

in the *Science* paper that genuine patients often realized that the pseudopatients did not have a mental-health disorder, and accused them of being undercover journalists or academics checking up on the hospital. Psychiatrists seemed less perceptive: it was several weeks before some of the pseudopatients got discharged.

Although Rosenhan died in 2012, Cahalan easily tracked down his archives, held by social psychologist Lee Ross, his friend and colleague at Stanford. They included the first 200 pages of Rosenhan's unfinished draft of a book about the experiment.

At first, it seemed that Cahalan's research was going to be easy, even though Rosenhan had given fictitious names to the pseudopatients she wished to track down, along with the hospitals they went to. Ross warned her that Rosenhan had been secretive. As her attempts to identify the pseudonymous pseudopatients hit one dead end after the other, she realized Ross's prescience.

The archives did allow Cahalan to piece together the beginnings of the experiment in 1969, when Rosenhan was teaching psychology at Swarthmore College in Pennsylvania. The students complained that the course was too abstract, so Rosenhan suggested that they check into a psychiatric hospital to get to know people with schizophrenia personally. The superintendent of the local Haverford State Hospital was willing to take them on, but Rosenhan cautiously decided to check things out for himself first. He emerged humbled from nine traumatizing days in a locked ward, and abandoned the idea of putting students through the experience. But it set him thinking about a scientific experiment aimed at exposing the system's travesties.

According to Rosenhan's draft, it was at a conference dinner that he met his first recruits: a recently retired psychiatrist and his psychologist wife. The psychiatrist's sister also signed up. But the draft didn't explain how, when and why subsequent recruits signed up.

Cahalan interviewed numerous people who had known Rosenhan personally or indirectly. She also chosed down the medical records of

individuals whom she suspected could have been involved in the experiment, and spoke with their families and friends. But her sleuthing brought her to only one participant, a former Stanford graduate student called Bill Underwood.

“Patients often realized that the volunteers were not ill, and accused them of being undercover journalists.”

Underwood and his wife were happy to talk, but two of their comments jarred. Rosenhan's draft described how he prepared his volunteers very carefully, over weeks. Underwood, however, remembered only brief guidance on how to avoid swallowing medication by hiding pills in his cheek. His wife recalled Rosenhan telling her that he had prepared writs of habeas corpus for each pseudopatient, in case an institution would not discharge them. But Cahalan had already worked out that that wasn't so.

Comparing the *Science* report with documents in Rosenhan's archives, she also noted many mismatches in numbers. For instance,

Rosenhan's draft, and the *Science* paper, stated that Underwood had spent seven days in a hospital with 8,000 patients, whereas he spent eight days in a hospital with 1,500 patients.

When all of the leads from her contacts led to ground, she published a commentary in *The Lancet Psychiatry* asking for help in finding them – to no avail. Had Rosenhan invented them, she found herself asking?

In recent years, other heroes of social psychology have been found to have misrepresented their data. The most prominent case is that of Dutch social psychologist Diederik Stapel, who was forced to retract 58 papers. Those who have followed these cases might be appalled by the Rosenhan story, but will not be surprised.

Cahalan, whose life was saved by front-line medical science in the context of psychiatry, was shocked by what she found. She writes that she cannot be completely certain that Rosenhan cheated. But she is confident enough to call her engrossing, dismaying book *The Great Pretender*.

Alison Abbott writes from Munich, Germany. e-mail: alison.abbott.consultant@springernature.com

The rise of the greedy-brained ape

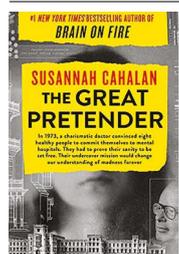
Gaia Vince takes an enjoyable sprint through human evolution. **By Tim Radford**

Gaze into a mirror. Reflected is a marvel of evolution: a weak-jawed, bipedal omnivore with a greedy brain, in which 100 billion neurons consume 20% of the body's energy intake. Science journalist Gaia Vince urges us towards such reflections in *Transcendence*, a book tracing the journey of *Homo sapiens* through genes, environment and culture to what might be, she surmises, a new state of being.

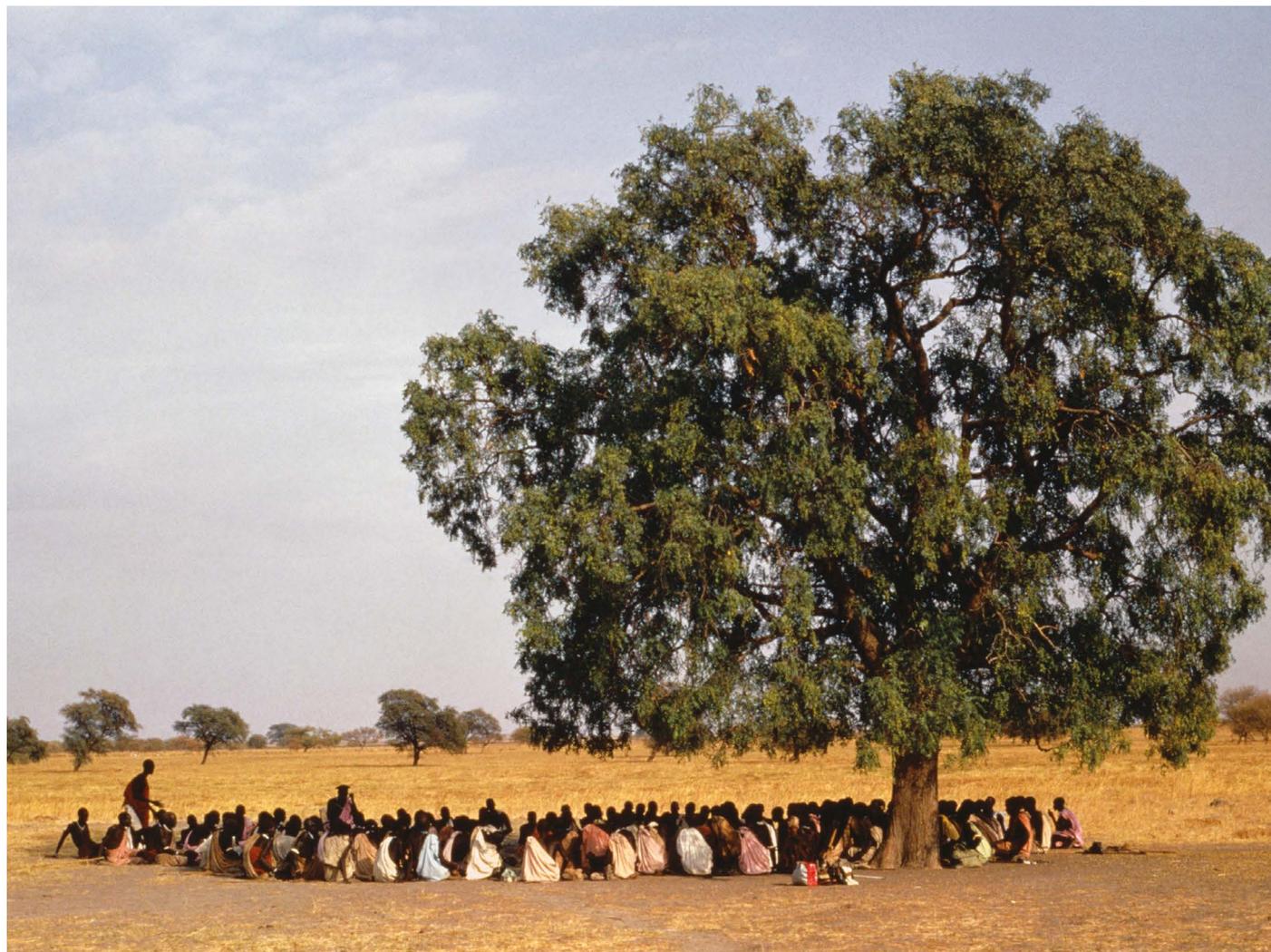
For her hugely enjoyable sprint through human evolutionary history, Vince (erstwhile news editor of this journal) intertwines many threads: language and writing; the command of tools, pursuit of beauty and appetite for trinkets; and the urge to build things, awareness

of time and pursuit of reason. She tracks the cultural explosion, triggered by technological discovery, that gathered pace with the first trade in obsidian blades in East Africa at least 320,000 years ago. That has climaxed this century with the capacity to exploit 40% of the planet's total primary production.

How did we do it? Vince examines, for instance, our access to and use of energy. Other primates must chew for five hours a day to survive. Humans do so for no more than an hour. We are active 16 hours a day, a tranche during which other mammals sleep. We learn by blind variation and selective retention. Vince proposes that our ancestors enhanced that process of learning from each other with the command



The Great Pretender: Mission that Changed our Understanding of Madness
Susannah Cahalan
Grand Central Publishing (2019)



EYE LUBIKI/ALAMY

Shilluk people in Sudan gather in the shade for traditional storytelling.

of fire: it is 10 times more efficient to eat cooked meat than raw, and heat releases 50% of all the carbohydrates in cereals and tubers.

Thus *Homo sapiens* secured survival and achieved dominance by exploiting extra energy. The roughly 2,000 calories ideally consumed by one human each day generates about 90 watts: enough energy for one incandescent light bulb. At the flick of a switch or turn of a key, the average human now has access to roughly 2,300 watts of energy from the hardware that powers our lives – and the richest have much more.

Humans are more social than other primates. We can keep track of around 150 other people, which demands a large brain and might also

help to expand it. To learn a fact stimulates one part of the brain; to hear a story activates many. That is why we find information 22 times more memorable in narrative form. *Homo sapiens* is a storytelling animal, and this adaptation ensures the transmission of skills and knowledge as fable, epic or cautionary tale. Vince, drawing on brain-scan studies, shows that neuroscientists have noted a synchrony, both spatial and temporal, between speaker and listener during storytelling, a phenomenon known as ‘neural coupling’.

The human capacity for narrative, metaphor and pattern-matching can lead us to see meaning where there is none, however. In a US psychological experiment in 1944, students were shown a short animation of two triangles and a circle passing across a screen, while a rectangle remained stationary (F. Heider & M. Simmel *Am. J. Psychol.* 57, 243–259; 1944). Of the subjects, 33 out of 34 anthropomorphized the moving shapes, creating narratives of anxiety, concern, rage and frustration.

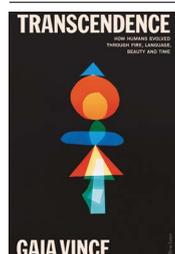
Vince continually returns to the evolutionary triad of genetics, environment and culture to address our similarities and differences.

Some human biological adaptations are part of cultural variety. The semi-nomadic Moken people of Thailand can see clearly underwater because they can constrict their pupils to the maximum limit of human capacity, increas-

“We find information 22 times more memorable in narrative form.”

ing depth of field and changing the lens shape. This is a learnt capacity: in an experiment, Swedish children mastered it. Divers of the Bajau people in Indonesia, however, exemplify heritability and environmental selection at work. Their spleens are 50% larger than average, acting as a reservoir of oxygenated blood and endowing them with consummate endurance underwater.

Our most profound cultural tool, language, is in some ways culturally selected. We owe our acrobatic way with words to a larynx that descends at three months of age. Thereafter, Vince notes, we can no longer swallow and



Transcendence: How Humans Evolved through Fire, Language, Beauty, and Time
Gaia Vince, Allen Lane (2019)

breathe at the same time. Our languages shape our thinking and cultural identity in many ways, but environment also shapes speech. Languages in warm, wet, wooded regions tend to have more vowels and fewer consonants. Languages that emerged at altitude have more words with a strong expulsion of air in the consonants.

Tonality in languages (in which a word has different tones that change meaning) is important. The emergence of non-tonal languages over the past 50,000 years – Homer’s Greek was tonal, modern Greek is not – might have influenced the spread of two gene variants involved in brain growth, according to a 2007 study (D. Dediu and D. R. Ladd *Proc. Natl Acad. Sci. USA* 104, 10944–10949; 2007). So words also shape our inheritance.

Vince has a lot to say about words. The average response rate between speakers during a conversation is 200 milliseconds. But it takes 600 milliseconds for the signal to go from ears to brain, to understanding, to the preparation of a response and its transmission. Thus, conversation must rely on a sophisticated prediction system that commits a large part of the brain to both speaking and listening. Language, writes Vince, “gives us an unparalleled ability to convey an infinity of ideas. We use it mainly to talk about ourselves.”

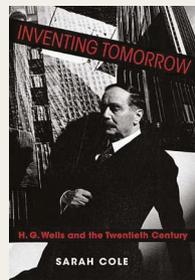
Of course we do. Humans might not be so much *Homo sapiens* as *Homo narcissus*, the self-absorbed species. Yet all of our capacities together have, in their different ways, endowed us with the capacity to become a super-organism. We are now a globally connected urban species, outsourcing our brains to computers, increasingly to artificial intelligence and (so far) to nine billion robots. We have begun the Anthropocene, and our demands on the planet are not sustainable. That could usher in a new dark age, or a global order in a new shared civilization. We transcend our evolutionary beginnings.

Vince dubs this emerging species *Homo omnis*, or *Homni* for short. Her chosen analogue for such a biological super-organism is not flattering: it is the slime mould, in which single cells coalesce as one to move on. The fortunate are protected at the centre; those on the margin become vulnerable to environmental change. Which sounds disturbingly like us.

Many aspects of *Transcendence* have been explored before. And, with that wealth of palaeoanthropological and other research to draw from, most of the chapters become a mosaic of tersely introduced evidence. Read it anyway. It is at least 22 times more memorable than many textbooks, and a good story without – so far – a happy ending.

Tim Radford is a former science editor of *The Guardian*. His book *The Consolations of Physics* is published by Sceptre. e-mail: radford.tim@gmail.com

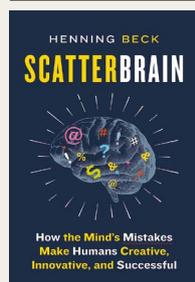
Books in brief



Inventing Tomorrow

Sarah Cole Columbia University Press (2019)

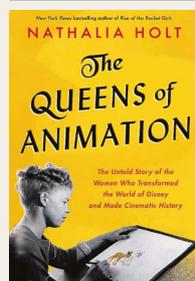
H. G. Wells was, asserts scholar Sarah Cole, a pioneer adept at “rescaling the cosmos and humanity’s place in it”. He straddled the border between science and literature, but not all his complexities were benign: he both repudiated racism and for some time shamefully ascribed to ideas on eugenics. Cole adroitly captures Wells, from his mould-breaking books (such as the 1895 science-fiction classic *The Time Machine* and 1920 *Outline of History*) to his unlikely intellectual kinship with subtle modernists such as Virginia Woolf.



Scatterbrain

Henning Beck Greystone (2019)

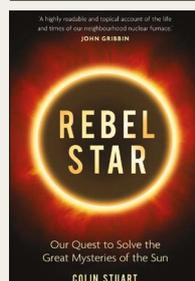
The human brain at work, notes neuroscientist Henning Beck, is sloppy – and that is precisely what makes us creative powerhouses. Beck’s coolly amusing narrative takes us through forgetting, pigeonholing, distraction and deep into creativity. He explores how idle wool-gathering is more conducive to creativity than is ‘efficient’ thinking, and the uncannily similar way in which true and false memories are generated in the brain. His is a hopeful message, ultimately. If we don’t err, we don’t change. So: “stay fallible”.



The Queens of Animation

Nathalia Holt Little, Brown (2019)

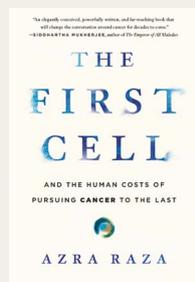
The early hand-drawn animations of Walt Disney Studios remain a technological wonder. Few know, however, of the company’s female virtuosi, who from the 1930s on injected nuance into characters from Bambi to a panoply of princesses. In her gripping corrective, Nathalia Holt ushers these animators and story developers into the limelight: Bianca Majolie, Sylvia Holland, Retta Scott, Grace Huntington and Mary Blair. Particularly in the early years, Holt shows, they paid a high price to work, forced to battle harassment in mostly male teams.



Rebel Star

Colin Stuart Michael O’Mara (2019)

This compelling portrait of the Sun packs in facts while speculating on gaps in our knowledge. Astronomy journalist Colin Stuart traces the arc of discovery from the fourth-century BC heliocentricism of Aristarchus of Samos through solar spectroscopy, star formation and nuclear fusion, the “epic journey” of sunlight to Earth and more. The Sun is both bountiful and belligerent, he reminds. Solar power could make 87% of countries energy self-sufficient – but the next big solar storm could send our electrical infrastructure into meltdown.



The First Cell

Azra Raza Basic Books (2019)

Each year, the United States spends US\$150 billion on treating cancer. Yet as oncologist Azra Raza notes in this incisive critique-memoir, the treatments remain largely the same. Raza wants to see change: eliminating the first cancer cell rather than “chasing after the last”, which is doable with current technologies. Meanwhile, she braids often-harrowing stories of patients, including her own husband, with insights gleaned from laboratory and literature on this complex, often confounding array of diseases. **Barbara Kiser**