

A New System of Chemical Philosophy

JOHN DALTON

R. Bickerstaff: 1808.

whereas Volume 2 is a detailed account of inorganic chemical compounds. Dalton's atomic theory is confined to the five-page final chapter of the first volume. Here, he explains that the fixed stoichiometries of chemical reactions — so much of element A combines with so much of B — can be rationalized by supposing that the constituent atoms unite into “compound atoms” of simple ratios, such as 1:1 or 1:2. The point is most famously and eloquently made in a plate that shows sketches of these unions. An “atom” of water comprises one atom each of hydrogen and oxygen; an atom of ammonia is a 1:1 union of hydrogen and nitrogen (Dalton uses Lavoisier's term, “azote”, for nitrogen).

The proportions are wrong — chemist Jöns Jakob Berzelius corrected many in the following two decades. And in 1813, he proposed an alphabetical representation (for example, H^2O [sic]) in place of Dalton's pictorial balls. Dalton, with the conservatism common to trailblazers, declared this “horrificing”, saying that the symbols “cloud the beauty and simplicity of the atomic theory”. His displeasure might have contributed to a stroke in 1837.

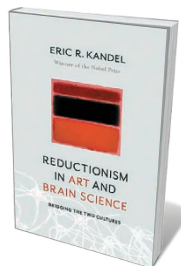
The *New System* is not a new theory of chemistry. Among other things, it offers no explanation for why atoms react. Roscoe put his finger on it when he said that the significance of Dalton's theory was his proposal that each type of atom has a unique mass. That made sense of the quantities in which elements were found to combine, and offered the first general and fundamental distinction between one element and the next — what eventually became embodied in the idea of atomic number.

Yet it is the idea of atoms as the indivisible units of matter that stuck in the mind, because readers could see them on the page. Dalton didn't intend his pedagogical diagrams of atomic unions — “compound atoms”, or molecules as we'd now say — to be taken too literally. There's no inkling in his book of molecular shape; the arrangements of atoms in binary, ternary and other unions are purely notional, and when Dalton draws “water particles” packed into the crystalline forms of ice, they too are spheres.

All the same, visual representation of atoms was surely the precondition for the emergence of a concept of molecular structure, with atoms in fixed spatial relationships, in the mid-nineteenth century. Something of this kind would surely have appeared whether or not Dalton had “invented” atoms as wooden balls — but that innovation was more eloquent than its inventor anticipated. ■

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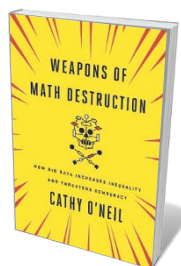
Books in brief



Reductionism in Art and Brain Science: Bridging the Two Cultures

Eric R. Kandel COLUMBIA UNIVERSITY PRESS (2016)

The sea-slug studies of Nobel-prizewinning neuroscientist Eric Kandel — which reveal the link between memory and synaptic connection — are models of reductionist science. In this intriguing treatise, Kandel finds methodological similarities in abstract art. By reducing image to colour, form or line, artists such as Piet Mondrian stimulated the brain's “top-down processing” in the viewer, encouraging ‘active seeing’. Kandel deconstructs this intricate dance between perceiver and perceived by way of recent neuroscience findings and deft analyses of seminal artworks.



Weapons of Math Destruction

Cathy O'Neil CROWN (2016)

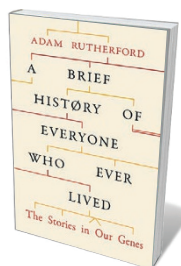
While working as a Wall Street analyst during the 2008 crash, data scientist Cathy O'Neil realized how maths can fuel social problems. Her propulsive study reveals many models that are currently “micromanaging” the US economy as opaque and riddled with bias. These algorithmic overlords can taint policing and court sentences with racial profiling, and exacerbate unemployment rates in poor communities. In an era when many people uncritically applaud the power of big data, O'Neil argues for the dark side of the deluge to be tackled through algorithm audits, transparency and legal reform.



Citizen Scientist: Searching for Heroes and Hope in an Age of Extinction

Mary Ellen Hannibal THE EXPERIMENT (2016)

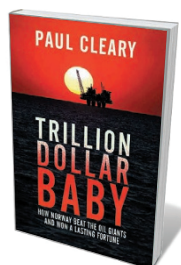
In this inside story on citizen science and biodiversity loss, Mary Ellen Hannibal meshes interviews with front-line scientists such as James Estes (*Nature* **533**, 318–319; 2016) with her own stints monitoring California wildlife. Inspired by the likes of marine biologist Ed Ricketts (*Nature* **516**, 326–328; 2014), she records starfish die-offs, meets the geeks who track deforestation, and plans a web-based supercommunity of citizen scientists to counter what many are calling the sixth great extinction. A cogent call to action.



A Brief History of Everyone Who Ever Lived: The Stories in Our Genes

Adam Rutherford WEIDENFELD & NICOLSON (2016)

Fifteen years ago, the first sequence and analysis of the human genome was published (E. S. Lander *et al.* *Nature* **409**, 860–921; 2001). A monumental surge in genetics followed. Science writer and broadcaster Adam Rutherford rides that tide and traces its effects, first focusing on how genetics has enriched and in some cases upset our understanding of human evolution, then examining the revelations of recent findings, such as deep flaws in the concept of race. Although digressive in the chapters on deep history, Rutherford unpeels the science with elegance.



Trillion Dollar Baby

Paul Cleary BITEBACK (2016)

Norway's government pension fund could hit US\$1 trillion in just four years. In this crisp economic history stretching back more than four decades, journalist Paul Cleary charts how this middle-income Scandinavian country ensured that 90% of the cash flow from vast oil discoveries accrued to its government. But despite its record of pragmatic fair-mindedness, Norway's eagerness to excavate environmentally sensitive reaches of the Arctic shows how its forward planning fails when it comes to climate change. **Barbara Kiser**