processes underlying the evolution of syndromes – *a molecular pedigree of evolutionary changes*. Together, the conjunction of a thorough phenomic characterization recommended by Ritchie *et al*. [3], the carefully designed selection experiments and the joint exploration of the "omic" compartments by functional methods would provide an excellent opportunity to illuminate the complex relationships between the genotypic and the phenotypic spaces that have fascinated evolutionary biologists since the publication of Lewontin's seminal book [1].

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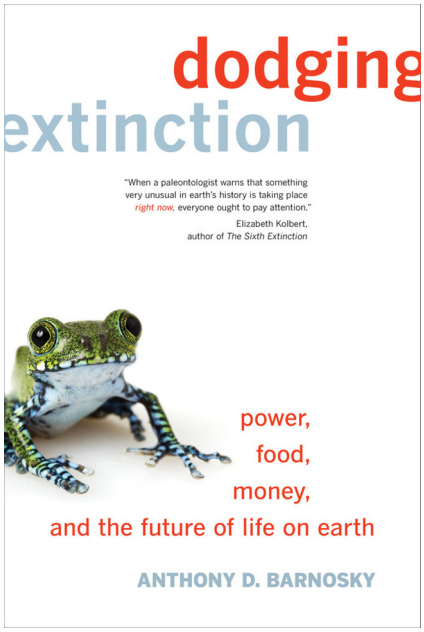
Book Review

The Most Inconvenient Truth

Jeffrey C. Nekola[1,*]



In the spring of 1902, Mont Pelée on Martinique stirred to life and the citizens of Saint-Pierre began to worry about their restless neighbor only 10 km away. However, municipal leaders refused to act; the island was in the midst of general elections with socialists poised to take control from right-wing politicians. Because Saint-Pierre was the main center of conservative voters, the governor – anxious to keep his cronies in power – put off evacuation until after polling on May 11. On May 2, Mont Pelée erupted, sending an incandescent pyroclastic flow directly towards Saint-Pierre. Within minutes the entire city and all but three or four of its 30 000 citizens had perished.

Anthony Barnosky in '*Dodging Extinction*' details a similar peril facing humanity. However, the magma filling the metaphoric volcano sitting over our global village – the size of the ever-growing human population and its insatiable requirements for energy and other resources – is never mentioned. As a result Barnosky conveniently chooses to ignore the growing body of work in human macroecology [1–4]. From these a convincing case can be made that humanity exceeded the sustainable carrying capacity for Earth around 1980 when there were only 4.5 billion people and *per capita* levels/extraction of arable land, freshwater, wild fisheries, wood-based building materials, phosphate, and petroleum peaked [1]. The current size of the human population is now 7.2 billion, with 2050 projections being raised continually from 9.5 billion (circa 2012) to 11.5 billion (summer 2015). Even if we were able to maintain current generation rates of 16 terawatts/year, and we take the now-abandoned estimate of 9.5 billion humans, this level of energy production will only provide those people with a Ugandan standard of living [2]. If we wish to live at current Chinese levels we will need to increase energy production by more than fourfold. Current US levels will require a 15-fold increase.

Where will this additional energy come from? According to Barnosky, conservation and renewable sources will be up to the task. Yet the inconvenient truth – as Barnosky himself points out – is that conservation will free-up only 10% of the energy needed to avoid a Third World existence. And, are the remaining renewable sources really without ecological cost, as his book suggests? Milton Friedman famously stated: 'there is no such thing as a free lunch', and, inconveniently, hydropower leads to a loss of riparian and riverine biodiversity, and currently represents the largest single anthropogenic source of methane, a potent greenhouse gas [5]. Wind farms already lead to the deaths of 5 million migrating birds per year [6]. Even solar cells come at an ecological price: the 2008 agreement between the Renewable Energy Corporation and HydroQuebec to make 'carbon neutral' solar cells at their Bécancour plant [7] never considered the requisite loss of terrestrial biodiversity and

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carbon uptake, or methane release through taiga flooding. Back-of-the-envelope estimates suggest that an area the size of West Virginia would need to be flooded to create enough solar panels for a 10 year transformation of residential power needs to solar in the USA. What about the increase in mining and toxic material generation necessary to make and ultimately retire the batteries needed for nighttime electrical use? And, the increased need for copper and other materials needed to connect each of these panels to the grid? And the fact that an all-solar USA power grid would require shading an area the size of Colorado? Of course we are only talking about energy here – not food, water, building materials, or the other resources that those 11.5 billion people will need. The challenges in these other areas are even larger and equally without viable current 'Earth-friendly' technological solutions.

There is no simple way to prevent the collapse of an exponentially growing population that has already exceeded its carrying capacity. The only way forward is to stop sugar-coating the problems. Real sustainability – and not the type fueled by greenwashing, boosterism, and the quest for grant money – will require acceptance of the most inconvenient truth of all: our survival requires us all to make serious long-term sacrifices that go against once-advantageous and now deleterious behaviors [3]. Yet never does Barnosky invoke sacrifice. For the sake of political convenience – like the governor of Martinique – he is choosing to put this off a few more days hoping beyond hope that the volcano does not erupt. It did not work so well for Saint-Pierre and it likely won't go much better for us. We must begin these difficult discussions and actions now.

Dodging Extinction by Anthony D. Barnosky, University of California Press, 2014. US$29.95/£19.95, hbk (240 pp.) ISBN 978-0-520-27437-2

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Book Review

A Full Immersion into Diving Physiology and Other Feats of Metabolic Suppression

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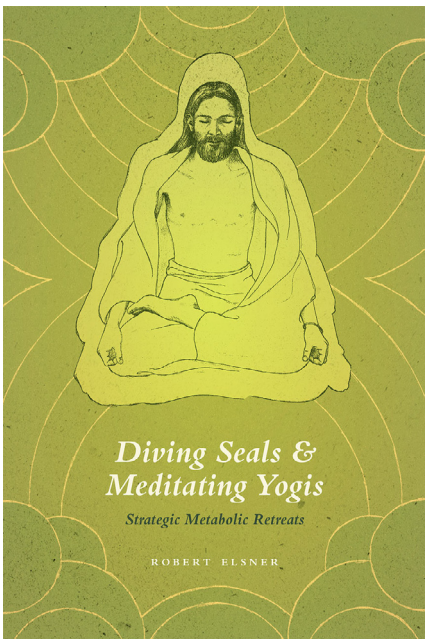

All of us have experimented with holding our breath. Particularly if we are submerged underwater, visceral feelings quickly take hold. Memories of these experiences maybe at the forefront of our minds when we contemplate the extraordinary diving exploits of our air-breathing cousins the seals and whales. Indeed, few topics have exercised the interest of animal physiologists more in recent decades [1]. Yet surprisingly few books have been written on the topic; a poor reflection of our considerable and accelerating understanding of diving physiology [2]. Robert Elsner's new offering *Diving Seals and Meditating Yogis* is a timely and detailed exploration broader than even the title suggests, including, among others, sections on hibernation and resistance to asphyxia in foetuses and neonates. Elsner's erudite mind, testament to more than half a century of research into mammalian divers, is unleashed onto the page to the benefit of all who desire a near-definitive text on metabolic downregulation in mammals. His close acquaintance with the topic over a protracted period and his intimate collaborations with some of the world's great respiratory physiologists are etched into his writing, which conveys many insights into the history of physiological research.

The prose employed by Elsner in his descriptions may, however, be hard work for those who have not previously submersed themselves in the language of metabolic physiology. Elsner's writing style fluctuates between hard-core physiology speak and a more accessible 'popular science'. He dives deeply into the detailed mechanisms underlying mammalian submergence in chapters 2, 4, 5, and 6, intermittently surfacing for chapters 3 and 8 with a more anecdote-based approach on aspects of human physiology; these chapters afford the reader some breathing space. In part this varying style reflects the relative depth of current knowledge on these two topics. However, arguably, more space could have been used to unpack various phrases,