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Eating the Sun: How Plants Power the Planet

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Life's Green Power Plant

Eating the Sun: How Plants Power the Planet. Oliver Morton. HarperCollins, 2008. 460 pp, illus. $28.95 (ISBN 9780007163649 cloth).

Anyone feel impelled to read a book devoted entirely to photosynthesis? Even as a plant scientist, I must admit that my pulse didn't quicken when this book appeared on my desk. How wrong I was.

There has always been an aura of impenetrability surrounding photosynthesis, a dry and difficult subject to be revisited only on a "need to know" basis. The chloroplast and its workings have remained safely compartmentalized from the rest of plant biology, though this may partly reflect the nature of the origins of photosynthetic research, as Oliver Morton demonstrates in *Eating the Sun: How Plants Power the Planet.* In fact, Morton has succeeded in producing a genuine page-turner covering the science of photosynthesis, its evolution and role in the history of our planet, and its importance in the current carbon and climate crisis. This is achieved in a drama of three acts: Part 1, "In the Span of a Man's Life," deals with the history of photosynthetic research during the 20th century; part 2, "In the Span of a Planet's Life," covers Earth's history and the origins and evolution of photosynthesis; and part 3, "In the Span of a Tree's Life," considers the development of ideas about oxygen and carbon dioxide, energy, and climate over the past three centuries.

One of the many revelations in this excellent book is that much of the groundbreaking work on the molecular mechanisms of photosynthesis was performed by scientific migrants from the physical sciences, in the pre- and postwar eras when physicists and chemists radiating out from Europe also laid the foundations of diverse fields from molecular biology to the atomic bomb.

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Several of these characters stride across the pages in a way that brings them as well as the book's subject to vibrant life. Pen portraits of the scientists whose names live on in the reactions and cycles that define photosynthesis breathe life into the first section in a most captivating way. What Morton achieves is to put us in the minds and laboratories of these pioneers, allowing us to digest the science as naturally as if we were involved in the investigation.

The overall effect of his zoom-lens approach from the human scale to the planetary scale and back again is to place plants center stage in our current predicament of climate change, and to offer a considered perspective on the seriousness of our plight, along with positive solutions that are within our grasp.

On the way to understanding carbon fixation and photosynthetic electron transport, we learn of the importance of radioisotopes, and get to live the lives of Kamen and Ruben in the Scripps Rad-Lab, producing their own (21-minute half-life) C11 in their cyclotron and running down the hill to the "Rat House" to use it before it decayed. Their story is one of triumphs but also of tragedies: Ruben died in a laboratory accident in the same Rat House while working on phosgene during the Second World War, and Kamen was dismissed from the Rad-Lab and attempted suicide after being accused of being an "atom bomb spy." Meanwhile, the tensions between Benson and Calvin at UC Berkeley led to Benson being banished from the lab and his work suppressed; Calvin subsequently won the Nobel prize for their joint work and had the Calvin cycle named after him, a process that only more recently came to be known as the Calvin-Benson cycle.

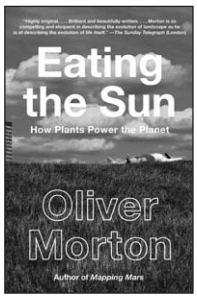
The contrast in styles and personalities is no more apparent than when the theme switches from carbon to light and from the energy and excitement of California to leafy Cambridge and the work of Robin Hill. The personalities loom large in this section of the book, and we assimilate photosystems, electron transfer, and the Z-scheme painlessly on the way.

The second section zooms out at a dizzying speed to the "span of a planet's life." The scope is enormous, starting with the origins of the planet and major shifts in oxidation and the appearance of life. The significance of the evolution of photosynthesis is brought out of the shade and given center stage. The section is a whirlwind tour through geological time, and although I enjoyed the ride, I would have benefited from a map showing me where I had been. There are a few diagrams in the first section, but the second section lacked these. The other minor criticism I would make of this section is that while the "great men" approach worked admirably and appropriately for the first section, the conversations with current scientists working on the evolution of photosynthesis don't work quite as well, perhaps reflecting the desire of the scientific journalist to have human interest stories. Nevertheless, at the end of the rollercoaster ride, we have become more familiar with the geological periods of Earth's history, and concepts such as the Gaia hypothesis have been evaluated in a balanced manner.

Another minor quibble is the occasional jarring of Morton's flights of fancy, exemplified by the start of the final section, which is hung on a misshapen cedar tree planted by Capability Brown. As a vehicle for returning to the history of photosynthesis from Priestley's phlogiston theory up to our current carbon and climate crisis, this approach is typically imaginative, but it started to feel a little labored at times. This is a matter of taste, however, and I can only

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admire the way that Morton manages to smuggle in so much hard science under this cloak of imagination. The overall effect of his zoom-lens approach from the human scale to the planetary scale and back again is to place plants center stage in our current predicament of climate change, and to offer a considered perspective on the seriousness of our plight, along with positive solutions that are within our grasp.



In summary, *Eating the Sun* is one of the most valuable yet readable scientific books that you are likely to encounter for a long time. I enjoyed it immensely and would recommend it to anyone interested in the central role that photosynthesis plays in the life of our planet.

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RETHINKING ANIMALS AND FOOD

The Future of Animal Farming: Renewing the Ancient Contract. Marian Stamp Dawkins and Roland Bonney, eds. Wiley, 2008. 256 pp., illus. $32.50 (ISBN 9781405177825 paper).

For centuries, humans have domesticated animals. We have provided food, water, shelter, protection from predators, assistance with birthing, medicine, and other forms of support. In return, animals have provided us with many essential elements for our existence: warmth, companionship, food, clothing, power to plow and haul, transportation, and, ultimately, their lives. Indeed, the term "husbandry" is derived from the Old Norse words *hus* and *bond,* meaning that the animals were bonded to their households. The essence of husbandry was thus grounded in animal care. This is the basis of the "ancient contract" we have with domesticated animals, and, as part of that contract, it is important that animals experience good welfare throughout their lives and die humanely at the end of their lives.

This ancient contract is widely viewed as a sustainable relationship between man and animals. But in the historical scenario described above, animals often starved and suffered, as did their human companions, during harsh winters, droughts, and food shortages. Therefore, rather than reflecting on some imagined scenario of the past, it is more helpful to reconsider sustainability in relation to modern livestock production and to determine how welfare improvements to our current systems may be made—thus rewriting the ancient contract. This is the task that Marian Stamp Dawkins and Roland Bonney have attempted to address in *The Future of Animal Farming: Renewing the Ancient Contract,* which comprises 15 invited essays by redoubtable experts in their fields. Following a brief introduction by the editors, the first four essays attempt to provide the arguments for changing current farming methods. Bernie Rollin tackles the ethical basis with gusto, and Mary Midgley and Joyce D'Silva argue urgently against continued animal suffering.

The overriding driver of the book, however, is not poor animal husbandry but rather a lack of environmental sustainability—the hypothesis that we will run out of space, food, and water, and will become overcome by disease and pollution if we continue as at present. Kate Rawles pursues the case for connecting animal welfare and environmentalism, pointing out that the two issues have shared roots. Climate change is thus part of the justification for improved animal welfare. A discerning reader who critically explores the arguments may find some flaws, but Rawles nonetheless makes her case for reconsidering how we raise our food.

The second part of the book tackles how to bring about change. The authors acknowledge that rewriting the ancient contract will require that farmers be able to stay in business. Thus good welfare must be a commercially viable goal, which means in turn that consumers must be able to have their expectations for animal welfare met through effective farm inspection and labeling. Major retailers (including supermarkets) play a key role here, and the drivers are well described in these chapters. Helen Browning also ably reminds readers of the important role that welfare must play in organic farming.

Consumers no longer need to make the blunt decision between eating or not eating animals; instead, they can make more subtle choices for welfare-friendly production systems.

In concluding, Dawkins and Bonney concede that they have not provided complete answers about the future of animal farming. However, they and their contributing authors have raised important questions and posed some challenges.

Perhaps the most important link in the food chain is the consumer. Through informed market choices, consumers will determine the desired quality of the food that they eat, and consumers will ultimately determine how we will deal with the environmental impacts of livestock production. Producers exist only to serve consumers. However, from a functional perspective, consumers are not only individual food-buying households but also—and more significantly—major food retailers and caterers who have their own commercial strategies. The engagement of producers in a powerful dialogue with all these consumers is absolutely essential. Consumers no longer need to make the blunt decision between eating or not eating animals; instead, they can make more subtle choices for welfare-friendly

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