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Rare but catastrophic climate events, such as drought, can have unfathomable costs.

CLIMATE CHANGE

Insurance for a warming planet

Climate policy should be viewed as protection against uncertain future risks, says **Martin L. Weitzman**.

Bjørn Lomborg has been a lightning rod for controversy since he published *The Skeptical Environmentalist* in 2001. Yet in the time between his first book and this third edited volume, there has been a sea change in his attitude to climate change. Lomborg, director of the Copenhagen Consensus Center think tank, now characterizes the fundamental question as “not *if* we should do something about global warming, but rather *how best* to go about it”.

Smart Solutions to Climate Change presents economic analyses of eight proposed solutions to climate-related problems: climate engineering; mitigation of carbon dioxide, methane and black carbon;

carbon sequestration by forests; market and policy-driven adaptation to climate change; technology-led climate policy; and technology transfer. Each proposal is set out, critiqued from two alternative perspectives and summarized by an expert panel of five economists. It is a constructive book that focuses seriously on finding effective ways to combat global warming, and the differences of opinions it expresses are stimulating and enlightening. But the book falls short in its treatment of risk.

To help prioritize the proposals, each analysis calculates a cost/benefit ratio. However, the estimates used are of uneven quality. Some solutions, such as technology-led policy, are too vague for a

meaningful value to be assigned. And cost alone is not the best way to choose between options — geoengineering, for example, is expensive in terms of risk but may be necessary if we are faced with a disaster scenario such as runaway temperatures. It makes more sense to think of the solutions as making up a portfolio of options, including others such as nuclear power, guided by risk analysis.

All of the cost/benefit estimates in *Smart Solutions* are based on deterministic models — uncertainty doesn't figure much in this book. The assessments rely on joint computer modelling of economic growth

and climate change to examine the trade-offs: whether or not we incur the costs of mitigation now to benefit from less-severe climate change in the future. Key parameters are approximated by firm values, such as the median or mean, rather than a probability distribution. The modelling thus becomes a knob-twiddling exercise in optimizing outcomes,



Smart Solutions to Climate Change: Comparing Costs and Benefits

BJØRN LOMBORG
Cambridge University
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\$29.99

where it is easy to flirt with high carbon dioxide concentrations.

Such modelling breeds complacency — temperature targets can be hit exactly, economic and ecological damages from high temperatures are low to begin with, and the pain of action now is greater than the pain of damages in a century or two when discounted at current interest rates. But in reality, there is no such thing as hitting a target of 2 °C, 4 °C or any other temperature change. Everything is probabilistic.

The economics of climate change is mainly about decision-making under extreme uncertainty. Climate-change analysis is hampered by many unknowns in the science combined with an inability to evaluate meaningfully the welfare losses from increased global temperatures. The values of key future parameters — global and regional average temperatures, damages to the world's economy and ecology, welfare, costs of unproven technologies and so forth — cannot be known now. Instead, they must be treated as random variables, yet to be drawn from some probability distribution that itself is uncertain.

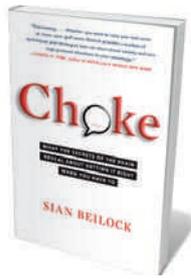
A striking feature of the economics of climate change is that rare but catastrophic events may have unfathomable costs. Deep uncertainty about the unknown unknowns of what might go wrong is therefore coupled with essentially unlimited liability. The resulting battle between declining probabilities and increasing damages is difficult to resolve. Alas, this uncertainty can figure prominently in evaluations of climate-change policies. Its absence in a book dealing with economic comparisons of smart solutions is a serious omission.

When confronted with the possibility of extreme damages at low probabilities, most people do not look to averages. Instead they think about how much insurance they need, and can afford to buy, to survive those events. Climate policy is better viewed as buying insurance for the planet against extreme outcomes than as the solution to a multivariate problem over which we have control. To analyse policies in terms of deterministic cost/benefit ratios is to marginalize the very possibilities that make climate change so grave.

Lomborg concludes that, if we value our planet's future, we must “start seriously focusing, right now, on the most effective ways to fix global warming”. Despite its limitations, *Smart Solutions* marks symbolically the end of one stage of thinking about climate change and the beginning of another. ■

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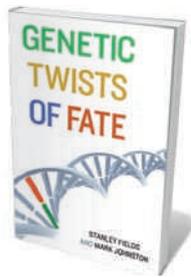
Books in brief



Choke: What the Secrets of the Brain Reveal About Getting It Right When You Have To

Sian Beilock FREE PRESS 304 pp. \$26 (2010)

When the pressure's on, we've all 'choked' — hit the wrong note, flunked an exam or messed up an interview. Cognitive psychologist Sian Beilock explains why. Describing how memory works, she shows that experts whose minds brim with facts are more likely to freeze than novices. Social stereotyping also leads us to underperform. Beilock's solutions for big occasions are simple: reaffirm your self-worth, write away your worries and keep practising. If the worst happens, pause and refocus.



Genetic Twists of Fate

Stanley Fields and Mark Johnston MIT PRESS 240 pp. \$24.95 (2010)

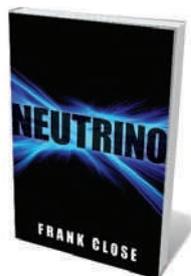
Minuscule inherited changes in our DNA can have major effects on our lives. Geneticists Stanley Fields and Mark Johnston explain how genes affect our health, from conditions such as Alzheimer's disease, cancer, diabetes and depression to rare genetic disorders. Giving the science a personal twist, they relate how a mother was wrongly accused of killing her son when the cause of death was in fact a rare inherited condition, and how former US president Dwight Eisenhower's hereditary heart disease was treated with an anticoagulant derived from rat poison.



Science is Culture: Conversations at the New Intersection of Science and Society

Edited by Adam Bly HARPER PERENNIAL 368 pp. \$15.99 (2010)

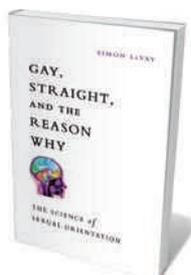
Science is often divorced from mainstream culture. This collection of conversations between 44 top scientists and thinkers from the humanities, first published in *Seed* magazine, aims to blur the boundaries. Entomologist E. O. Wilson discusses evolution with philosopher Daniel Dennett; linguist Noam Chomsky and sociobiologist Robert Trivers debate war and deceit; and astrobiologist Jill Tarter muses on alien life and reality with Will Wright, designer of the computer game *Spore*.



Neutrino

Frank Close OXFORD UNIVERSITY PRESS 176 pp. £9.99 (2010)

By the time you have read this paragraph, some 50 trillion neutrinos will have passed through your body. Formed in stars and through radioactivity, these enigmatic particles rarely interact, travelling through matter almost unseen. Particle physicist Frank Close explains how it took 26 years for the neutrino — 'little neutron' in Italian, as named by Enrico Fermi — to be detected in the lab after its prediction by Wolfgang Pauli in 1930. Close describes ongoing attempts to capture neutrinos, to determine their mass and to understand their significance in the Universe.



Gay, Straight, and the Reason Why: The Science of Sexual Orientation

Simon LeVay OXFORD UNIVERSITY PRESS 432 pp. \$27.95 (2010)

The theory that sexual orientation has a biological basis receives support in neuroscientist Simon LeVay's book. Relating evidence from genetics, neuroscience and developmental biology, he suggests that prenatal interactions between hormones and the developing brain influence adult sexuality. LeVay, who published a 1991 *Science* paper on brain differences in gay and straight men, believes we should accept that homosexuality in humans is biologically hardwired, as it may be in other species such as geese.