of light. In 1999, *Mnemonic* juggled archaeology and neurochemistry. Might audiences be more afraid of maths than any of these topics?

We're addressing that. The play begins with the explanation of the functional equation of the Riemann zeta function — to do with the distribution of primes — and that is as difficult as it gets. Even if the audience doesn't understand the mathematics, they start to get a sense that it can be beautiful, simply for its elegance and economy. Great ideas themselves are touching, in the same way that a human story is touching.

Hardy was the only person who could recognize how incredible Ramanujan's work was, because he could appreciate something enormously, even if it was plain wrong. The pattern of how or why it was wrong fascinated him — as we might be enchanted by any other work of art.

What idea would you like to play with next?

Consciousness. Theatre must always be interested in what we don't know. We still can't explain consciousness — whatever Daniel Dennett might say. Putting things we don't understand on stage is a process of trying to learn about them: you communicate something of what you're learning, and perhaps take the audience on the journey you are in. ■

Interview by Sara Abdulla, *Nature*'s chief commissioning editor.

***A Disappearing Number* runs at the Barbican Theatre in London from 5 September to 6 October (www.complicite.org).**

The animal in us

The Human Animal in Western Art and Science
by Martin Kemp
University of Chicago Press: 2007. 320 pp. $40

Alison Abbott

On waking, Henry Jekyll stared with horror at the metamorphosis of his hand, normally "professional in shape and size… large, firm, white and comely". Jekyll's experiment to separate the human and animal sides of himself had been all too successful. He noted further: "The hand which I now saw.… lying half shut on the bedclothes was lean, corded, knuckly, of a dusky pallor and thickly shaded with a smart growth of hair. It was the hand of Edward Hyde."

Thus Martin Kemp ends his treatise *The Human Animal in Western Art and Science* with this apposite quote from Robert Louis Stevenson's 1886 novel. It epitomizes the dilemma that has fascinated us for millennia. How much of the animal is there within us? Conversely, how much is human in animals?

Kemp answers these questions. Science, from Darwin to the latest neuroscience and genomics, has shown that there is no sharp animal–human divide, only a sliding scale. And in guiding us to this conclusion, Kemp's six chapters deviate through an amusing and erudite visual history, drawing from art, philosophy, literature, film and other cultural media.

We humans have always had a tendency to anthropomorphize, and no amount of science will erase our pleasure in imagining the lion as fierce but noble and generous, the snake as cold and deceitful. We also instinctively assign animal labels to our moods and attributes, a tendency frequently exploited over the centuries as a literary device. In the fables of Jean de La Fontaine (1621–95), so beautifully illustrated in the eighteenth century by Jean-Baptiste Oudry, animals endowed with specific human failings (and speech) enact tales of eternally relevant morality. And when negotiations between the head pig and the farmer in George Orwell's 1945 *Animal Farm* become ugly, the other creatures "looked from pig to man, and from man to pig again; but already it was impossible to say which was which".

In classical times, the theory of physiognomics attempted to provide a rational framework for all this. Those with the broad brow and square face of a lion might be expected to share the lion's perceived nature, for example. Artists have often used such physiognomics to inform their portraits — Albrecht Dürer for sure, and Rembrandt, ventures Kemp, and the tradition was revived in the eighteenth century by William Hogarth and Francisco de Goya.

Until Darwin came along, such cross-attribution never shook the deeply held belief that humans, with their capacity for abstraction, were cleanly distinct from animals, with their inability to rationalize their feelings or control their instincts, appetites and passions. In the seventeenth century, René Descartes argued that animals were but machines without souls, incapable of experiencing the finer emotions that elevate humans.

That concept was dangerously extended in the eighteenth century by Julien Offray de La Mettrie, who described humans as 'perfect machines'. He was not putting the human soul in doubt — but European philosophy was certainly moving along a path that spelt trouble for God. Automata became popular in La Mettrie's time. These 'living' or 'philosophical' machines could accurately reproduce particular behaviours of animals and so demonstrate the redundancy of the soul. The 'digesting duck' of Jacques de Vaucanson, for example, could eat grain and apparently expel the digested waste from its anus (a mechanical achievement not diminished by the fact that the chemical laboratory claimed for the stomach was later found to be absent). The greater challenge for philosophers was Wolfgang von Kempelen's 1770 chess-playing automaton, 'the Turk'. It seemed to have the ability to reason, a defining characteristic of 'humanness'.

The boundaries between what is human and what is animal became increasingly blurred in that century, with the rise to fame of some feral children raised alone in the forest, who had a limited ability to learn to speak or behave in other ways considered to be human. Travelling circuses and freak shows were popular. They displayed animals trained to do 'human'

MUSÉE DU LOUVRE, PARIS/PHOTO RMN/M. BELLOT

This sketch by Charles Le Brun of a man with a beak-like nose plays on the similarities between animals and humans.

tricks, such as the learned pig, which could spell out words. They also displayed unfortunate humans, such as microcephalics and hairy women, who were branded as 'freaks' for showing animal characteristics.

The boundaries came close to merging in the nineteenth century. The widespread study of primate anatomy and behaviour made the similarities between humans and apes hard to dismiss. Satirists saw this as an opportunity: for example, one hairy creation, Sir Oran Haut-Ton, bought a baronetcy and entered parliament — where, his creator reported, little distinguished his behaviour from that of his fellows aside from his muteness. Darwin's influence on our mental image of primitive man is unmistakable. In Renaissance pictures, he is clearly *Homo sapiens*, albeit extremely unkempt. Post-Darwin paintings endow primitive man with decidedly simian characteristics.

Kemp's book is beautifully illustrated and written, but the breadth of its discussion is packed into a form that may be too abbreviated. It is not a light read, and sometimes one struggles to follow the thread of the narrative. Then again, it is not supposed to be a linear plot. How else could all this knowledge be shoe-horned into a coffee-table format?

Also packed in are discussions of the science of phrenology, as developed by Franz Joseph Gall in the first half of the nineteenth century, and the fashion for quantification of primitiveness through measurement of jaw angle — the ideal reference being Apollo Belvedere (who was decidedly caucasian) from antiquity.

The great French nineteenth-century neuroscientist Paul Broca also made the error of assuming that caucasians must provide the baseline. However, he was forced to abandon his theory that intelligence was related to brain size when facts intervened — his own measurements showed that the brains of some non-caucasian races were in fact larger. His contemporary Cesare Lombroso, who launched the field of criminal anthropology, even tried to match skulls with particular shapes, and brains with particular features, to show that those with criminal tendencies had the physical attributes of the throwback — or of other animals such as apes, or even rats.

With hindsight, it is easy to scoff at these past theories. Instead, Kemp acknowledges most of them as appropriately reflecting the state of knowledge at the time. Gall's phrenology, he notes, had its own internal logic and was based on careful, systematic measurements.

Robert Louis Stevenson was also of his scientific time. His Mr Hyde is a Lombroso-style atavistic regression, exemplifying the thin veneer of civilization that only just manages to repress our natural animalistic tendencies. Dr Jekyll's dilemma resonates as strongly in today's sophisticated times — the adjective 'Jekyll-and-Hyde' has made its way into the *Oxford English Dictionary*. ■

Alison Abbott is *Nature*'s Science in Culture editor and senior European correspondent.

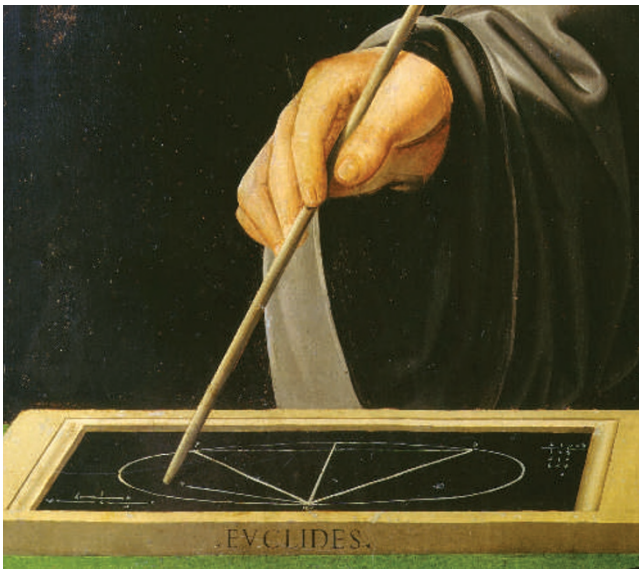
A question of truth

A Certain Ambiguity: A Mathematical Novel
by Gaurav Suri and Hartosh Singh Bal
Princeton University Press: 2007. 304 pp. £16.95, $27.95

Katherine Körner

When Euclid laid out his axioms of geometry — five statements on the properties of points, lines, circles and angles that he believed to be self-evident — he sought to demonstrate further truths by building logically on these supposedly indisputable foundations. *A Certain Ambiguity* uses the structure of a novel to explore the nature of the beauty inherent in such mathematical arguments, and of the truth to which they lead.

The authors' commitment to wowing their characters as much as their readers is one of the book's strongest points. Gaurav Suri and Hartosh Singh Bal draw on some of the most elegant results in the ancient Greek arsenal — proofs that there are infinitely many prime numbers, for instance, and that the square root of 2 cannot be written as a fraction. The book's characters and readers are led through deep (but accessible) reasoning before being challenged with questions about what makes these arguments valid, and on what this validity depends.



A. DAGLI ORTI/MUSEO DI CAPODIMONTE, NAPLES/ART ARCHIVE

Euclid's axioms are used to demonstrate other geometric truths.

The book is at its most successful, and the story at its most engaging, when the authors allow their natural exuberance to carry them away. The joy that accompanies their early excursions into proof will buoy up a floundering newcomer, while allowing old hands to recall the thrill of meeting the ideas for the first time.

Through a series of court transcripts rationed out over the course of the book, the narrator's grandfather, under arrest for blasphemy in 1919, talks his judge, his grandson and us through the components of logical argument and his belief in the truth derived from it. Only the judge is allowed to answer back, and the discussions that ensue are by far the most gripping and entertaining aspect of the book. Together, judge and grandfather journey from their delight at finding a way through simple proofs, to awe at the world this reveals, all the way to spiritual torment when the truth of Euclid's axioms is brought into question. In one of the most profound sections, the authors offer a lucid introduction to the rejection of one of these axioms by noneuclidean geometry.

We also follow the less-stimulating conversations of the narrator with his undergraduate friends as they, too, grapple with the nature of truth. Although their mathematical focus on our knowledge of infinity is fascinating and well presented, the discussions themselves are common to those of many students in the pub at closing time and do not particularly enlighten the reader or add much of interest. Each of these characters seems to have had his or her list of personality traits allocated at random, and it was galling to see 'love interest' on the list of the only important female character flagged up from early on.

The book's main weakness is that these same characters are tedious. The grandfather's story is compelling, and the combination of socratic dialogue and very human digressions throughout should interest those readers less inclined to mathematical textbooks. But — just as the characters' excitement in mathematics encourages the reader's — when it is hard to warm to the characters, it is hard to care about the topics they choose to discuss.

In any introduction to a subject, there will be areas the specialist might wish to see covered in more depth or from a different angle. The interested layperson, however, should take from *A Certain Ambiguity* a good grounding and a new curiosity that will help them tackle the books referenced in the bibliography. Mathematicians should enjoy the infectious enthusiasm with which the discipline is presented, and it could even spur them into finding new ways to share their own passion. ■

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