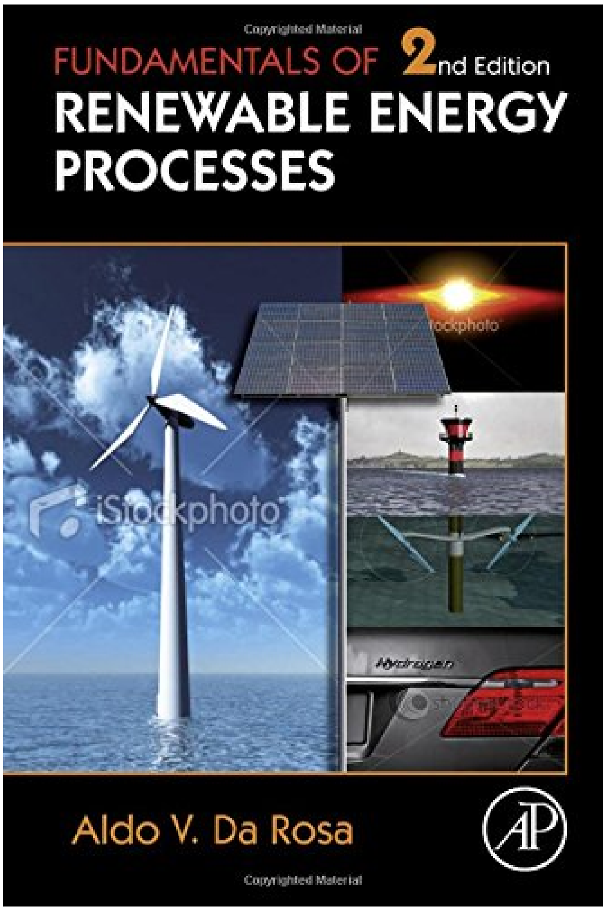
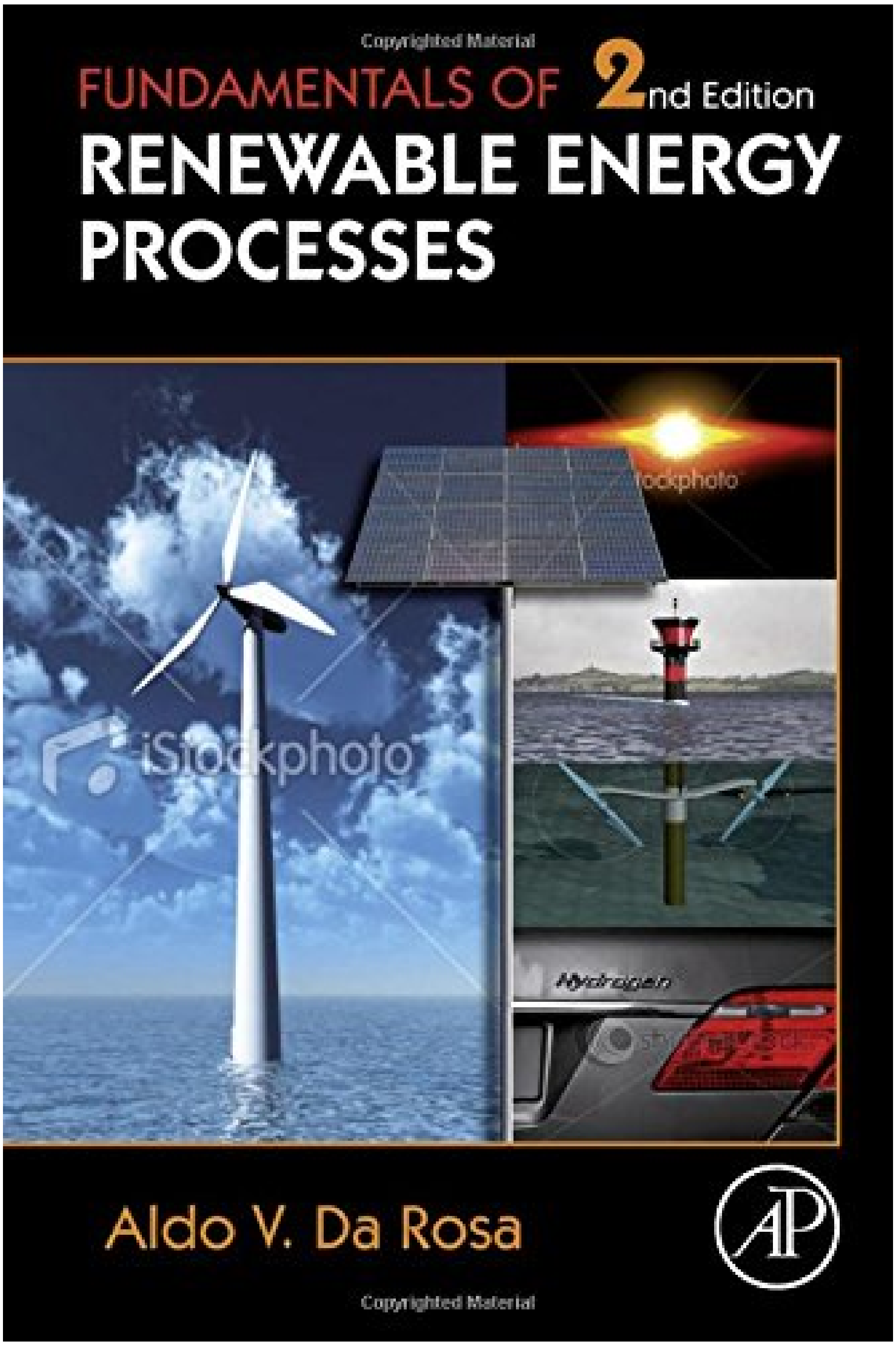
FUNDAMENTALS OF RENEWABLE ENERGY PROCESSES, SECOND EDITION BY ALDO V. DA ROSA

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About the Author
Dr. da Rosa taught the perennially popular Renewable Energy course at Stanford University for over 30 years. Former Chairman of the Brazilian National Research Council, Director of the Aeronautical Technical Center, and founder of Brazilian NASA, he also served as the CEO of a tech start-up, Chairman of the Board for a microprocessor manufacturer, and as a member of Siemens Corporation's scientific advisory board.

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We are hearing a LOT about renewable energy these days! But unlike most available resources on alternative energy that focus on politics and economic impacts, da Rosa's practical guide, Fundamentals of Renewable Energy Processes, is dedicated to explaining the scientific and technological principles and processes that enable energy production from safe, renewable, clean sources.

Advances in the renewable energy sphere are proceeding with an unprecedented speed, and in order for the world's alarming energy challenges to be solved, solid, up-to-date resources addressing the technical aspects of renewables are essential.

This new, updated 2e of da Rosa's successful book continues to give readers all the background they need to gain a thorough understanding of the most popular types of renewable energy?hydrogen, solar power, biomass, wind power, and hydropower?from the ground up. The latest advances in all these technologies are given particular attention, and are carefully contextualized to help professionals and students grasp the "whys and hows" behind these breakthroughs.

•Discusses how and why the most popular renewable energy sources work, including wind, solar, bio and hydrogen
•Provides a thorough technical grounding for all professionals and students investigating renewable energy
•The new 2e of a highly regarded guide written by an internationally renowned pioneer

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About the Author
Dr. da Rosa taught the perennially popular Renewable Energy course at Stanford University for over 30 years. Former Chairman of the Brazilian National Research Council, Director of the Aeronautical Technical Center, and founder of Brazilian NASA, he also served as the CEO of a tech start-up, Chairman of the Board for a microprocessor manufacturer, and as a member of Siemens Corporation's scientific advisory board.

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30 of 34 people found the following review helpful.
Idiosyncratic survey course
By Scott C. Locklin
When I review reference books, I like to think about what they're supposed to be used for. This book is

apparently used for a course in Stanford. Now, I ask myself ... what is this course used for?

This book is a wide-ranging collection of more or less stand alone chapters. Upon first scan, I was tempted to simply echo the other "wow -very complete; I feel smarter already," reviews already in place. But I am afflicted with this thing called "a conscience" so I actually read a few chapters rather than looking at the table of contents and declaring Professor da Rosa a genius, as well as myself by association. The first indication something is seriously awry here is the first chapter, which includes a lengthy defense of the cold fusion work of Pons & Fleischmann, which is, well, wrong. I feel qualified to comment on this, as I know several researchers who actually attempted to reproduce their results, have attended several talks which debunk their claims, and maintain a journeyman interest in the subject which apparently surpasses that of the author of this book. This is admittedly a short section of a chapter, so I move on. I come to the section on mechanical heat engines, where the author makes the outrageous claim that, had early automobile manufacturers gone with the Stirling engine rather than the Otto or Diesel engines which were used, vehicles today would be "more efficient and less polluting." This statement is so wrong, it makes my head spin. I'm reviewing a book here, so I can't get into why this is wrong, but it is absurdly wrong. A giant hint as to why it is a silly statement should come from the fact that nobody in the early development years of motorized vehicles ever bothered sticking a Stirling engine into a vehicle, despite people trying things like electric, steam and even compressed air were actually deployed in real, useful vehicles. Rather than blurting out something that incorrect, a more useful discussion might be why something like a Stirling engine wasn't a useful device for vehicle power, and/or why this is different now. Perhaps a little discussion of the history of the Stirling engine, and why it was never even a serious competitor even to other external combustion engines (aka steam engines) might also be useful.

Moving on, the chapters on thermoelectric and thermionic power are fairly informative. I'm familiar with the physics of this sort of thing, as I've worked with things like klystrons, and have collected antique radios for the last 24 years or so. I'm not familiar with thermionic generators being any kind of "renewable" energy transforming device, though I suppose it is vaguely possible. I have seen clever corner applications of things like thermionics and thermoelectrics to generate power in remote locations (spacecraft, and Siberia, believe it or not), but for large scale industrial purposes, I've never heard of such a thing. I find it a little weird that he never compares these odd corner cases to conventional ways of generating power, such as plain old turbines and electric generators, but I guess this isn't really a book about "renewable energy" -it's a book about "weird ways to obtain energy that you haven't heard of." I mean, why not mention Faraday disk generators? Faraday disks are simple, cool, and they're actually useful in interesting places.

When I first read chapter 8, I figured the author had completely lost his mind, but really, people do use radio-noise generators. I had a key card from my days at Larry Berzerkeley Labs which was powered by such a thing. Of course, there is nothing "renewable" about this; it's just a way of powering something very small by using radio waves. The thing is, this chapter is just chucked in there next to thermionic generators and before hydrogen power, and various hints are given that this could figure into some kind of large scale energy generating scheme. Huh? Obviously this is not true. Maybe it's OK for "renewable energy" students to know about this. Maybe it will give them some idea for obtaining energy in some RF rich environment. No hint is ever given as to where this RF rich environment might be. Solar powered satellites beaming microwave energy to earth, a la Gerald O'Neill? Nikola Tesla like magnifying transmitter technology? Who knows: the author never tells.

Next, the author gets into "hydrogen power." Helpfully, he includes what most people call "batteries" in the chapter on fuel cells, because that's all a fuel cell really is: a fancy battery. I also agree that fuel cells of all kinds do belong in the hydrogen chapter, despite the fact that they sometimes have nothing to do with hydrogen: even carbon fuel cells (which he manages to avoid mentioning for some reason) can be thought of as a way to store hydrogen-like things. I was getting pretty comfortable and having a good time reading this chapter until he claimed that the only reason we don't have fuel cell powered cars right now is because we don't have the mass production tooling to do this. Once again, I'm confronted with a pie eyed statement which is so far beyond wrong as to boggle my mind. Who published this book again? A professor from Stanford? The fact of the matter is, I can purchase all the fuel cells I want. Enough to power a car even. Go google for it: you can find them. The difficulty lies in the fact that the fuel cells can't tolerate "dirty" fuels, such as we use for our energy infrastructure. There is a huge amount of active research on making these things work with even relatively clean stuff, like highly distilled alcohols (which still contain many impurities). It's a hard problem. The author of this book seems to be unaware of this. I'm no expert in "renewable energy" or any other kind of energy, but I'm aware of this. Why doesn't he mention it? It is a mystery. This chapter contains a decent appendix which actually mentions energy storage density, making a comparison between conventional batteries, fuel cells and "supercapacitors." Now, I very much approve of such comparisons. In fact, I make such comparisons all the time. He doesn't ever make the obvious comparison between the approximately kilowatt/kilogram of fuel cell versus a the 45-48 megawatts per kilogram of fossil fuels. By the way kiddies; that's why we don't use electric powered cars. Gasoline and diesel are very, very efficient means of storing energy in a small volume. I'm guessing the author doesn' t mention this because it's embarrassing for "renewable energy" people to be confronted with thermodynamic reality.

His chapter on the industrial production of hydrogen seems OK, though obviously I didn't read in great detail. The chapter on storage of hydrogen is again missing an important fact: if you store hydrogen in metal hydrides, you can't get the metal hydrides "dirty." In this case, "dirt" includes atmospheric oxygen. This is rather an interesting problem; obviously, if we're going to use hydrogen motorcars, we need some way to store the hydrogen. He also doesn't compare the energy density able to be stored in metal hydride containers to the obvious way of storing hydrogen carbides: a gallon of gasoline. Gasoline is a very efficient way to store hydrogen. So is methanol. But, we're in "renewable" land here, which I guess means "imaginary technologies I wish were practical" in this book.

The section on Solar Power starts off much better than the rest; he goes into very practical details as to how solar energy can be used by people. Biomass, check -nothing terribly wrong presents itself upon a quick skim. It would be nice if he could make some gestures towards the efficiency of harvesting biomass versus, say, building a big solar power plant, but at this point I'm not expecting much: I'm just trying to get through the whole book without having an aneurism. Section on photocells; check -nothing terrible there I was able to discern. The section on wind energy appears to be excellent; I actually learned a few things from reading it. Ocean power? Well, I guess it was OK if you just want a list of things you could do to make power using the oceans.

There is a lot of weirdness scattered through out this book. In the chapter on thermodynamics, he includes a bizarro aside about "how to plot data." His conclusion seems to be, don't use histograms when you want to preserve the area under a curve. Well, yes, that's true ... sometimes. So what has this to do with anything? The first chapter on solar power has a not so helpful aside on the measurement of time. Yes, I guess time is vaguely pertinent to solar power, as it is to anything else in science, but ... gads, this is just bizarre. Orbital mechanics ... somewhat less bizarre, but still just added in as filler/trivia as far as I can tell.

Now, for what is missing from this doorstop. Wind and ocean and solar array boilers are potentially cost effective technologies for harvesting actual renewable energy. What he leaves out is how to transport and store the energy. These are non trivial problems. For example, let's imagine a pie in the sky scenario where America is able to power it's entire GDP on solar power. Great. What do we do when it's dark outside, whether because of clouds, or just because there's no sun at night? We need ways of storing vast amounts of power. Waving your hands and saying "fuel cells" is baloney; we need energy storage on a vast scale. Now, lets get into it a little deeper: total solar energy impinging on North America is going to look like something like 500watts/square meter peak, at noontime. Assuming an unrealistic conversion efficiency of 10%, and taking a sort of mean over the course of the day, call it an optimistic 25 watts/square meter harvested. We use trillions of kilowatt hours in America. OK, so that's some absurdly large solar panel somewhere out in Nevada. How we gonna get the power to somewhere it can be used? Similarly with ocean and wind power - even worse really: we need to transport the diffuse energy collected from point A in the wilderness to point B in a city or factory. This requires technology and/or material we do not have. There are technologies for dealing with this sort of issue, but the author of this book never mentions them. He also doesn't mention how finance works. Oh, he does mention compound interest, and that finance is important, but there are vast issues here which he never even alludes to. For example, volatility in the price of natural gas has a huge effect on whether or not things like the "renewable energy" technologies he mentions are practical or desirable. If you're going to get renewable energy invested in, it's going to happen because of finances, not because of political will. In the absence of central planning, finance always wins. There are decent financial arguments to be made for investing in some kinds of "renewable energy" -if the volatility of fossil fuel prices exceeds the risk of using new energy technologies -the new energy technologies will get funded and built. There are plenty of other "renewable" technologies which he just plain doesn't mention, despite having entire chapters on things which are neither practical, nor particularly relevant to anything resembling "renewable energy." One which comes to mind is magnetohydrodynamic generators; a great way to harvest waste heat which has actually been used on large scale projects. If he's going to devote a sub-chapter to "cold fusion" - he might as well talk about practical fusion technologies; some of them, such as Polywell fusion are both potentially useful, and use technology not much more advanced than that used in "cold fusion." Other things missing are discussions of energy budgets in motor vehicles. He mentions hybrids as being "more efficient" without much supporting evidence or indications as to why this might be so. If hybrids are so much "more efficient" -why haven't long haul truckers adopted them? More to the point, the way people fool themselves into thinking stuff like this: most hybrid vehicles pull a game of three card monte on consumers by using simple efficiency tricks like less sticky tires and more aerodynamic chassis -something which figures hugely in the energy budgets of motor vehicles.

This is not, ultimately, a serious book. It's certainly serious looking; you could probably hurt someone with this thing. It even has equations in it. But the topics covered are not going to be useful to any serious person who wants to know about renewable energy technologies, even to the point where he might want to select an interesting one to devote his life to. I give it a star for the material it does cover without waxing ridiculous, but only one star, as some of his choices of material and pie-eyed statements are so bad, I don't fully trust the material I don't actually know about. The book appears to be a collection of notes someone cobbled together and called a book. After writing the above, I went out and tried to figure out who the author was, imagining him to be some kind of dreadlock wearing hippy. He is actually a very great man -much greater than I, typing this review in my underpants in my tiny little hovel, can ever hope to be, and I admire his life and all he has accomplished. But I still don't think he wrote a great book, and while I am not a great man, I am a very honest one, and so I'm not going to change my opinion because Aldo da Rosa is an amazing individual.

3 of 3 people found the following review helpful.
wide survey of the field
By W Boudville
If you have any interest in alternative energy sources, then this updated 2nd edition [2009] should be of interest. da Rosa writes for an engineering reader and uses simple undergraduate level physics as the basis for an extended survey across all the proposed energy sources.

There are a couple of chapters on basic thermodynamics and heat engines. These are seen in most starting books on thermodynamics and could perhaps have been omitted here, but the author chose to include them as a foundation for the bulk of the text.

The topics include thermoelectricity, thermionics, fuel cells [mostly hydrogen based] and solar cells. For the latter, we see a division into photovoltaic [ie. for electricity generation] and for heat generation. Most of the coverage here is for photovoltaic. There is a brief foray into the theory of semiconductor heterojunctions, where the electron hole pairs are generated by incident photons. Efficiencies are still somewhat low. But perhaps if you are thinking of going into research in this field, this is inspiration!

The last section of the book delves into wind and water sources. The details should suggest that windmills are simpler to build and maintain. Whereas the extraction of energy from tides and waves involve much more mechanical stresses on the equipment, and greater corrosion effects.

It is a good measure of the book's sweep that the author included an appendix to one chapter that was on batteries. Strictly, the study of alternative energy sources has nothing to do with batteries. The latter are about storing energy that we get from some source. But as a practical matter, there is also a need for more efficient batteries, whatever the sources of energy for these. One very specific case is for reducing the use of oil in vehicles. A vital global need, especially to head off global warming. Many proposed alternatives involve batteries for cars. The book shows that much work needs to be done.

As a throwaway mention, the book has several pages talking about cold fusion, starting with the Pons and Fleischmann results from 1989. It emphasises the lack of anyone else to duplicate the original results. But suggests from ongoing low level work by others that there might be something in this after all. The discussion of cold fusion is a good synopsis of 20[!] years of controversy and research. The treatment here is a far soberer alternative than perusing some way out websites peddling woo woo tripe on the subject.

Another minor section talks about radio noise generator. A fundamentally simple concept of converting heat directly into electricity by hooking two resistors in parallel and having them at different temperatures. A current will flow from the hotter to the colder, and the current can be used for any task. Alas, the analysis shows severe drawbacks for any practical implementation.

4 of 5 people found the following review helpful.
Not the Book For Which You're Looking
By Tom D
Whether you think this book has any value relative to its price is going to depend on your definition of Fundamentals. The core content consists of the very basic, and in some cases closer to conceptual, physics and engineering equations that characterize the forms of renewable energy discussed. You will need a math background through differential equations to be comfortable with these. The first of two redeeming characteristics is that it includes at least some of the basics of thermodynamics, electronics and chemistry as they relate to alternate forms of energy. Normally these would be in separate books. Nevertheless, a user/reader will need at least one undergraduate course in each of these topics as well as the math background to have any hope of applying the equations. In a few cases, such as photovoltaic semiconductors and wind turbines, the technical minutia is more appropriate to a dedicated text.

As the author writes, "Economics are crucial to the success of any energy utilization system,..." (p625) yet the economics of renewable energy are only mentioned in passing where examples of historical costs or project cost estimates are available from other sources. The promising ethanol plants around the US aren't mothballed in bankruptcy because of technology; it's the economics that are fundamental.

There's a caveat in the forward to this second edition that pretty well sets it up. "By discussing fundamentals more than the state of art, it is hoped to delay the obsolescence of this writing, especially in this time of very fast evolution of ideas." So understand up front there's no pretext of including anything that's state of the art and arguably not much that's state of the current market. The examples and thoughts seem to be largely at least ten to twenty years old. Arguably "fundamentals" don't change, but enough has changed to make portions of the text obsolete. Again as an example the author cites and old NASA study on Solar Power Satellites (now called Space Based Solar Power) stating "All told, the SPS study did not lead to any major practical application but one can learn from it." The technology has changed to the point that private corporations (Powersat and Solaren, see Wall Street Journal 16 JUN 09) expect to provide commercially viable space based solar power. (see also adAstra, Spring, 2008). Similarly, California's Solar Two is briefly mentioned, but the technologies and economics of thermal solar have changed yet Nevada's Solar One isn't even mentioned, nor are all the operating solar thermal plants in Spain.

And some of the content, in the context of being "fundamentals" is perplexing. Twenty pages on measuring time and orbital mechanics could only be useful at a precision in calculations that's so far beyond the variability in practical applications that it's useless. Forty pages on gasoline engines, even if it does set the stage for hybrid engines doesn't make sense when a little over one page (538-539) is spent on "High Temperature Solar Heat Engine[s]," which are emerging as one of the more practical forms for converting solar energy to electricity. Even that one page is woefully incomplete on key issues. Solar thermal has inherent advantages with respect to storage and operating efficiency over a broader range of insolation than solar photovotaics but neither advantage is mentioned.

The second almost redeeming characteristic is the technical material in the chapter on fuel cells. The economics are still missing as are some of the important operating details. For example, a solid oxide fuel cell may require a couple of days to bring up to capacity so the thermal gradients don't cause self destruction. And there are practical limits to the overall output for each fuel cell type. So, a hydrogen fuel cell that can deliver almost instantaneous output may not be practical for a passenger vehicle because can't deliver sufficient specific horsepower to be practical.

There's one passing paragraph on algae (alga in the text). Yet over 40 pages on the technical details of theoretical semiconductor photovoltaics. In the end you'll know virtually nothing about algae from the text and though you may know that "Photovoltaic (PV) cells exposed to monochromatic light can theoretically achieve 100% efficiency..." (p 632) you won't know what the practically achieved efficiencies are today either in working installations or in lab demos.

The chapter on wind turbines is representative. It covers very, very basic fluid mechanics and the ubiquitous simplifying assumption of "constant velocity" wind. But you won't have any idea whether a propeller type wind turbine should have two, three, four or more blades. Height above ground and all the factors that go into sizing a wind turbine aren't mentioned. Even the basics, such as the available wind power at 150 feet above the ground is 2 to 3 times that of ground level isn't mentioned. You won't have any idea, nor the "fundamentals" to begin to decide whether one large wind turbine makes more sense than say a series of smaller ones. And you won't have any notion of the issues related to connecting to the grid or the huge and constantly varying stresses that complicate wind turbine design and operations.

It's incidental but there are some weird and indefensible statements in the text. "Mechanical and electrical energy are `noble' forms of energy: no entropy is associated with them." That will certainly surprise any mechanical engineering student after their first course in thermodynamics.

At first pass it's tough to figure out what the target audience might be for this book. A close reading of the forward explains that it's used in a college course and then it all makes sense. The market is the hapless students who take the course and are required to use this incomplete and out-of-date text. The course material will need to be heavily supplemented to be of value.

If I can find a way to donate this text to some student who has to take this class, it's theirs. It isn't worth the shelf space.

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About the Author
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