

BOOKS & ARTS

When doubt becomes a weapon

Brian Wynne wishes that a book on the vulnerability of scientific evidence to attack by ideologists had grappled more with the larger question of why science is such an easy target.

Merchants of Doubt: How a Handful of Scientists Obscured the Truth on Issues from Tobacco Smoke to Global Warming

by Naomi Oreskes and Erik M. Conway
Bloomsbury Press: 2010. 368 pp. \$27, £25

In *Merchants of Doubt*, science historians Naomi Oreskes and Erik Conway describe how a small circle of influential and ideological US scientists paralysed policy action on various environmental and health issues, from the dangers of tobacco smoke to global warming. The group did so by manipulating scientific uncertainty to undermine evidence that supported regulation. Oreskes and Conway document the relentless drive of this doubt-casting juggernaut in more detail than has been done before, and reveal its devastating impact on international policy and science. But they fail to grapple with the larger question of why science is vulnerable to such manipulation.

Fuelled by anti-communist paranoia before and after the cold war, a handful of top US scientists and government advisers perceived a hidden agenda of state intervention in free markets under the guise of acting on environmental or health issues. Supported by millions of dollars of covert commercial funding, this group used scientific uncertainty as political propaganda to defuse what they saw as communism by other means. Their negative messages ploughed through many arenas: challenging environmentalist Rachel Carson's exposure of chemical pesticide damage; undermining scenarios of nuclear winter; dampening evidence of tobacco smoke's toxicity; and fostering inaction on ozone-depleting chlorofluorocarbons, acid rain and climate change. Although Oreskes and Conway do not note it, these campaigns also helped to entrench the prejudice that the burden of proof for harm should be placed on those who advocate intervention against dangerous substances.

Oreskes and Conway starkly portray science's inherent vulnerability to these tactics. Because uncertainty arises in any scientific study, powerful elites find it easy to derail policies by representing the justificatory knowledge as inadequate, even when collective scientific and



The scientists who spread doubt about tobacco and cancer did so about ozone and climate change.

related judgement supports intervention. To make science more robust against such attacks, Oreskes and Conway recommend the widespread adoption of peer-review procedures, following the model of the Intergovernmental Panel on Climate Change, with the demand that the public should trust such a process to judge the proper policy significance of scientific uncertainty.

The authors rightly support the vigorous rebuttal of doubters' arguments. But they miss a crucial point: the ingrained assumption that scientific

evidence is the only authority that can justify policy action — scientism — is what renders both policy and its supporting science vulnerable to the dogmatic amplification of doubt.

The doubters' success lies in the way that policy questions are framed, with science placed at the centre. If a policy commitment is reduced only to a question of whether the

science is right or wrong, then evidence can easily be made to unravel. Paradoxically, this happens when science attains its greatest political influence, when it goes beyond supplying the facts to defining the public meaning of problems. Public-policy issues always have dimensions beyond science, and require more than technical responses. When framing debates, policy-makers should prioritize discussion of social benefits as well as science: there are many good non-scientific reasons to reduce global environmental footprints and consumption frenzy, and to pursue greater justice, for instance. If the many factors that go into a policy commitment are recognized, science does not become the sole centre of authority and the sole target for opposition.

A more enlightened institutional culture around science and policy would foster wider debate about the implications of interventions, and of burdens of proof weighed against social benefits and the costs of erroneous outcomes. This might resemble the 'extended peer review' system of philosopher-

"A more enlightened institutional culture around science and policy would foster wider debate about the implications of interventions."

sociologists of science Jerome Ravetz and Silvio Funtowicz, in which specialists (including non-scientists) review policy-relevant scientific claims but a wider variety of stakeholders bring further knowledge to bear in interpreting them. Rather than assuming that disputes are solely scientific, opening up these decision-making processes would render their primary nature more honestly political and economic, while giving proper weight to scientific reason and evidence.

Merchants of Doubt is an impressive

account of science's role in many key public issues of today, especially given the difficulties of accessing archival materials on recent and still-unfolding events. Yet it is incomplete: it does not examine other areas, such as genetically modified organisms, in which grounds for doubt have been downplayed rather than amplified by powerful players to the same deregulatory ends. Oreskes and Conway could have gone further in asking how scientific uncertainty should be interpreted in policy, and how science can be led

to overreach itself in arbitrating public facts, meanings and norms. ■

Brian Wynne is professor of science studies and associate director of the ESRC Centre for Economic and Social Aspects of Genomics (CESAGen), Lancaster University, Lancaster LA1 4YD, UK. He is the author of *Rationality and Ritual: Participation and Exclusion in Nuclear Decision-Making*.

e-mail: b.wynne@lancaster.ac.uk

See also *Nature* 465, 686–687 (2010).

Behind the periodic table

The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements

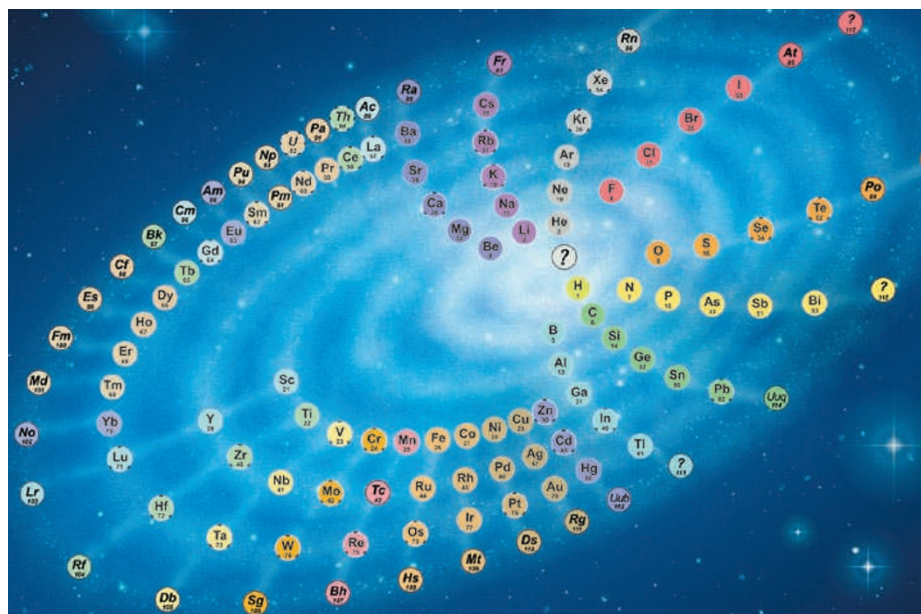
by Sam Kean

Little, Brown and Company: 2010. 400 pp.
\$24.99, £18.99

Aesthetically speaking, there is little to venerate in the periodic table. It is a messy family tree whose charm stems more from its quirks than its orderliness. No one doubts its mnemonic utility, but it is perverse that we regard the table both as an object of beauty and as an intellectual framework of chemistry, rather than simply as the piecemeal way things turned out at this level in the hierarchy of matter.

In *The Disappearing Spoon*, writer Sam Kean accepts the reverential notion of the periodic table. He portrays it using a cast of characters whose stories illustrate our interactions with the physical world. By weaving handfuls of tales into loose themes in each chapter, he leaves no corner of the table untouched. All readers will learn something — in my case, how the tin solder belonging to Robert Scott of the Antarctic was allegedly converted into a brittle form by the extreme cold. But most of Kean's tales have been told before. Despite focusing on the periodic table, the book is not the survey of chemistry one might expect. *The Disappearing Spoon* dwells as much on nuclear physics as on chemistry, and molecules feature only occasionally or implicitly. It is an attractive collection, but lacks a moral.

Kean writes with energy and pace. Yet there is a fine line between the wryness of hindsight and smirks at the conventions of the past. Emilio Segrè did slip up when he failed to spot the first element heavier than uranium — neptunium — and Linus Pauling's inside-out triple-helix model of DNA was worse than a poor guess, ignoring the implausibility of the closely packed



Chemists have tried many ways of portraying the order of the elements.

anionic phosphate groups. But it would be more illuminating to put such routine mistakes into context than to deride them.

The cult of the periodic table has led to many pointless attempts to find a new taxonomy of the elements. The resulting spirals, pretzels, pyramids and hyper-cubes only reveal that we have not yet cracked the geometry of the elements, that there is some hidden understanding to be teased out from these baroque juxtapositions of nature's building blocks. Similar desires to find cryptic order probably motivate the search for grand unified theories and supersymmetry; but in the case of the table, such impulses are inappropriately directed towards contingency.

To call the periodic table contingent will probably elicit howls of protest from many scientists, who would contend that the allowed configurations of electrons around nuclei are surely a predictable consequence of quantum

mechanics. But the logic of these arrangements is tortuous. Electron shells are subdivided and become interleaved as they are filled by electrons, and the delicate balance of electron-electron interactions creates untidy anomalies. Relativistic effects — the distortion of electron energies by their tremendous speeds in heavy atoms — elicit oddities such as mercury's low melting point and gold's yellow lustre. All can be explained, but not elegantly.

In making the periodic table the organizational emblem of his book, Kean ends up with an arrangement of facts about the behaviours and histories of the elements that does not add up to a thesis about our conception of the material world. Consequently it is best taken in small bites, rather than digested at one sitting. ■

Philip Ball is a writer based in London and author of *The Ingredients: A Guided Tour of the Elements*. His latest book is *The Music Instinct*.