

carbon dioxide from solution and convert it into a solid carbonate form, similar to naturally occurring limestone or shell. Such layers might be used in carbon fixing or in carbon-negative architectures. Their experiments so far have shown that carbonate-producing material can be accumulated; further work to stabilize these irregular shells with silicates is ongoing. Proto-cell systems are also being developed for insulation and environmental remediation.

Chemist Lee Cronin's group at the University of Glasgow, UK, is pursuing another type of artificial inorganic chemical cell, or 'chell', which has potential architectural uses including chemical and biological sensing to detect carbon dioxide and pollutants. The internal chemistries of the chells can be finely controlled using a digital delivery system for the ingredients, making them useful for fuel-cell technology or as chemical delivery systems for responsive surfaces.

#### NEXT STEPS

Distributed, self-assembling systems may one day enable buildings to grow, self-repair and respond creatively to the unpredictable effects of climate change. For example, a collaboration between the University of Southern Denmark, the University of Glasgow and our research groups at University College London and the University of Greenwich is developing living claddings. Driven by gravity feed and chemical gradients, these might produce water in desert environments and harvest sunlight to produce biofuels.

The pressing environmental problems of Venice are amenable to some synthetic-biology solutions. Our installation entitled *Hylozoic Ground*, displayed at the Canadian Pavilion at the Venice Biennale 2010 and created with architect Philip Beesley from the University of Waterloo in Ontario, Canada, showcased the recycling of carbon dioxide exhaled by visitors into solid carbonate using protocell technology. Similar deposits could stabilize the city's foundations by growing an artificial limestone reef beneath it.

The application of synthetic biology to architecture holds promise for solving major environmental problems. Further collaborations between biologists, chemists, architects and industry are needed to expand the range of tools, methods and materials available. As with any new technology, engagement with the public and with policy-makers is vital to direct future regulation that will protect public safety and address perceived risks. ■

**Rachel Armstrong** is a researcher at the Bartlett School of Architecture, University College London, UK.

e-mail: [rachel.armstrong@ucl.ac.uk](mailto:rachel.armstrong@ucl.ac.uk)

**Neil Spiller** is head of the School of Architecture and Construction at the University of Greenwich, London, UK.

#### GENES AND DEVELOPMENT

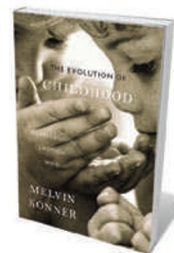
# The importance of childhood

Our emotional brains are shaped by social interactions during infancy, finds **Morten Kringelbach**.

The late English poet Philip Larkin took a stark view of childhood, writing in *This Be The Verse*: "Man hands on misery to man. It deepens like a coastal shelf. Get out as early as you can, And don't have any kids yourself." Yet we clearly need to nurture children to survive as a species. And there is more to childhood than survival: our psychological state later in life is shaped by our extended infancy. Psychologist and anthropologist Melvin Konner places childhood firmly within an evolutionary framework in his magisterial book.

Synthesizing decades of research across many disciplines, *The Evolution of Childhood* highlights evidence for interactions between genes and the environment in what Konner calls the "behavioural biology of psychosocial development". He argues that it is the essence of life — and especially of childhood — to interact with, recognize and change in response to the environment. Such shifts are brought about on many levels by evolutionary algorithms.

The book is structured in four parts: evolution, maturation, socialization and culture. The first part firmly places ontogeny — the



**The Evolution of Childhood: Relationships, Emotion, Mind**  
MELVIN KONNER  
Belknap Press: 2010.  
960 pp. \$39.95,  
£29.95

development of the individual — at the heart of evolution and explores our current understanding of the brain and behaviour in relation to it. The second section focuses on the physiological paths of maturation of neural and neuro-endocrine systems, which allow psychosocial development. The third part turns to comparative cross-species and cross-cultural approaches to understanding and reconstructing phylogeny and history. The fourth considers interactions between genes and culture, and the effects of human cultural variation on their evolution.

The parent-infant relationship is central to Konner's understanding of childhood. Parents perceive infants' cues and respond appropriately and promptly. Such



The early relationship between parent and child is crucial to later development.

E. MCCONNELL/GETTY

interactions are evident from the moment of a baby's birth. When parents imitate and elaborate their infant's facial expressions they communicate a wealth of social information, a process that was noted by pioneers of evolution such as Charles Darwin.

The responsiveness that Konner describes implies that interventions early in life can enhance the well-being of future generations, often at a fraction of the cost of delayed attempts to do so in adolescence and adulthood. It is well established that parent–infant interactions in the first 18 months are crucial to the child's later health. Perturbations to these relationships, such as postnatal depression — which occurs in around 13% of mothers and 5% of fathers in rich countries — can adversely affect behavioural, emotional and cognitive outcomes in adulthood. Infants of mothers with postnatal depression are at increased risk of experiencing anxiety and depression later in life.

Although not mentioned in the book, there is emerging evidence that the common congenital abnormalities of cleft lip and palate in infants can create difficulties in interactions between parent and infant. Infants who had their cleft lip repaired within the first week of birth had better psychosocial outcomes later in life than those who received the surgery a few months after birth. Seemingly small differences in parental responses in early infancy can have a large impact on later development.

Such findings are suggestive of the power of social pleasures in general in shaping our lives. Although we are only just starting to gain insight into how our emotional brains are constructed in childhood, a better understanding of the underlying neural mechanisms might allow us to intervene and have a positive influence on future generations — perhaps helping them to see the glass as half full rather than half empty.

Konner is an excellent tour guide to the sacred lands of childhood. He has produced a scholarly, detailed and beautifully written study, although its very length makes it challenging to read and use as a reference work. *The Evolution of Childhood* shows that the pleasures of life are linked to the evolutionary imperatives of reproduction and survival, and that we are starting to understand their underlying neural mechanisms. Contrary to Larkin's views, it is clear that meaningful social interaction with children is not only a basic pleasure but also helps children to fulfil their potential. ■

**Morten L. Kringelbach** is director of *Hedonia: TrygFonden Research Group at the University of Oxford, UK, and at Aarhus University, Denmark. His most recent book is The Pleasure Center.*  
e-mail: morten.kringelbach@psych.ox.ac.uk

## Books in brief



### Kingdom of Ants: José Celestino Mutis and the Dawn of Natural History in the New World

Edward O. Wilson and José M. Gómez Durán JOHN'S HOPKINS UNIV. PRESS 120 pp. \$24.95 (2010)

The forgotten ant studies of eighteenth-century naturalist José Celestino Mutis — also celebrated for his work in botany, astronomy and mathematics — are rediscovered in this volume by Edward O. Wilson and José Gómez Durán. On leaving his native Spain to explore modern-day Colombia and finding ants swarming everywhere, Mutis built his own classification system for the species he saw, laying the foundations for New World entomology.



### The Amazing Story of Quantum Mechanics: A Math-Free Exploration of the Science that Made Our World

James Kakalios GOTHAM 336 pp. \$26 (2010)

Physicist James Kakalios borrows from science fiction to explain how quantum mechanics underpins today's technology, from DVD players to magnetic resonance imaging scanners. Referring to portrayals of nuclear energy in comic books such as *Watchmen*, he weaves in popular culture to tell the story of how Werner Heisenberg, Erwin Schrödinger and others developed quantum theory. He looks ahead to nanotechnology breakthroughs that might one day harness quantum phenomena to bring us jet packs and time travel.



### Pink Ribbon Blues: How Breast Cancer Culture Undermines Women's Health

Gayle A. Sulik OXFORD UNIV. PRESS 424 pp. \$29.95 (2010)

Examining the 'pink ribbon' culture of fund-raising for breast-cancer research, medical sociologist Gayle Sulik interviews patients and those in the cancer industry to question whether awareness campaigns are effective in improving women's health. Although these efforts generate funds and a feel-good factor, she argues that such 'pink merchandising' preys on sentimentality and does not advance medical research. Sulik outlines some alternative approaches.



### The Wonderful Future That Never Was: Flying Cars, Mail Delivery by Parachute, and Other Predictions from the Past

Gregory Benford and The Editors of *Popular Mechanics* HEARST 208 pp. £16.99 (2010)

From the funny to the prescient, this collection presents the best predictions of future technology from the archives of *Popular Mechanics* magazine. Visions imagined by experts in 1903–69 include glass cities, flying vehicles and asbestos clothes, as well as the now-realized pocket-sized computers and frozen dinners. With text by astrophysicist and author Gregory Benford, the book reminds us that utopian dreams of the future can be hit and miss.



### Jane Goodall: 50 Years at Gombe

Jane Goodall STEWART, TABORI & CHANG 144 pp. £19.99 (2010)

Primatologist Jane Goodall celebrates 50 years of chimpanzee research at the Gombe Stream National Park in Tanzania in this latest edition of her book. Updated with text and photographs from the past decade, it describes her research on apes, as well as other projects undertaken at Gombe by researchers from the Jane Goodall Institute. These include studies of AIDS progression and local community projects to implement rainforest conservation initiatives and improve sanitation and health care.