atomic Precision Manufacturing is what will immediately change the world in the short and long term

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Teresa says

I rarely abandon a book midway, but I just couldn't keep plodding on through this book. I knew when I began that it was an advanced topic, but I wasn't scared off by that awareness. In fact, I did not have difficulty understanding the material being presented, but the delivery was done in such a dry manner that since I am not in this field, I just didn't ever get hooked.

Life is too short to force myself to finish a book when I give it an honest try and fail to find a connection, or have my curiosity piqued sufficiently to commit to completion. So, regrettably this review has not much to offer directly about the material. I remain curious about the topic and will look for other books to give me insight into the topic and how it will transform us.

Atila Iamarino says

Comecei o livro achando que ele trataria de nanotecnologia e perspectivas recentes, mas encontrei algo bem diferente. Drexler passa a maior parte do tempo definindo como ele é o criador da área e maior autoridade no assunto desde que publicou Engines of Creation: The Coming Era of Nanotechnology (algo corroborado por outros pesquisadores da área, mas não é bem nesse livro que essa informação precisa estar para ser confiável) e pouco tempo falando sobre nanotecnologia de fato. Depois vem uma grande explicação sobre como o termo nanotecnologia foi cooptado por outras áreas para conseguirem dinheiro que seria direcionado à nanotecnologia molecular (área atual que realmente representa o que Drexler defende).

O livro acaba sendo uma grande defesa de como ele foi mal interpretado e "roubaram" a atenção e o fomento de sua área. O que parece ser bem verdade, mas não contribui muito para tornar o livro interessante e deixa o assunto do título completamente secundário. Outro ponto complicado é que o livro é bem mais longo do que o necessário por conta de digressões em várias direções que mostram como o autor é capaz de fazer várias ligações e tem um domínio de muitas áreas, mas não contribui para o tema também.

No fim, fiquei bem interado das disputas na área, mas ainda preciso de uma boa referência mais popular sobre nanotecnologia.

Ken Hamner says

Definitely not my favorite book. The subject is complicated, and this book did little to untangle the knot.

Paul McNeil says

Just a few months ago, I read Neal Stephenson's The Diamond Age, a fantastic novel about a future where atomically precise nanotechnology is the norm and civilization as we know it has moved from nations to self-determined enclaves. One of the scientific heroes of this world is K. Eric Drexler, one of the real-life pioneers of nanotechnology, and this book, Radical Abundance, is his take on the past, present, and future of this technology. He is not talking specifically about nanotechnology as we usually use the term (meaning small-scale tech, and he talks a lot about how, in his view, such an approach to small-scale materials has hijacked research and press from his focus), but rather what he calls atomically precise manufacturing, or atomic machinery that can be used to make materials and, ultimately, other machines. Drexler's vision is of a world where we can make just about any material faster, cheaper, stronger, and better, all with these molecular-scale machines. He shares the history of this technology, and his role in it, and discusses all the progress going on behind the scenes. As for the future, he envisions a society fundamentally remade by better, cheaper materials, which can help us with energy and water crises while bettering the standard of living world-round. Futurists like Ray Kurzweil cite Drexler's work, but in this book, Drexler steers clear of things like the singularity, focusing instead on a physical abundance (the direct products of these processes), where what is basically the ultimate 3D printing process possible makes sure we always have enough of everything at a fraction of today's costs.

However, Drexler recognizes there is a long road, and I got the feeling while I read that his main goal was to inspire future researchers. Although he writes for a general audience, and does not expect much previous knowledge in the way of physics (this biology grad could follow it), the book still has a somewhat technical feel, and some of the debates going on, while interesting, don't have the same effect on an outside reader, like myself. For example, he discusses the important distinctions between science and engineering, and how his project requires advances in both, but especially the approach of the latter. This is an interesting and important division that I had never thought about much, but he really wanted us to understand it, so a few chapters focus on this idea. However, once I muscled through those parts, I was left hopeful that this technology could come to fruition in my lifetime, but, at the same time, I won't plan on seeing it either. It seems to good to be true, but Drexler has shown that maybe, just maybe, it isn't.

Andrei Khrapavitski says

This book is about an incredibly exciting subject: nanotechnology. The field is booming and promising. The best way to start exploring it is probably by reading the father of the term itself.
I'm afraid to report, this book was not a good read. I soldiered through pages and pages of repetitions and finally reached the end. The book is long and extremely monotonous. Dexler, who invented the term "nanotechnology," could've written something more exciting on his progeny...

And yet if you are able to cope with the repetitiveness of the text, it is worth reading for those of you interested in Kurzweil's predictions and the potential of new technologies. If you're not as patient as me, many parts can easily be skipped.

Douglas Summers-Stay says

I've been following the developments in nanotech since the 90's, when I read Drexler's original book (Engines of Creation). Both that one and the subsequent one (Nanosystems) were better than this one. The technical details he presents in this book were already familiar, as well as the potential for revolution in the manufacture of physical goods and the potential for incredible cost reductions and performance improvements that molecular factories would make possible. The remainder of the book was mainly about the politics of science (like Noble Savages, the last book I reviewed) a subject which is no doubt endlessly fascinating to the participants, but very boring to anyone else. Drexler is upset that people use the term nanotech to include any tech on the nanoscale, since what he meant when he coined the word was atomically precise manufacturing. The former, being easier, has siphoned away a lot of money that could have been spent on the latter.
The most interesting part of the book to me was the contrast of science and technology. Since my work is a hopeless mishmash of both, often technology pretending to be science, I enjoyed his take.
All of my criticisms, though, are of style and presentation. Everything Drexler suggests seems like a good idea that should be heavily funded if possible. He seems quite level-headed despite the limitless potential of the system he describes.
One important idea that I had to work out for myself, that he spends some time on in this book, is how much time speeds up in virtually every way as you shrink down in size. If you think about how systems inside a cell must work, by accidental collisions until the right molecule comes along to latch to, it seems impossible that enough interactions could ever happen for such a system to work. But when you take into account the short distances involved and the associated speed-up possible, it no longer seems so absurd. I must have read a little about this in Engines of Creation, but it wasn't developed in such detail.
What I would have liked was a carefully thought out plan for precisely how modern molecular assembly (I'm thinking of how they use DNA and RNA to make structures) can be used to build atomically precise machines of the type he describes. Such machines seem to have two competing restrictions: they need to be as small as possible to make them assemblable (sp?) one atom at a time, but as large as possible to make them behave more like bulk materials than like chemistry. He makes some vague descriptions, but the technical detail is what I was looking for.

Bill Leach says

This book is so full of unsubstantiated generalities, that it is unreadable.

Some very strange ideas - the clashing concerns of science and engineering.

I took nothing away from it.

Ben Rieger says

When the author was giving specific information the book was great. Unfortunately those instances were in the minority and the rest of the time the author was speaking in generalizations and meaningless vague language. The "information" in this book mostly fell into a useless middle ground between digestible example or analogy, and technical detail.

The majority of the book reads like the author had personal demons to exorcise, rather than exciting or important information to share. There were certainly a handful of parts that were inspiring or packed with semi-technical information, but the rest of the book was drowned in a muddle of overly intellectual rambling. This book should be edited to cut out or refocus that bulk.

David Haller says

What a frustratingly dull book.

It seemed, on the surface, like a go-to source for a survey of nanotechnology; it is, after all, written by the fellow who coined the term. The author, unfortunately, uses the book as a mere platform to decry the bastardization of the term nanotechnology itself (alas, sometimes words fly way on their own after you coin-and-release!), advocating the more "accurate" term "atomically precise manufacturing" (APM); he goes on, even more sadly, to desperately remind the reader AGAIN and AGAIN that he is the fellow who initially popularized the subject of nanotechnology himself (though it's worth noting that he has done little in the actual technical or theoretical development in the field.)

One positive note: Drexler DOES provide an insightful discussion in the contrasting aspects of science and engineering, in particular, too, providing a nice overview of the methodology of engineering development (though a similar discussion can be found in the more entertaining "Synthetic Biology: A Primer")

I soldiered through, and it was rough. One hopes that there are better surveys out there.
