

A male baboon can “ask” a nearby female for some grooming, but neither of them can discuss the likely outcome of compliance with this request, which might have serious consequences for both of them, especially if the male is not the alpha male of the troop. We human beings not only can do things when requested to do them; we can answer inquires about what we are doing and why.

It is this kind of asking, which we can also direct to ourselves, that creates the special category of voluntary actions that sets us apart.

The author is one of the most original thinkers of our time, and *Freedom Evolves* brings a fresh perspective to an ancient problem. But is his explanation correct? Will future commentaries on free will be mere footnotes to Dennett? I doubt it. Many general readers will not embrace Dennett’s tenets, especially his claims that humans are soulless evolved animals and consciousness is nothing more than neuronal activity. Many philosophers prefer a free will that is either a form of indeterminism or a cognitive illusion, because although it is hard to deny free will’s subjective reality it is equally hard to prove its ex-

istence. Finally, although I accept most of Dennett’s claims and agree that he has thoroughly debunked the indeterminism argument, I remain unconvinced that free will can ever be derived from determinism. I think the best we can do is “pseudo-freedom.” In the complex world of human beings and social systems, causes are so numerous and interconnected that it is difficult—nigh impossible—to get our minds around the causal net in its entirety. The enormity of this complexity leads us to feel and act free, even if our actions are actually determined. Because no cause or set of causes we select as the determiners of human action can be complete, freedom arises out of this ignorance of causes.

References

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SYSTEMATICS

Hyperdiversity Up Close

T. R. Schultz

The world is crawling with ants. Remove all the ants from planet Earth, and the terrestrial animal biomass would be reduced by fifteen to twenty percent. Within terrestrial ecosystems, ants occupy key positions, participating in complex associations with plants, fungi, microbes, and arthropods. This evolutionary success story is due partly to the organization of ants into social “superorganisms,” cooperative family groups consisting of egg-laying mothers and more-or-less neuter daughters. But sociality cannot be the whole explanation because although ants have been around for approximately 130 million years, they only assumed ecological dominance during the latter half of that time span. Even more telling,

it is a minority of the estimated 20,000 extant ant species that accounts for most of the dominance.

Describing and explaining ant diversity and dominance is the job of a small network of ant systematists and ecologists. To cope with the considerable challenges of their task, they have developed a variety of mass-collecting protocols for sampling ant species from soil, leaf litter, tree canopies,

and other habitats. As these researchers sort through the exuberant diversity captured in their samples, one group of species emerges again and again, relentless in its ubiquity: the genus *Pheidole*. In tropical and temperate zones, in forests, savannahs, and deserts, myrmecologists encounter a bewildering procession of *Pheidole* species. This riot of speciation in a single ant genus represents a striking evolutionary phenomenon that

cries out for explanation, and the necessary first step is basic taxonomic analysis. Only when the species of *Pheidole* are recognized, defined, and named will they be rendered accessible to phylogenetic, behavioral, and ecological study.

Nearly twenty years ago, Edward O. Wilson decided to undertake a major portion of this task. *Pheidole in the New World* re-

Pheidole in the New World
A Dominant, Hyperdiverse Ant Genus
by E. O. Wilson

Harvard University Press, Cambridge, MA, 2003. 804 pp. and CD-ROM. \$125, £85.95. ISBN 0-674-00293-8.

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ports his results. In this massive, 794-page taxonomic monograph, he describes 624 *Pheidole* species, 337 of which are new to science. Wilson estimates that when the Old World species receive the same treatment, *Pheidole* may turn out to contain in excess of 1500 species. That conclusion would mean that 7.5% of the global species diversity of ants is disproportionately concentrated into one of the 300 ant genera. (For perspective, consider that there are only 1700 species in the most speciose order of mammals, the rodents.) Wilson's monograph contains 101 pages of dichotomous identification keys and 648 pages of species descriptions, with each species receiving a one- or two-page treatment. These treatments include beautifully rendered line drawings (penciled by Wilson and inked by Minsheng and Xiufen Wang) that document lateral full-body profiles and dorsal full-face head views of both the major ("soldier") and minor worker castes. In the tradition of field guides, the drawings include "field marks," which point to anatomical characters important for telling the species apart.

Perhaps the most unusual feature of this monograph is the CD-ROM that comes with it, tucked into a pocket inside the back cover. Engineered by Piotr Naskrecki, Sara Ashworth, and Wilson, the CD contains a database of full-color digital photographs. These images document multiple views of the major and minor worker castes, as well as the data labels, of type specimens of all the newly described species. Wilson's line drawings illustrate the previously described species. The digital photographs were produced using a high-resolution video camera mounted on an optical microscope and AutoMontage, a computer program that integrates multiple images captured at different focal planes to produce a single information-rich, fully focused picture. The result is an unprecedented photo gallery of exotic and beautiful beasts normally invisible to the unaided human eye. Scrolling through the images on the CD is the myrmecological equivalent of leafing through a well-illustrated field guide to the birds or mammals of the New World—a sublime aesthetic experience for those who appreciate natural form and variation.

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Major and minor castes. *Pheidole browni*, from wet forests on the Atlantic slope of Costa Rica, is among the 337 new species described in the monograph. Wilson named it after his mentor, the ant systematist William L. Brown, whom he also honors with the volume's dedication and a short memorial essay. (Scale bars = 1 mm)

Does this monograph put us any closer to understanding the evolutionary success of *Pheidole* in particular and, by extrapolation, of ants in general? In an insightful six-page chapter, "The Origins of Hyperdiversity," Wilson conjectures that the success of *Pheidole* may be due to three key evolutionary innovations: (i) the division of the worker force into two morphologically disjunct castes (a typical ant minor worker specialized for brood care, nest construction, and

foraging; and a big-headed, major worker specialized for colony defense or, in some species, for the milling of seeds); (ii) the loss of a functional sting; and (iii) the complete absence of ovaries in the worker castes. It is probably significant that the only ant genus that rivals *Pheidole* in hyperdiversity, *Camponotus*, has independently evolved the first two of these traits.

E. O. Wilson is best known to non-biologists for highly visible popular works like *Naturalist*, *Consilience*, and *The Future of Life* and to biologists for influential scientific syntheses like *The Insect Societies*, *Sociobiology*, and (with Bert Hölldobler) *The Ants*. Why, some of the readers of these books may wonder, would Wilson choose at this stage in his career to devote twenty years to the taxonomy of a single genus of ants? Taxonomic monography is, after all, among the most undervalued and least visible of scientific enterprises. I think the obvious answer is that Wilson, who began his career with a taxonomic revision of the ant genus *Lasius*, understands the personal pleasure as well as the considerable scientific rewards that come with exploring and describing the vast uncharted territories of natural history. If we are to have a general evolutionary theory that explains the data of hyperdiversity, then those data must be obtained by getting up close and personal with the natural world: digging up ant nests, sorting museum specimens, and squinting through microscopes to count hairs and mandibular teeth. With *Pheidole in the New World*, Wilson has returned to his inspirational wellspring.

BROWSEINGS

Gentle Bridges. Architecture, Art and Science. Zwischen den Räumen. Architektur, Kunst und Wissenschaft. R. Anthony Hyman et al. Birkhäuser, Basel, 2003. 120 pp. €45. ISBN 3-7643-6750-4. Translated by Michael Robinson and Thomas Menzel.

This volume explores the interplay of design, art, and research at the Max Planck Institute of Molecular Cell Biology and Genetics (MPI-CBG) in Dresden. The dual-language (English and German) text includes essays on architecture and the multimedia work of the Swiss artist George Steinmann. The large-format illustrations depict the Institute's building (a project of the Finnish architects Mikko Heikkinen and Markku Komonen) and sample Steinmann's art (including the photographic and video *Metalog*, installed at the MPI-CBG). In a broad overview of the Institute's scientific program, director Marino Zerial comments on a series of pictures his colleagues have obtained from their experimental systems, such as the fish-scale keratocytes used to study cell motility, which are imaged (above) by phase contrast microscopy and pseudocolored with different settings.

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