

animate duck could somehow heal his beloved son's ill body.

Catherine follows Henry's misadventures in Germany in her increasingly obsessive reading of his notebooks. His story takes a fairy-tale turn as he is led to Furtwagen, a small town in the Black Forest, by a mysterious man named Sumper, who claims to possess the skills to recreate the avian automaton. With a trio of eccentrics — a collector of fairy tales, a preternaturally gifted child and his superstitious mother — Henry listens sceptically to his host's fantastic story of his own travels to England.

In a brilliant narrative turn, Carey uses this third storyline — Sumper's time in England as assistant to Albert Cruickshank, the inventor based on Babbage — to meditate on the automaton as a concept that lies at the heart of modernity. Whereas Enlightenment devices were aesthetic objects demonstrating the wonders of mechanical craft, the technology of the Industrial Revolution was deployed pragmatically to create ever more powerful engines and productive factories, and to expand empires. The process of modernization took what was useful from the beautiful automata and created the world of steam, smoke and industrial machines.

Catherine's efforts to rebuild Sumper's automaton (which turns out to be a swan, in a possible nod to Hans Christian Andersen's *The Ugly Duckling*), and Henry's desire to present a marvel from the previous century to his son, represent a wish to return to untroubled pasts, and to bring the dead and dying back to life, that mirrors the automaton-maker's role in breathing 'life' into inert materials. This deeply moving, intellectually profound novel on the heartbreaking grief of 'living machines' tells the story of the essential human desire to return to the individual Edens that we inhabited before we knew about the unavoidable pain of our mechanical lives. ■

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ECOLOGY

Trashed world

Sonja Vermeulen ponders two takes on the twinned global issues of consumption and waste.

Consumption drives economies but threatens human existence. Two books deal with this global issue in diametrically opposed ways. Ecologist Rob Hengeveld's *Wasted World* is a monumental *cri de coeur*, echoing ground-breaking 1970s thinking on the issue. But Pulitzer-prizewinning journalist Edward Humes' *Garbology* delivers hard facts and practical solutions.

The United States accounts for one-fifth of global consumption but only one-twentieth of the world's population. Humes focuses on how to reduce the average US citizen's lifetime legacy of 93 tonnes of refuse, using personal stories to draw out the wider social issues around waste management.

The usual approach, Humes observes, has been to make waste "appear to disappear". This is borne out by evocative examples such as the great Pacific garbage patch: not a continent-sized floating island of rubbish, as many imagine, but rather a "swirling sewer" of "barely visible particles circling endlessly". Humes shows how innovative clean-up technologies — such as an artificial 'beach' that collects fine marine debris but not sea life — can be part of the solution. But the more practical answer, he says, is to avoid creating the waste in the first place.

Reducing waste means consuming differently. Humes doesn't believe that profligate consumption is hard to shift. He sees humans as naturally thrifty, and points out that prodigious marketing has gone into creating modern consumer culture, down to the engineered 'preference' for plastic bags over paper

Wasted World: How Our Consumption Challenges the Planet

ROB HENGEVELD

Univ. Chicago Press: 2012. 360 pp. \$30, £19.50

Garbology: Our Dirty Love Affair with Trash

EDWARD HUMES

Avery: 2012. 288 pp. £16.90, \$27

ones. Not that Humes is anti-business: as in his book *Force of Nature* (HarperBusiness, 2011), he presents a balanced picture of the choices faced by major companies.

Key to Humes's 'can do' message are case studies of commercially successful innovations. Recycling company TerraCycle, for instance, was launched in 2001 by two students at Princeton University in New

Jersey, who turned university food waste into organic fertilizer by feeding it to earthworms.

Their start-up gained publicity from lawsuits lodged by a larger competitor contesting their advertising claims, even though they lost. TerraCycle is now one of the world's fastest-growing recycling firms.

Humes thinks that individuals can make a difference by simply saying no to unwanted

stuff, and focusing on the cost of lifetime ownership rather than the purchase price. The pioneers of new attitudes towards waste, says Humes, are "ordinary people", not moralists or separatists. In this sense, his book is simultaneously reassuring and radical.

In *Wasted World*, Hengeveld's intellectual compass is firmly aligned with the powerful decades-old environmental rhetoric of thinkers such as environmentalist Donella Meadows (co-author of *The Limits to*



MARTIN O'NEILL



The Planet in a Pebble: A Journey into Earth's Deep History

Jan Zalasiewicz (Oxford Univ. Press, 2012; £9.99)
Palaeontologist Jan Zalasiewicz takes a pebble as the protagonist in a story of Earth's geology. He shows that even the most mundane piece of matter has a history that reaches across time and space to the beginning of the Universe.



Neutrino

Frank Close (Oxford Univ. Press, 2012; £7.99)
As you read this, you are being bombarded with neutrinos — the particle about which we know least. Physicist Frank Close recounts the hunt for the "commonest" and "weirdest" of the things that make up the Universe, and explains how following them could lead us to the farthest cosmos.

Growth; Universe Books, 1972) and population biologist Paul Ehrlich. Hengeveld argues that we are depleting resources and polluting the environment faster than human survival can bear — literally “wasting” the planet.

To his credit, Hengeveld squanders no space on using resources more efficiently in support of economic growth. He homes in on how the human population already exceeds Earth’s capacity. His basic argument is convincing, but most of the book is a rambling litany on how we waste our world. When Hengeveld finally commits to how much Earth can carry — and gives one paragraph of solutions — he proposes that we reduce the population to less than one billion, through contraception and voluntary sterilization.

Aside from the plan’s obvious difficulties, it points the finger at the populations that are growing fastest, not those consuming most. Indeed, Hengeveld says that 75% of Earth-threatening future population growth will be in “poor, non-developing countries”. By contrast, the United Nations estimates that the least-developed countries (LDCs) will contribute around 38% of growth up to 2050.

More important is that the LDCs have an annual energy consumption of less than 500 kilograms of oil equivalent per capita, compared with 7,045 kg in the United States. So a Haitian or Ethiopian family of 14 uses less and pollutes less than a single US citizen.

Any serious discussion of planetary capacity must address this. Paul and Anne Ehrlich’s most recent analyses give equal weight to population, inequality and power. But Hengeveld does not engage much with these ideas, nor with research that explores how a steady-state society might live, work, eat and govern.

One of Humes’s interviewees suggests that the liberty at the heart of the American dream is a call to the financial freedom of reduced consumption, rather than bondage to belongings. Messages such as these — which Humes dubs “the new normal” — strike a chord in these times of recession, resource scarcity and uncertain futures. ■

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CORVID COGNITION

Feathered apes

Nicola Clayton is fascinated by the mind of the crow, and the bird’s ancient links with humankind.

I have often wondered whether it is an evolutionary accident that our planet ended up being ruled by apes. What would it have been like to live on a planet of the crows, with humans serving as mere intellectual curiosities for our avian masters — those big-brained, beady-eyed, feathered apes?

The idea that these birds could be as intelligent as our primate cousins triggers mixed reactions. Dismissed by some as ‘birdbrained’, the corvids have an alien intelligence that disturbs others, who are reminded of Alfred Hitchcock’s 1963 thriller *The Birds*. Yet a select few of us respect them. These few include John Marzluff and Tony Angell, whose delightful



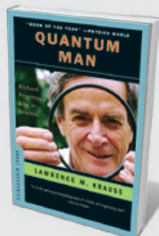
Gifts of the Crow: How Perception, Emotion and Thought Allow Smart Birds to Behave Like Humans
JOHN MARZLUFF AND TONY ANGELL
Free Press: 2012. 304 pp.
\$25, £15.97

Gifts of the Crow is their second book together on this *rara avis*, following *In the Company of Crows* (Yale University Press, 2005).

The authors argue that crows share seven striking similarities with humans: language, delinquency, frolic, passion, wrath, risk-taking and awareness including



Pathfinders: The Golden Age of Arabic Science
Jim Al-Khalili (Penguin, 2012; £9.99)
Medieval Islam helped to shape science, and physicist Jim Al-Khalili describes the life and work of some of its great thinkers. These polymaths pioneered the study of refraction, were first to use inhalant anaesthetics and calculated the height of the atmosphere.



Quantum Man: Richard Feynman’s Life in Science
Lawrence M. Krauss (Norton, 2012; \$15.95)
An account of Feynman’s science, this book documents the effort and insight informing work that fundamentally defined how we look at quantum theory. (See Leonard Mlodinow’s review: *Nature* **471**, 296–297; 2011.)