Book Reviews

SURVIVAL OF THE FATTEST: THE KEY TO HUMAN BRAIN EVOLUTION. By Stephen C. Cunnane. Singapore: World Scientific Publishing. 2005. 368 pp. ISBN 981-256-191-9. $38.00 (cloth).

The brain holds a special place in the study of human evolution and rightly so. Our encephalized state lies at the heart of our social complexity and accounts for the sophistication of our artistic and technological achievement. But if large brains unleashed our quintessential qualities as a species, this unquestionably came at a steep price. The human brain consumes a great deal of the body's energy, and even temporary disruption in its supply leads to irreparable damage. Much work on hominin encephalization has focused on the changes in diet, physiology, metabolism, and body composition required to walk this metabolic tightrope and free up fuel for a large brain while protecting its delicate supply line.

From its title, Stephen Cunnane's *Survival of the Fattest: the Key to Human Brain Evolution* might sound like a synthesis of this literature. Instead it is primarily a defense of the shore-based diet hypothesis, itself the loose progeny of Alistair Hardy's aquatic ape hypothesis. Cunnane notes that brain growth requires nutrients, vitamins, and minerals that are synthesized by the body inefficiently if at all. These "brain selective nutrients"—iodine, iron, copper, zinc, selenium, and the long-chain polyunsaturated fatty acid, docosahexaenoic acid—presumably were required in higher quantities to support encephalization. Because maritime foods like shellfish are among the rare naturally occurring foods enriched with these nutrients, the shore-based diet hypothesis proposes that hominin encephalization occurred on, and indeed was triggered by arrival at, the shoreline.

To help make this case, several early chapters are devoted to brain biochemistry and nutrition. Although repetitive in places, these are the book's best chapters, for this is Cunnane's area of expertise. Here we learn the importance of iodine for normal brain development, the metabolism and structural role of docosahexaenoic acid, and dietary sources of these and other nutrients critical in brain development. This review is background for the book's broader evolutionary thesis, and here Cunnane quickly runs into trouble. In the introduction, he frames the book's central problem by noting what he sees as a mystery: the slight reduction in hominin brain volume during the past 30,000 years. He then poses a question that sets up key themes for the volume: "Agriculture was a major invention and has been widely adopted in the past 5,000 years; could it (or any other significant dietary change) affect brain size on a global basis?" (p. 49).

Ignoring the fact that bodies, including brains, have shrunk since the late Pleistocene, Cunnane focuses on the decrease in *absolute* brain volume, creating the appearance that brain size has regressed as populations have moved away from the shoreline. In fact, relative brain size is about the same today as it was during the late Pleistocene, and the suggestion that this was a period of cognitive decline is clearly problematic. It was during this time that we see the first explosion of cultural diversification and a steep rise in the quality and sophistication of technology, not to mention the first examples of symbolic representation and art. Such unsound evolutionary reasoning is, unfortunately, no stranger to this volume.

One chapter reviews evidence that hominins inhabited shorelines, used riverine areas, and ate fish. That our ancestors exploited highly productive habitats is not surprising, nor is it evidence that a shore-based diet was necessary for encephalization. The rapid encephalization of *Homo* predates the first evidence of maritime food use by at least 400,000 years. By contrast, there is extensive evidence for hominin carnivory and carcass scavenging at early *Homo* sites, and as others have shown, scavenged or hunted brain tissue would have provided a rich source of docosahexaenoic acid and other scarce nutrients.

To support his model, Cunnane points to evidence that diets consumed by many contemporary inland human populations impair cognitive development. While iodine deficiency and cretinism are endemic in certain regions with leached soils, this is of questionable relevance for an understanding of hominid encephalization. Not only did encephalization not occur on the shore, but much has been achieved by modern landlocked populations (at Harrappa, Ur, Teotihuacan, and Cuzco, to name a few) without the benefit of maritime foods or iodized salt. With respect to essential fatty acids, Cunnane concedes that "it is possible to achieve normal brain function without a dietary source of docosahexaenoic acid." (p. 163). He further undermines his hypothesis when he discusses vegan children who eat no meat, dairy, or eggs—the main sources for polyunsaturated fatty acids—yet have normal cognitive development.

Early on, Cunnane proposes a paradox that may be viewed as a straw man: "How did humans get bigger, more sophisticated brains without the skills that already need a bigger brain?" (p. 30). He sees a fundamental flaw in hypotheses that explain encephalization by reference to enhanced brain function, for the advantages of brain expansion can be enjoyed only after the brain is enlarged. As Darwin showed, this is only a problem if one envisions a trait like the brain as an all-or-nothing state rather than the product of an incremental process that gradually ratchets up complexity.

Arguably there is no paradox here, but the book culminates by proposing an odd solution: encephalization was not driven by the benefits of large brains but was instead a by-product of diet change. Without the benefit of evidence, Cunnane asserts that animals, including primates, have unrealized capacities for brain growth. He claims that diets poor in brain selective nutrients restricted a latent genetic capacity for brain expansion that was expressed in our ancestors once they stumbled upon the unique nutritional resources of the shoreline. According to Cunnane, our large brains initially served no function, nor did they provide an adaptive advantage. Life was so bountiful in this utopian setting that "hominids heading towards the human lineage were intent not on survival but on play" (p. 220), and "The first primitive tools were useful for play activities but they were not necessary for survival ... They were optional. Effectively, they were playthings" (p. 218).

This model has obvious flaws. If it were correct, we should see diet-related variation in relative brain size

among modern human populations, not to mention other species. The shore-based Inuit should have higher encephalization quotients, and the oceans and shorelines should be loaded with highly encephalized species. Instead, brain size scales tightly with metabolic rate, suggesting deeply conserved *energetic* constraints on brain growth. And if the absence of a shore-based diet was all that held back this latent genetic potential, why was hominin brain expansion a gradual and intermittent process requiring millions of years rather than an abrupt response to arrival at the shoreline?

This model also misses an important point, for what requires explanation is not merely the size of the brain but the entire complex of coevolved supporting traits. Although the human brain is unusual for its size and energetic cost, one important mystery is why, despite this, humans do not have an elevated metabolic rate. Brain expansion must have been accompanied by anatomic and metabolic trade-offs, which have been the subject of much prior research. The book acknowledges some of this complexity in passing (such as the two sentences devoted to the expensive tissue hypothesis), but ultimately fails to synthesize this literature. Instead, Cunnane proposes that the brain and its supporting cast were somehow catalyzed to their present form by an abundant shoreline. The complexity of coevolved traits, combined with the opportunity cost of diverting 20–70% of the body's energy to fuel the brain, renders an "accidental" encephalization hypothesis of this sort untenable.

Because this book is marketed for a public audience, it does not uphold the same scholarly standards as writing aimed at scientific peers. For instance, there are no in-text citations but merely a bibliography. This enables some of the book's speculative excesses and makes it inappropriate for graduate students or researchers looking for an entry point into this literature. At the same time, it is a source of concern that this book is designed for public consumption. Evolutionary scenarios that would not stand up to scientific scrutiny will instead enter directly into already problematic public narratives about human evolution. In this sense, it does our research community a disservice by making the study of human evolution out to be little more than the spinning of just-so stories.

Survival of the Fattest is most successful in making the case that brain development requires certain nutrients that are rare in most ecologies. This is an interesting point, but the leap that a shore-based diet was a necessary condition for encephalization denies the fact that hominin achievement, for millions of years, unfolded far from the shore. Although the title of the book implies a focus on energetics and body composition, there is little attempt to integrate prior work in this area. In several passages Cunnane laments the fact that anthropologists have, by and large, avoided the aquatic ape hypothesis and its shore-based progeny. Having finished this book, I have a hunch this trend is destined to continue.

CHRISTOPHER KUZAWA
Department of Anthropology
Northwestern University
Evanston, Illinois

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