**Reviews**

**Corralling CO₂**
Review by Peter Bane

ALBERT BATES
*The Biochar Solution: Carbon farming and climate change*
208 pp. paper. Illustrated. $17.95

Albert Bates is driven by the specter of runaway climate change, of a world that may become uninhabitable. Though he’s not a full-time climate physicist, it’s hard to call him a layman either. He began writing on the subject 20 years ago. *Climate in Crisis* (1990) made comprehensible what researchers were just then discovering: that atmospheric temperatures had marched in lockstep with carbon dioxide levels through four ice ages and possibly longer than three million years. That was bad news because CO₂ levels were at 350 parts per million, rising steadily, and the atmosphere was then in territory that hadn’t been seen since proto-humans had last been dragging their knuckles along the African savannas. Worse, the effects lagged the cause by at least 30 years, meaning scientific concern was way out in front of public awareness, which in turn led policy action by as much as a generation. Needless to say, but tragic nonetheless, concerted action by governments and global institutions has floundered, and the ticking CO₂ timebomb is now at 392ppm, its increasing rate of change slowed only the tiniest amount by a massive global recession.

Twenty years of intensely focused scientific research has revealed the penchant of the climate system to flip into dramatically different states in a very short time (we are talking only a decade or even a year). This is because it is far more delicately balanced than humans had imagined even a generation ago. The concern troubling the sleep of climate scientists now is the growing awareness of “tipping points” that can trigger these rapid changes of equilibrium in climate, and the fear that we are fast approaching, or may even have crossed the threshold of several already. Eminence gris and Gaian apostle James Lovelock, accepting that catastrophic warming is now unstoppable, has discounted the future of humanity to well below junk bond status. Author Bates still has a horse in the race, but he’s taking nothing for granted. On this, Lovelock and Bates agree: the chances of large, even runaway greenhouse gas forcing of atmospheric temperatures are much greater than minimal, and the consequences of such a scenario range from the collapse of civilization to the extinction of humans and most higher forms of life on the planet. You would think this would have gotten the attention of everyone who can rather they are the result of human beings burning things—mostly fossil fuels—in ever greater amounts. This is, of course, an economic issue, chiefly the failure of both markets and governments to properly price uniquely valuable and uniquely dangerous concentrated carbon fuels. But that is another story. *The Biochar Solution* is an exploration not of why humans have messed things up so badly, but of what we might now, in the scantest nick of time, still do to save ourselves. The book treats not of the delusional world of economics, but of the physical world: soil biology, cultural encounter, combustion technology, and photosynthesis. It is an engrossing read.

Carbon dioxide levels in the atmosphere, by any sober assessment, must be brought down and brought down fast. There are two approaches. The first, essential but mired in politics, is to restrain the combustion of fossil fuels on the way toward eliminating them. Without essentially ending our use of fossil fuels directly, steadily, and within about 30 years, there is no hope of securing a livable planet for our descendants. The second, which this book explores with the urgency of a bomb squad searching the grocery aisles for a hot-wired can of peas, is to pull that innocuous but fateful gas out of the atmosphere. Leaving aside unproven smokestack capture, and extremely risky and costly underground pumping of the gas itself (Known in the trade as Carbon Capture and Storage, or CCS, it is the hope behind the hype of that ultimate oxymoron, “clean coal.”), there is one surefire hope behind the hype of that ultimate oxymoron: photosynthesis. It is an engrossing read.

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Argument has been raging for almost as long as the climate debate itself, on whether and how to employ forestry and agriculture to capture carbon. There’s no doubt that trees and crops do fix carbon out of the air—after all, the annual swing in CO₂ levels (up 7ppm in November, down 5ppm in May) reflects the vast surge
in photosynthesis that kicks in and out with the Northern Hemisphere growing season. But most of that carbon is called "labile," or short-cycle. It goes into soil or plant bodies and back out to the atmosphere by respiration in a few years or even months. The new twist, and where this book takes its name, is the possibility of creating recalcitrant or stubborn carbon from that photosynthetic potential.

Biochar is a new word for the charcoal made by the deliberate and controlled burning of biomass in the absence of oxygen, a process known technically as pyrolysis. So, how could ‘burning’ more carbon-based material be an answer to the problem of too much CO₂ in the atmosphere? The answer lies in the difference between pyrolysis, which drives off volatile gases and liquids in the biomass, leaving about 60% of the carbon behind as stable, or recalcitrant charcoal, and combustion—true burning—which combines all the carbon in the biomass with oxygen from the atmosphere to produce CO₂ and a small amount of ash.

Humans have been making charcoal for as long as we’ve been making fire, and it’s undoubtedly been a commercial product for as long as we’ve been cooking food in permanent settlements. Charcoal is lighter than wood—therefore more easily transported—and it burns cleaner and hotter. It’s essential to the small-scale smelting of bronze and iron, and has many uses as a filtration medium and in the graphic arts. It’s also one of the dirtiest of traditional industries and has contributed to the deforestation of large areas of the planet and to the deaths of millions of colliers and cooks. Therein lies the rub, and much of the reason biochar has garnered a significant controversy among climate activists. Some view it as one of the few hopeful technologies available immediately; others are fighting tooth and nail to exclude it from international mitigation protocols.

Why Albert Bates finds biochar hopeful lies in its potential, not just to sequester carbon for hundreds or thousands of years, but to improve soil fertility while doing so. Theoretically, we could grow lots of trees, make them into houses and furniture, and not burn down or demolish either for centuries, but practically, we don’t have enough room or need for that many cedazas and ski chalets. We do, however, have a problem with our agricultural soils.

They’ve been steadily losing organic matter (carbon) since the dawn of history, and without chemical life support in the form of energy-intensive NPK fertilizer, they couldn’t be able to feed several billion of us right now. But that NPK, coming out of factories, is part of the fossil fuel use that has to go away. Worse, its use contributes inordinately to the climate problem on the downstream end just from the release of nitrous oxides, to say nothing of further soil carbon losses, and the destruction of estuary photosynthesis (dead zones at the once biotically rich mouths of major rivers the world around).

Evidence for the power of biochar is growing almost daily, from new scientific work on the Little Ice Age, to better understanding of the terra preta (dark earths) of the Amazon, which continue to hold huge amounts of soil carbon hundreds of years after they were created by indigenous farmers. That power lies at the center of the vision Albert Bates creates for us. The opening of his book is one of its greatest strengths and hooks the reader immediately, as Bates takes us on a journey down the Amazon with Francisco de Orellana, the first European to traverse the great river from west to east. The account of that journey, based on the author’s translation of Orellana’s journals (the first into English), is part of a dramatic telling of the ongoing, century-long rediscovery of the recipe for terra preta, and of the rapid response of climate to broadscale reforestation (in this case, induced by a massive native die-off coupled with the immense fertility created by pre-Columbian carbon farming).

Biochar, being the crystalline remains of once-living plant tissues, is full of microscopic holes—the cell walls carbonize and their liquid contents are boiled off. When the biochar is brought into contact with soil organisms—or with compost or compost tea, recipes for which Bates supplies—it is colonized by them and becomes like a coral reef, teeming with life. Added to the upper layers of soil, it inoculates even relatively inert soils with the organisms that make them fertile—fungi, bacteria, beneficial nematodes, and protozoa. These are the organisms that mobilize minerals from subsoil and parent rock and bring them into the rhizosphere of plants. And we have billions of acres of damaged soils ready to be enhanced with biochar.

Permaculture loves solutions that solve several problems at once, and if these are world-shaking problems, so much the better. Biochar is one of those kinds of solutions, and as a permaculture teacher, Albert is all over it. To give you the skinny on everything he writes about the subject would take almost as much space as he uses—the book is short, read it. However, it’s not just about biochar, though that remains the centerpiece. It’s primarily about climate change, and for that biochar is only part of the solution. Tree-planting, specifically, reforestation of desert areas, is an even bigger part of the answer. So is carbon farming, or building organic matter levels in soils using Keyline plows and compost tea. All this is addressed in levels of technical detail that are impressive if somewhat breathless. How to get the water (solar desalination), how to establish the new forests (swales and food forestry with animals, a la Geoff Lawton’s Dead Sea reclamation project), how to nurture the seedlings (the Groboxx, a Dutch invention); we even get a short fantasy on one way to get it done in which the U.S. Marines drop into the Horn of Africa by chopper from a carrier at sea to…take soil samples, leave pyrolysis stoves, and contour a promising spot of climate-shift-induced rain with swales in preparation for a “bombing run” of seedballs. It would certainly be a redemptive future for an outfit that’s lately been blowing up houses in Fallujah.

James Bruges gave us a first look last
year at the biochar debate. Albert goes further by leaps and bounds. Not only was he blogging from Copenhagen last December, as the Global Ecovillage Network’s representative to the U.N. climate talks, (and so has a first-hand perspective on the international political struggle over biochar), but he’s been to the technical conferences among producers who are attempting to characterize and set ethical standards for biochar, enabling him to recount for us who’s who in the industry and what they’re up to. He gives us an honest assessment of the risks: done badly, biochar won’t help anything and may make the climate problem worse (marginally). It could become part of the next speculative Wall Street bubble. But it has too much promise for us to sit on our hands or hold our noses in the air, or to get it wrong. Too much is at stake.

The importance of biochar lies in its centrality in a synergistic web of climate repair strategies, all of which are layed out in the book.

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In describing that web, *The Biochar Solution* reviews cook stove technology, scanning several prominent models and favoring one called the Worldstove. The deforestation/wood-fuel/dirty cooking/pneumonia-tuberculosis epidemic problem is another one of those unsexy global calamities that biochar might just be able to put behind us. (Carbon soot, much of it from wood cooking fires, is a not-insignificant contributor to global warming.) Worldstove’s design not only applies advanced fluid dynamics to achieve great energy efficiencies from the pyrolysis (using the “waste” gases to cook while also producing biochar, a saleable or usable soil amendment), but applies some savvy business thinking to help create jobs and industries in Africa and other needy parts of the world.

If there is a smart, multi-functional, low-cost, democratic strategy that can help to pull carbon out of the atmosphere, it’s probably in this book: chinampas, step-harvest planting of trees (with six times the carbon density per acre), harnessing youth to the task, agroforestry, greening the desert, uneven-aged forest management, carbon farming, the soil food web, and more. Each of these gets a relatively brief, punchy, and fairly technical description. Bates is a good and stylish writer; he has an ear for the pithy phrase, and reading him is generally a pleasure. This book, based on original scholarship, vast knowledge of a rapidly changing global field, and the arcana of many loosely linked disciplines brings the skills and interests of its polymath author together for a supremely important purpose. I do not have any doubt about his integrity or any reason to question his thinking, and stand by my endorsement of the book as a tour-de-force and an important contribution to the global climate debate. A small caveat is in order.

In many of the chapters quite a bit of math is displayed, which is at once respectful of the reader’s intelligence, but more problematic than misspelled words. They may provide an opening for disreputable critique by climate deniers or other malevolent parties, and unfortunately may allow those without a clear opinion on the subject to discount the tremendous amount of research and work that holds up this valuable report.

Like Vandana Shiva in her foreword, I heartily endorse Albert Bates’ vision of gardening the planet; I’ve promoted such a vision myself for 20 years. If we are to save ourselves from species suicide or even from a catastrophic collapse of civilization, then we will need all of the intelligence and appropriate technology found on the pages of *The Biochar Solution*, but as the author acknowledges, we will also need to bring down carbon emissions from the economy. This, in my opinion, will require a major miracle to break the political logjam over cutting carbon emissions from industry, consumers, and the military in the world’s largest and richest economies. I no longer expect this to come about from an uprising of the well-informed through democratic processes—as George W. Bush admitted, we are all addicts, and he ought to know. Rather I hope for a shock to the economic and political system that is like the proverbial two-by-four that gets the attention of the jackass. It must stop the thing in its tracks without killing it or knocking it to the ground. Only after such a blow—enough but not too much, I now believe, will an opening be created into which an informed and prepared mass of civil society could reach for the political changes that will be required to curb fossil fuel use and consumption and to reorient economic life fundamentally. Katrina was one such blow, the September 2008 meltdown of Wall Street another, but evidently neither was enough. Arguably too, we were not prepared to exploit the opportunities. More such blows can be expected.

This book is part of your homework. People, get ready.  

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