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Book review

HÖLLDOBLER, B. & WILSON, E.O. 2008: *The Superorganism: the beauty, elegance and strangeness of insect societies*

W.W. Norton and Company, New York, 576 pp., ISBN-10: 0393067041, ISBN-13: 978-0393067040, Price: €41.99

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Ecologists have long realized and appreciated that the world consists of hierarchies. Matter is composed of atoms, atoms build molecules such as DNA, which comprises genes, genes prescribe proteins, proteins form cells, cells form tissues, tissues form organs, which eventually form multicellular organisms. However, a level of organization relatively underappreciated outside of many biological circles is that of the so-called superorganism, which are entities composed of groups of individual organisms that interact and cooperate and take on behavioral and growth characteristics of single organisms. Indeed in the past century or so, there has been considerable debate, whether such entities exist or are figments of imagination. In this wonderfully woven treatise, Hölldobler and Wilson clearly intend to revive this concept in the attempt to establish its acceptance among scientists and in doing so, spawn many new research directions.

The beginning chapters were devoted to the hierarchical nature of life and that natural selection can target all levels, but the unit of selection are genes. They also provided description how colony-level selection could occur and how it is not necessarily incongruent with kin selection or components of individual selection. Colony-level selection simply requires that between-group selection is stronger than within-group selection. However, much of this discussion was frankly difficult to follow, especially for a book geared toward a general audience, because in places they criticize kin selection, equate kin selection with group selection, but then provide a defense of kin selection. Sounds like a powder keg of coming debate.

A larger surprise awaits the reader in Chapter 3 devoted to sociogenesis, where I expected the usual account of the development of colony life from the founding queen to a mature colony, along with changes in traits of worker size and their numbers. Instead, they gave a brief review of self-organization and social algorithms, clearly building a case for the evolutionary and proximate mechanisms of sociality and evolution of superorganisms. Complex behaviors emerge from simple algorithms employed by individuals, the best examples of which is honeybee dance language and the role of trail pheromones in ant recruitment. This chapter clearly serves as a vehicle that is elaborated upon throughout the book. These ideas are echoed in the sub-

sequent chapter on the genetic evolution of decision rules (Chapter 4) where the emerging theme in sociogenomics / sociogenetics is that social behavior is prescribed by genes conserved from solitary ancestors – there are no "true social genes" in other words.

The next two chapters on the division of labor (Chapter 5) and communication (Chapter 6) are the "meat" of the book and give a lengthy review of more than fifty years of research. The remainder of the book is composed of a chapter on ant phylogeny (Chapter 7), a section on the ant subfamily Ponerinae (Chapter 8), an overview of a well studied superorganism, the fungus-gardening ants (Chapter 9) and finally a discussion on a relatively new field, nest architecture (Chapter 10). They devoted an entire chapter to the Ponerinae because much knowledge of these ants has been gained in the past 20 years and has not been properly reviewed. Ponerines are interesting because they possess many primitive traits and wide variation in social organization, which makes them ideal model systems for the study of the evolution and structure of superorganisms. Fungus-gardeners are the ultimate superorganisms in terms of their ecological dominance and behavioral and symbiotic complexity. Among the more salient points of these sections is that – while kin selection can be invoked to explain elements of division of labor and communication systems – in some cases, group or colony selection is a better or sole explanation, especially in the fungus-gardening ants. Critical to understanding the nature and evolution of superorganisms is natural history, which is the only medium that can organize the role of information networks, decision rules, kinship, self organization, context-dependent thresholds, phenotypic plasticity, among other concepts.

Compared to the monograph of *The ants*, the paperback version I reviewed was much smaller and thus easy to hold while reading – something on the order of a lecture was not required. The book features a glossary and "A note to the general reader" that was basically a primer of biology and ant biology, both of which will be of help to the non-scientist. However, I found terms and techniques, especially in the field of molecular biology, such as microarray and microsatellite, that were not clearly defined.

I feel that this book advances a revolutionary mode of thinking, certainly more than the masterpieces *The insect societies* or *The ants*. It brings a level of seriousness to the idea that superorganisms do in fact exist and selection can indeed occur at levels higher than the individual. At the book's end, the authors confess to disagree. They leave it up to the readers to settle: are all insect societies (primitive to advanced) superorganisms (Wilson)? Or should the term be reserved for highly integrated and advanced societies, where the entire group is dependent on successful reproduction of the colony (Hölldobler)?