learn sign languages more easily than spoken languages. But there is no citation here because there is considerable evidence (for example, the work of John Bonvillian and Virginia Volterra) that deaf children learn their first signs at the same age as hearing children learn their first words. Also in the domain of language acquisition, Corballis gives credit for the well-known book *Rethinking Innateness* (MIT Press, 1996) to Jeffrey Elman, Elizabeth Bates and Elissa Newport. The first two authors are correct, but the third is an outspoken opponent of the ideas in this book and will be horrified to see her name there (as will Mark Johnson, Annette Karmiloff-Smith, Domenico Parisi and Kim Plunkett, authors whose names are omitted).

Corballis also claims that Kanzi, a bonobo who understands some English words and phrases, could have done well in the comprehension experiments in which he participated by simply performing the most likely actions involving the objects involved. But the researchers conducting these studies dealt with this explicitly by having some experimental conditions in which semantic plausibility was controlled, and this is prominently underscored throughout the monograph.

Finally, Corballis cites as crucial support for his theory the existence of mirror neurons, which have been documented mainly for manual reaching, thus providing a neural substrate for learning gestures by imitation. But it is likely that if researchers were to look they would find the same thing for vocalizations — neurons that fire when an animal either produces or hears the same sound (call them echo neurons) — so the fact that neuroscientists looked first at reaching behaviour is not crucial. Unless we know that echo neurons do not exist, then mirror neurons do not provide crucial support for a gestural theory.

It is inevitable that any scholar who takes on a wide range of disciplines and tries to synthesize them into a coherent whole cannot be an expert in all of them and is bound to be superficial in some places. In this case, there are several inaccuracies with the empirical data that in some cases lead to implausibilities in the theory. These could easily be rectified and would in some cases actually help Corballis' argument. But despite all this, he has still written an interesting and thought-provoking book that provides a welcome fresh perspective on the evolution of human linguistic communication. ■

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Life out of nowhere?

Things Come to Life: Spontaneous Generation Revisited
by Henry Harris
Oxford University Press: 2002. 168 pp. £20, $34.95

Paolo Mazzarello

One of the longest-lasting scientific problems in history is the question of spontaneous generation. The idea that animals and plants could be formed at any time from inanimate matter by a process of natural, spontaneous transmutation is rooted in the mists of time. But only in 1668 was it first tested scientifically, by Francesco Redi, who found no place for the spontaneous generation of macroscopic beings. The theory was resurrected some years later, after the discovery of microorganisms, which were considered to be a bridge between inorganic substances and life. In the following two centuries, some of the best natural scientists devised experiments that were intended to prove or refute the spontaneous development of life. But decisive experimental evidence against its occurrence was not produced until the second half of the nineteenth century, by Louis Pasteur and John Tyndall.

A need for seed? Louis Pasteur provided evidence that life could not develop spontaneously.

The story of the crucial experiments and the alternate success and failure of this phoenix-like idea, resurrected and buried many times, is now clearly narrated by the cell biologist Henry Harris, author of *The Birth of the Cell* (Yale University Press, 1999), a history of cell theory. *Things Come to Life* is, in many respects, different from most other books on spontaneous generation. The origin of life is one of the fundamental questions that every culture has tried to answer in one way or another. For this reason, most studies of spontaneous generation deal mainly with the ideological controversy and its metaphysical meaning, rather than with the scientific details of the debate. Philosophy and theology are not entirely absent in this book (a brief chapter is entitled "Materialism, For and Against"), but its main aim is to describe the principal experiments and to judge what we can consider, in hindsight, to be right and wrong. So this is more a book of facts than of opinions about the facts, and more of experimental evidence than of the philosophical consequences.

Harris has avoided flooding the narrative with too many technical details and has added schematic reconstructions of some of the main apparatus used by the protagonists of this long story. For these reasons this small but informative book is suitable for a wide audience, including biologists (especially microbiologists), philosophers and historians of science. Because this is also the history of the rising of a modern biology postulate, according to which life comes from life and nothing is generated *ex nihilo*, it could be of formative value for students of medical and biological topics as well.

The story of the spontaneous-generation debate is a confirmation of the heuristic

importance that theories can have for the history of science, even when they are ultimately shown to be wrong. Wrong ideas do not always hinder the progress of science — they can even have positive consequences. Spurred on by the impossibility of solving the controversy with a single crucial experiment, scientists were engaged in a gigantic and often acrimonious hunt for biological findings in the hope of shifting the balance in one direction or another.

In the course of this battle, as Harris shows, many standard microbiological instruments were conceived, which influenced, and still influence, everyday laboratory life and the food industry (such as swan-necked flasks, cotton-wool air filters and autoclaves). So the wrong theory of generation without seeds was itself the seed of many ideas that had an enormous positive influence on the development of the microbiology and pathology of infectious diseases. ■

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Gases get cool

Lévy Statistics and Laser Cooling: How Rare Events Bring Atoms To Rest
by François Bardou, Jean-Philippe Bouchaud, Alain Aspect & Claude Cohen-Tannoudji
Cambridge University Press: 2002. 214 pp. £60, $90 (hbk); £19.95, $30 (pbk)

Bose–Einstein Condensation in Dilute Gases
by C. J. Pethick & H. Smith
Cambridge University Press: 2001. 414 pp. £70, $110 (hbk); £27.95, $40 (pbk)

Keith Burnett

Laser cooling uses light fields to remove kinetic energy from atoms in the gas phase through the exchange of momentum between the light fields. The fact that this leads to cooling is remarkable in its own right. What is even more surprising, as was shown in pioneering work in which the authors of *Lévy Statistics and Laser Cooling* played a pivotal role, is that atoms can be made to randomly pick up then throw away the momentum gained from the field until they find themselves 'trapped' in a region of low momentum.

This process can be used to cool atoms to low temperatures (sub-microkelvin, a fraction of a degree above absolute zero) where an atom's momentum is less than that of a single photon, a technique known as sub-recoil laser cooling. This method of laser-cooling atoms, known as velocity-selective coherent population trapping (VSCPT), means that atoms can be cooled to close to the conditions for producing Bose–Einstein condensates. These condensates are unique sources of coherent matter waves and are opening up new avenues of research in physics, as discussed in the second book. But more of that later.

Laser cooling has led to a broad range of new theories and experiments, as well as the 1997 Nobel Prize in Physics for Claude Cohen-Tannoudji, one of the authors of this book. The crucial issue, from the point of view of the book, is the extraordinary utility of the method of Lévy statistics for qualitative and quantitative understanding of laser cooling based on VSCPT. The authors have provided an excellent and readable account that will be of considerable use not only to people interested in laser cooling, but also to those wishing to see this important set of techniques make an impact in studies of ultracold matter.

The authors first give a brief explanation of the methods of laser cooling, with the details of the link between the physics and the models discussed in the book being partly relegated to an appendix to avoid breaking the flow of the text. They then show how the process calls out for a statistical method that can handle broad distributions. Lévy statistics, which is also used in many other fields including biology, Earth sciences and finance, fits the bill. This statistical method is described in just the right amount of detail for the reader to appreciate its use in laser-cooling theory. The application of the general concepts to the problem at hand is then given in clear and convincing terms, supported by a solid, physically based discussion of what is going on. The book then gives more specifics of the results, which will be used eagerly by other workers in the field. This includes, most importantly, methods for optimizing the cooling produced for various systems that can be used in the laboratory.

The book is a significant addition to the literature in both laser cooling and statistical physics. It is rare to have such a lucid and convincing account of a technique that will be new to most scientists. It will be greatly welcomed both by workers in the field of ultracold atom physics and by those who want to see an important theoretical apparatus used in practice.

One of the most exciting applications of laser cooling is the production of atoms that are sufficiently cold and dense to be evaporatively cooled to produce Bose–Einstein condensation. The laser-cooled atoms are trapped using magnetic fields and cooled by evaporation of the more energetic atoms. *Bose–Einstein Condensation in Dilute Gases* is an excellent and much-needed text of the theory of these condensates.

In a condensate, all the atoms in a gas share exactly the same de Broglie wave. In this sense they constitute giant quantum waves, in which the wave nature of matter

Look back in amber

Republished in English for the first time, the *Atlas of Plants and Animals in Baltic Amber* by Wolfgang Weitschat and Wilfried Wichard (Friedrich Pfeil, 75 euros, $98) is a rich catalogue of the flora and fauna that have been preserved in Baltic amber. It guides us through the history and geography of petrified resin and discusses the geology of amber. This spider is one hundreds of life-forms captured in amber that illustrate the book.