Move to the rhythm

Many systems, from pendulums to fireflies, work in synchrony.

Sync: The Emerging Science of Spontaneous Order
by Steven Strogatz
Hyperion/Allen Lane: 2003. 338/352 pp. $24.95/£14.99

J. J. Collins

One of the central challenges facing many scientific disciplines, including physiology, molecular biology and physics, is to understand the dynamics of complex networks of interconnected components. Attempts to identify generic behaviour or universal organizing principles for such systems often leads to results that are suggestive and intriguing but lack a rigorous, mechanistic foundation. Exceptions to this are studies that deal with synchrony, a phenomenon in which the dynamics of multiple components become locked in time. Synchrony has been the object of rigorous scientific enquiry since 1665, when Christiaan Huygens noticed from his sick bed that the two pendulum clocks hanging next to one another in his room were synchronized.

Steven Strogatz, a pioneer and researcher into synchronization, offers an expert tour of this area in his new book, *Sync*. His aim is to provide the reader with a sense of the diverse forms and implications of synchrony in animate and inanimate systems, and an idea of the mathematics used to model such systems. He succeeds admirably in a work that is part general science book and part memoir.

General science books typically fall into one of two categories: either they offer a solid but dry description of the science, or they present an entertaining but superficial treatment of the subject, leaving the reader craving more substance. Strogatz combines the best qualities of these two: he is a first-rate storyteller and an even better teacher. Throughout the book he makes effective use of colourful analogies to build the reader's intuition about the system or model under study. These include comparing a cardiac pacemaker cell to a leaky toilet bowl, and a boson to the character Pig Pen from the *Peanuts* comic strip. Teachers of undergraduate science and engineering courses who struggle to find ways to give students a real 'feel' for dynamics and underlying mechanisms will find much inspiration in this book.

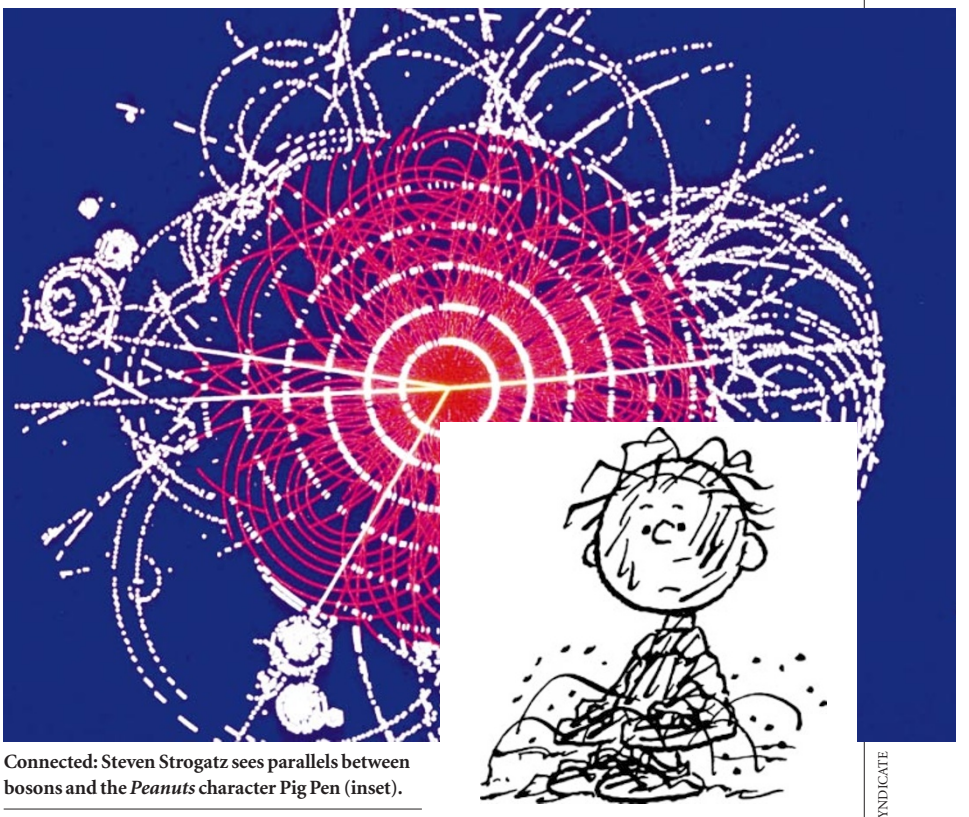
Strogatz covers a considerable amount of material, including synchronized fireflies, chemical oscillations, superconductors, lasers, synchronized chaos and small-world networks.

My favourite stop on his tour is the chapter on "Sleep and the daily struggle for sync". Strogatz explains, among other things, how Chuck Czeisler studied human subjects over extended periods of time isolation, and discovered that the sleep-wave cycle can become desynchronized from the body temperature cycle, and yet remain linked to it in a consistent way. In particular, Czeisler found that subjects who fall asleep when their body temperature is low tend to sleep for short periods, whereas those who fall asleep when their temperature is high will sleep for long periods. Moreover, the relationship between sleep duration and sleep onset time relative to the temperature cycle is discontinuous. Several hours after the body temperature reaches its low point, sleep duration jumps abruptly from very short periods to very long ones, then slowly decreases back to short durations. This gradual descent leads to the surprising effect that if you stay awake longer than usual and go to sleep later in your body's temperature cycle, you tend to sleep less, even though you may be exhausted from a late-night party.

The memoir portions of the book offer fascinating glimpses into the daily life of a scientific researcher that are some of the best I have read. Strogatz illustrates through several anecdotes the fits, starts and strange turns that are part of cutting-edge research projects. He also indirectly emphasizes the importance of 'play' in research, the need to be bold and open to new possibilities, and the critical value of having like-minded collaborators with different but complementary backgrounds.

I particularly liked the story of how Strogatz, as a graduate student at Cambridge University, dispirited by the cultural divide between England and America, stumbled into a local bookstore and came across Art Winfree's classic book *The Geometry of Biological Time* (Springer, 1980). Strogatz tells how he revisited the shop several times to continue sampling Winfree's book, finally dipping into his Marshall Scholar stipend to buy a copy. A short time later he got up the courage to send off a letter to Winfree, which led to a gracious reply and eventually an invitation to join Winfree's lab as a summer student. This serendipitous course of events led to the pairing of two of the most creative biomathematicians of the past few decades, and yielded landmark results on scroll waves. *Sync* is filled with many such stories and colourful portraits of leading synchrony researchers, including Charlie Peskin, Nancy Kopell, Kurt Wiesenfeld and Lou Pecora.

Sync is a great read. I will recommend it



Connected: Steven Strogatz sees parallels between bosons and the *Peanuts* character Pig Pen (inset).

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to my students who are considering graduate studies and possible careers in research, as well as to friends and colleagues who are looking for a starting point to explore and understand the dynamics of natural and technological networks. ■

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All in the mind?

Placebo: The Belief Effect
by Dylan Evans
HarperCollins: 2003. 240 pp. £16.99

Walter A. Brown

In recent years the placebo response has captivated both the scientific community and the general public. *The Lancet* ran a series of articles on the placebo effect in 1994, and the US National Institutes of Health (NIH) sponsored a conference on it in 2000. Over the past five years, television programmes, newspapers and news magazines from around the world have carried stories about the placebo effect. Why the recent flurry of interest in a phenomenon that has been recognized for most of the past century and subjected to a low but steady rate of enquiry for 50 years?

Part of the fascination comes from the recent attention given to the mind–body relationship. Technology-driven advances in our knowledge of the brain and an interest in alternative and complementary medicine, with its emphasis on self-healing and spirituality, both focus attention on the links between mind, brain and illness, the arena in which placebo operates. The high visibility of clinical trials in recent years has also drawn attention to the placebo response. These trials keep telling us that for some conditions, such as depression and pain, placebo treatment brings almost as much benefit as 'real' drugs and surgical procedures. They have also spotlighted the ethics of placebo controls.

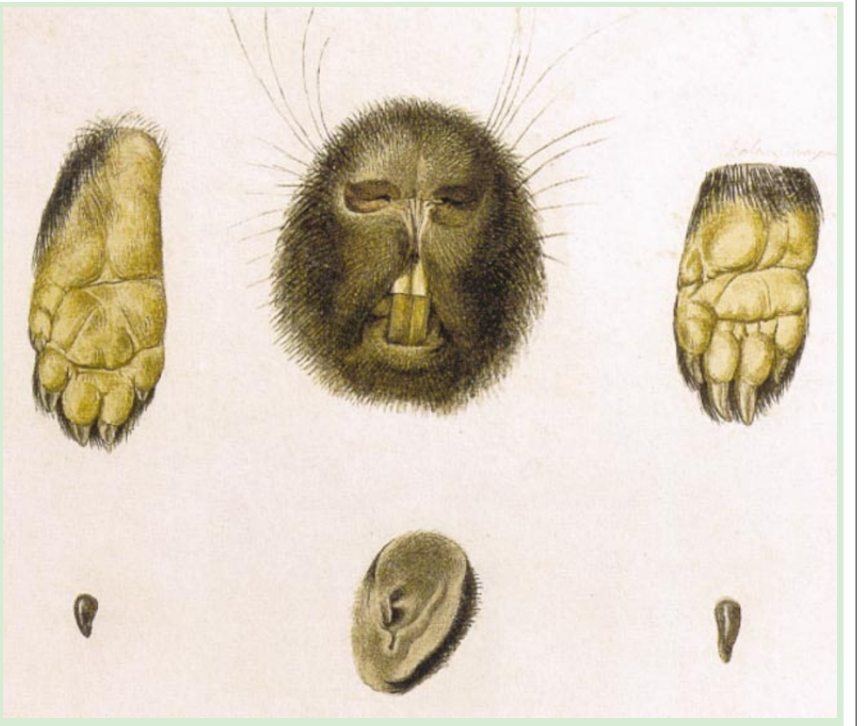
The placebo effect has long been considered a nuisance that obscured the identification of new treatments. For most of the past century, in the rare instances when doctors deliberately gave patients placebos, they did so to placate patients who were thought to be complaining too much, or to 'prove' that a symptom was psychologically based rather than 'real'.

But these views are changing. The placebo response is now widely regarded as a phenomenon worthy of study in its own right. After its placebo conference, for example, the NIH requested grant proposals to study both the basic mechanisms and the clinical application of the placebo response. Recent studies have shown that functional changes in the brain are associated with the placebo response in both depression and Parkinson's disease. And some clinicians are beginning to consider the placebo response as an integral part of healing, and are seeking ways to harness and enhance it.

Given the subtitle of Dylan Evans' book, one might expect it to offer a comprehensive assessment of the role of belief in the placebo effect. But that's not what we get. Instead there is a smorgasbord of facts and speculation presented in support of the author's main — and in my view thoroughly implausible — hypothesis that "all placebo-responsive conditions" involve activation of the inflammatory response and that placebos work by suppressing inflammation. If a highly placebo-responsive condition such as depression doesn't seem to involve the inflammatory response, Evans is undeterred: he comes up with a bit of information (in this instance one study showing that depressed patients have increased interleukin levels) to convince us otherwise. He manages to fit Parkinson's disease into his model, along with a raft of other ills that few others would ever consider as diseases of inflammation. Evans does state at the outset that this is an unsubstantiated hypothesis, but later in the book, as he gets rolling, he seems to assume that he has demonstrated its validity.

His case is not helped by inaccuracies ranging from trivial errors of fact (he tells us that no study of depressed patients has included both a placebo and a no-treatment group, but there is at least one such study, and it is cited in a paper he reviews in depth), to misinformation (he says that placebos don't help asthma) and major misconceptions (that classical conditioning entails belief in the connection between the conditioned and unconditioned stimuli).

Evans does provide a reasonable critique of the widely discussed meta-analysis by Asbjørn Hróbjartsson and Peter Gøtzsche (*New England Journal of Medicine* **344,** 1594–1602; 2001) that compared placebo to no treatment. The data were largely misinterpreted, including by the authors, as showing that a placebo offers no more benefit than the passage of time. And Evans includes an entertaining chapter speculating on the evolution of the placebo response and how the capacity for it might be adaptive. It's utter nonsense, but I'm a natural-selection junkie and I enjoyed the attempt.



Through the eye of the lynx

Italy is brimming with art treasures, but now and again new troves emerge from obscurity. In *The Eye of the Lynx* (University of Chicago Press, $50), art historian David Freedberg brings together a wealth of mostly unknown natural-history drawings produced by the world's first modern scientific academy, the Accademia Nazionale dei Lincei (Academy of the Lynxes), which was founded 400 years ago. Revolutionary at the time, the drawings were aided by the use of a new instrument — the microscope — which was created by turning around Galileo's new telescope. Pictured here is a selection of Vincenzo Leonardi's carefully observed details of the anatomy of the common porcupine, drawn in the early seventeenth century.