

respiratory systems: “They cooperate, they depend on each other, and they are basically useless by themselves.”

At his best, Schutt guides us on a journey from the origin of the first contractile cells more than 500 million years ago to the emergence of vertebrates, not long afterwards. He takes in, for example, horseshoe crabs, their blood coloured blue by the presence of the copper-based oxygen-transport protein haemocyanin (equivalent to humans’ iron-based haemoglobin).

We learn that insects, lacking a true heart, have a muscular dorsal vessel that bathes their tissues in blood-like haemolymph. Earthworms, too, are heartless but with a more complex arrangement of five pairs of contractile vessels. Squid and other cephalopods have three distinct hearts.

There are plenty of zoological nuggets to enjoy along the way. The tubular heart of a sea squirt, for instance, contains pacemaker-like cells that enable it to pump in one direction and then the other. Some creatures need masses of oxygen, others little, leading to more diversity. The plethodontids (a group of salamanders) have neither lungs nor gills, he explains: their relatively small oxygen requirements are met by diffusion through the skin.

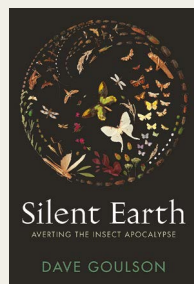
Cardiac records

Hagfish can get by with the lowest recorded aortic pressure of any vertebrate, between 5.8 and 9.8 mm Hg. A giraffe’s heart, by contrast, must generate extraordinary pressures – up to 280/180 mm Hg – to send blood up its 2-metre-long neck to its brain. Hummingbird hearts can reach an astonishing 1,260 beats per minute. Shrew hearts must work faster still, each cardiac cycle lasting just 43 milliseconds – a heart rate that must be “awful damn close” to the electrophysiological maximum.

Schutt refers to one of his own research interests, cold adaptation in bats: a physiological trick that sees the heart rate collapse from well over 500 beats per minute during flight to less than 20 beats per minute during hibernation. These metabolic extremes might help to explain why bats are a reservoir for so many viruses (A. T. Irving *et al. Nature* **589**, 363–370; 2021). However, *Pump* contains no reference to SARS-CoV-2 and the many ways – direct and indirect – in which this particular coronavirus seems to affect the cardiovascular system (M. Nishiga *et al. Nature Rev. Cardiol.* **17**, 543–558; 2020).

As Schutt works his way around the evolutionary tree, he is keen to stress that “there should be no bragging rights associated with the fact that some circulatory systems are quite complex while others are relatively simple. The key here is that all of them work.” Rather than seeing humans as the

Books in brief



Silent Earth

Dave Goulson *Jonathan Cape* (2021)

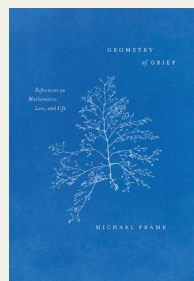
Biologist Dave Goulson loves insects. As a child, he fed yellow-and-black caterpillars and watched them become cinnabar moths. As an adult, he showed how bumblebees avoid wasting time on a flower visited by another bee – by sniffing it for the fresh whiff of smelly feet. They also detect a decrease in the electrostatic charge on its pollen. Bees are “the intellectual giants of the insect world”, he writes enchantingly, while pondering an alarming estimated 75% decline in global insect populations over half a century.



Bright Galaxies, Dark Matter, and Beyond

Ashley Jean Yeager *MIT Press* (2021)

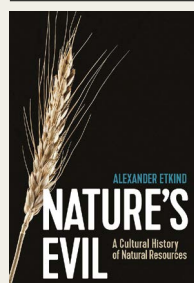
‘More matter than meets the eye’ is a chapter title of this insightful biography of the pioneering astronomer Vera Rubin by science journalist Ashley Yeager, who interviewed her in later life. Best known for her observations of galactic rotation rates, which provided evidence for the existence of dark matter, Rubin also campaigned for equality in science. Her many honours did not include a Nobel prize, but a new observatory in Chile bears her name and this is the second biography of her in a year (see A. Abbott *Nature* **591**, 523–524; 2021).



Geometry of Grief

Michael Frame *Univ. Chicago Press* (2021)

This brief, intriguing personal meditation is inspired by mathematician Michael Frame’s lifelong love of geometry – including 20 years’ collaboration with fractal geometer Benoit Mandelbrot – and the childhood loss of his aunt, who set him on his career path. He writes: “Grief informs geometry and geometry informs grief.” How so? His epiphany on first understanding any beautiful mathematical idea is always tinged with sadness, because it is unrepeatable. With quirky illustrations, he integrates the lives of his Mom and Dad.



Nature’s Evil

Alexander Etkind *Polity* (2021)

In detailed chapters on grain, animal products, sugar, hemp, metals, peat, coal and oil, historian Alexander Etkind explores how nature and its commodification has shaped states and societies, as the pursuit of power and wealth has degraded people and despoiled the planet. His Eurocentric survey weaves together material, intellectual, economic, ecological and moral history to reflect on “the mess we have made of our world”. To predict the outcomes of our choices, he argues, it pays to know the consequences of choices that people made in the past.



The Collected Papers of Albert Einstein, Volume 16

Eds Diana Kormos Buchwald *et al. Princeton Univ. Press* (2021)

Albert Einstein’s collected papers began publication in 1987. The 16th of these uniquely comprehensive volumes covers 1927–29, up to Einstein’s 50th birthday, when he hid from acclaim. It includes the 1927 Solvay Conference on quantum mechanics, where he sparred with Niels Bohr but scribbled a note: “Who knows who’ll be laughing in a few years?” He also engaged further in politics, dubbing himself an anti-fascist, and hired assistant Helen Dukas, who preserved his letters post-mortem, creating his vast archive. **Andrew Robinson**