

anyone with a general interest in the beauty of using a simple system to study fundamental questions in developmental and evolutionary biology.

References

1 Bonner, J.T. (1959) *The Cellular Slime Molds*, Princeton University Press

- 2 Chisholm, R.L. and Firtel, R.A. (2004) Insights into morphogenesis from a simple developmental system. *Nat. Rev. Mol. Cell. Biol.* 5, 531–541
- 3 Foster, K.R. *et al.* (2007) What can microbial genetics teach sociobiology? *Trends Genet.* 23, 74–80

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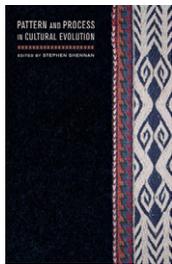
Book review

Linking the micro and macro in cultural evolution

Pattern and Process in Cultural Evolution: Origins of Human Behavior and Culture edited by Stephen Shennan. University of California Press, 2009. US\$60.00/£35.00, hbk (352 pages) ISBN: 978 0 520 25599 9

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The study of cultural evolution has a history as deep as that of the study of organic evolution. Darwin speculated that technological and linguistic evolution are both subject to selection-like forces [1]. However, despite much empirical and theoretical research since then, no general theory of cultural evolution has yet developed to rival the contemporary theory of genetical evolution. This slower speed of

progress is largely due to the complexity of cultural evolution: unlike genetical evolution, transmission of cultural variants occurs repeatedly throughout the lifespan and cultural ‘parents’ are numerous, with non-additive influences on behavior.

Since the 1970s, however, a small group of anthropologists and population biologists has been building explicit population models of cultural processes [2,3]. Several volumes have appeared in recent years to represent research in this area. *Pattern and Process in Cultural Evolution* collects some of the contributions that archaeologists and anthropologists have made that link the study of cultural microevolutionary processes (the individual forces, such as learning strategies, which influence culture change) with cultural macroevolutionary processes (technological and social evolution, intergroup competition and cultural diversification). Every chapter in this volume reflects a commitment to linking population models to particular case studies in cultural evolution.

Archaeology has a privileged part to play in this area. As Shennan’s introduction and the first chapter explain, archaeological data are key to testing cultural evolutionary theory, in part because archaeology has both necessary time depth and an explicit tradition of sampling diversity. As variation is the handle that selective processes take hold of, this is a virtue of the field. Likewise, the practical obstacles to collecting macroevolutionary data for contemporary human societies make archaeology the obvious cultural analog to paleontology. The chapters in this

volume demonstrate the potential for archaeology to be a key player in the continuing development of a descriptively accurate and dynamically sufficient theory of cultural evolution.

Shennan himself is well regarded for being intellectually ecumenical, and that shows in the broad collection of chapters in this volume. Ranging from philosophical issues to the details of specific models to the impact of archaeological context on the construction of data, the chapters represent an adaptive radiation of approaches, instead of the editor’s particular style of research. The common themes are ways of testing for particular microevolutionary processes in the archaeological, ethnographic and culture-historical record; and representing long-term patterns of cultural diversification using phylogenetic inference.

A strong influence on this area has been the application of phylogenetic methods to archaeological data. Phylogeneticists will probably find fault here. Several of six explicitly phylogenetic chapters use unmodified methods from genetical evolution to build phylogenies of cultural items. A lingering concern that the basic processes of transmission are quite different from those of genes (making inferred phylogenies difficult to interpret) is barely addressed, although the authors are aware of it. Tehrani and Collard use maximum parsimony to build a phylogeny of Iranian tribal (Turkmen) textiles. They use the Retention Index (RI) to argue that the cultural evolution of these textiles has been less reticulated and more like genetical evolution than many would presuppose. They miss the fact that even random trait data can produce high RI values, leaving the reader wondering what has been learned.

What is needed here, as in some of the other chapters, is explicit alternative evolutionary models fitted to the same data. For example, Kohler, Cole and Ciupe fit a dynamic demographic model of warfare, based on an ecologically inspired model of Turchin’s [4], to a rich time series from the American pueblos. Given that they fit only one model, however, it is hard to tell how well that model fits. A model comparison approach is needed [5]. Although the same criticism could be laid on many of the chapters, Steele’s chapter, on how different processes in cultural evolution

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can produce quite similar patterns of diffusion, demonstrates that this problem has not gone unnoticed.

Despite these quibbles, this collection of case studies shows that cultural evolutionary theory has generated a lively and self-sustaining empirical tradition that grounds itself in formal evolutionary modeling. Those interested in the current cutting-edge will profit from both the diversity of approaches represented in Shennan's volume, and the attention paid to empirical and theoretical detail in each chapter. Many of the authors spend time nominating loose ends and open questions that will inspire readers to get involved in this rapidly transforming area of research.

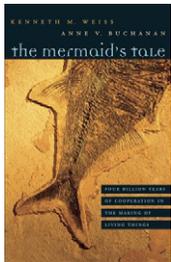
Book Review

The evolution of ideas whose time has come

The Mermaid's Tale: Four Billion Years of Cooperation in the Making of Living Things by Kenneth M. Weiss and Anne V. Buchanan, Harvard University Press, 2009. US\$35.00, hbk (336 pages) ISBN: 978 0 674 03193 7

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The Mermaid's Tale, an engagingly written collection of thoughts across a range of topics, should be read by all evolutionary biologists. Some might regard this volume lightly, comfortable explaining biocomplexity with random variation and selection. Others will find new ideas and connections among them, comforted by the authors' reassurance that nothing that they propose invalidates natural

selection. Yet others will experience a strong sense of déjà vu, recognizing topics that they proposed and that caused great commotion, the last time we celebrated a Darwin anniversary. However, it is unlikely that they will find their work cited (none of mine is).

The time was not right for those ideas 25 years ago. If the time is now right, then it might be important to avoid the historical baggage that provoked professional antagonisms a generation ago. One way to remove that stumbling block is terminological rebranding. Darwin spoke of organisms being 'indifferent' to their surroundings with respect to their reproduction. In keeping with changing social mores, 'indifferent' became 'selfish.' More recently, the popularity of self-organization morphed 'selfish' into 'autonomous'. These are different words, but all underscore Darwin's hypothesis that organisms exhibit pronounced insensitivity to the environment with respect to reproduction, in contradistinction to Lamarckian views emphasizing a direct relationship between reproduction and adaptive responses to environments. For Darwinians, this 'misfit' between reproductive products and the environment is a mechanism, natural selection, producing indirect adaptive responses. Whereas Lamarck believed that species simply adapted to the changing conditions, Darwin believed that

References

- 1 Darwin, C. (1877/2004) *The Descent of Man* (2nd edn), Penguin
- 2 Cavalli-Sforza, L.L. and Feldman, M.W. (1981) *Cultural Transmission and Evolution: A Quantitative Approach*, Princeton University Press
- 3 Boyd, R. and Richerson, P.J. (1985) *Cultural and the Evolutionary Process*, University of Chicago Press
- 4 Turchin, P. (2003) *Historical Dynamics: Why States Rise and Fall*, Princeton University Press
- 5 Burnham, K.P. and Anderson, D.R. (2002) *Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach*, (2nd edn), Springer-Verlag

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environmental change could outstrip the adaptive capabilities of species, leading to extinctions, perhaps even mass extinctions. In this case, terminological rebranding maintains conceptual continuity.

Efforts to make new ideas more palatable can, however, reintroduce conceptual difficulties that previous terminology was designed to eliminate. Maynard Smith and Szathmáry [1] proposed that evolutionary transitions resolved conflicts of interest in favor of division of labor, because division of labor led to more efficient means of storing and transmitting biological information. The authors of this volume have a similar view, but they suggest that different elements of life cooperated to avoid conflicts of interest. Trying to rebrand, they inadvertently re-introduce teleology into evolutionary theory. In this case, they would have been well advised to read treatments of the topic from the 1980s [2]. Niles Eldredge has eloquently shown (e.g. Ref. [3]) how inferences of intentionality blur the distinction between Lamarckian and Darwinian explanations.

When Ed Wiley and I addressed the centrality of historical correlations and irreversibility in evolutionary diversification [4], we struck a sour note with an optimistic scientific consensus that believed in a sort of 'Archimedes lever' view of evolution (give me enough variation and the right environment, and I will change elephants into mice). A decade later, Maynard Smith and Szathmáry wrote about evolutionary transitions, all of which are irreversible events in the history of life, resulting from the conjunction of improbable events, making irreversibility seem epiphenomenal. Their rebranding successfully introduced temporal irreversibility into the vocabulary and research programs of many who reacted so viscerally to the original Brooks and Wiley proposal.

The authors of this volume avoid this entire issue by suggesting that biologists have been paying too much

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