lem is not open malice but repeated small episodes of frustration".

Consequently, Tenner refuses to despair. He urges us, in effect, to expect the unexpected and to be more, not less, vigilant than our predecessors as we try to anticipate revenge effects and react to them when they do emerge. As he reminds us, Murphy's law — "if anything can go wrong, it will" — was intended by its originator, a frustrated military engineer, as a plea for alertness and adaptation, not a resignation to forces beyond our control. (So much for the intended effects of that declaration.) Tenner in fact offers a positive corollary: "Sometimes things can go right only by first going very wrong". This optimistic view of disasters has been documented in several books by the civil engineer Henry Petroski, whom Tenner cites.

Why Things Bite Back offers a much-needed healthy balance between contemporary technological utopian fantasies and neo-Luddite despair. This superb guide to our high-tech world deserves a wide readership. □

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VISIONS of the future as seen through the eyes of Americans earlier this century are explored by Joseph J. Corn and Brian Horrigan in *Yesterday's Tomorrows*, now out in paperback. Although technology was invariably seen to advance rapidly, society and politics were not — as witness plans for anti-aircraft flying circular-saws and waterproof furniture to allow "the housewife of 2000 [to] do her daily cleaning with a hose". Originally published in 1984 to accompany a Smithsonian exhibition, the book contains a wealth of visual material drawn from popular science magazines, world trade fairs, films, advertisements and so on. Johns Hopkins University Press, $24.95, £20.50.

Wishful thinking?

Massimo Piattelli-Palmarini

The Logic of Failure: Why Things Go Wrong and What We Can Do to Make Them Right. By Dietrich Dörner. *Holt: 1996. Pp. 222. $25.*

MANY people, in many walks of life, are under the impression that things are not working as they should and that it is becoming more and more difficult to get some things, indeed anything, properly accomplished. Witness, for example, the hail of complaints in the international press about the dismal logistics and lapsed security of the Olympic Games in Atlanta. The problem, of course, is not to be found in the things themselves, but in the heads of the people who fail to carry them out. What has gone wrong? And what can be done about it?

Books on 'why nothing works' and 'why we can't think straight' make up a new literary genre, with diverse, at times perceptive, contributions by mind-reformers, film stars, policy-makers, educators, experts in managerial decision-making and professional psychologists and anthropologists. Explanations and recommendations range from a needlessly elaborate rephrasing of the obvious to genuinely novel psychological discoveries. The latest example is Dietrich Dörner's analysis of 'decision traps' in complex situations. Dörner, a professor at the University of Bamberg and director of the cognitive anthropology project at the Max Plank Institute in Berlin, has impeccable credentials in this special branch of cognitive psycho-anthropology. And he graces us with the nicest title so far: "The Logic of Failure". It reflects his belief that "people court failure in predictable ways" and that "failure does not strike like a bolt from the blue; it develops gradually according to its own logic".

His lively treatise, accessible to the cultivated lay reader, capitalizes on real-life cases (such as the Chernobyl disaster) and refined *ad hoc* experiments. In the latter, both expert and naive subjects are asked to make decisions in fictional, yet perfectly plausible, model worlds. Computers are then used to simulate the web of interlocking consequences of these decisions in the years ahead. The decision-makers have the benefit of absolute dictatorial power in changing the variables of the model, and can instantly check, if they so wish, the long-term consequences of any of their actions. The rationale for the approach is straightforward: "By removing the constraints of the real world, we hoped to see how people think and act when they are entirely free to do as they wish... [and] to illuminate the psychological factors bearing on human planning and decision making".

So just how much has been learned about these factors through such experiments? Despite many stimulating examples and judicious reconstructions of some recurrent decision traps, I am sorry to say that no new deep psychological discoveries have been made. Given a moment's reflection, most of us could predict what the faulty ingredients are likely to be: acting with insufficient reflection, short-sightedness in calculating consequences, becoming enamoured of our own predictions in the teeth of contradictory data, over-involvement with self-generated projects, excessive focus on small corners of a problem, neglect of early signals of impending catastrophe, and so on.

On these psychological mishaps, the book has, as one would expect, a lot to say; and what Dörner does say is lucid, well balanced, well supported and instructive, and invariably far more than just common sense. (I have witnessed top managers being fed with far lesser stuff on decision-making, in courses judged, to my amazement, to be quite successful.) But the reader will look in vain here for important insights comparable to those in other areas of the cognitive science of decision-making, such as the so-called 'cognitive illusions' pioneered by the findings of Daniel Kahneman and the late Amos Tversky. The academic discipline of 'heuristics and biases' that Kahneman and Tversky did so much to establish deals with deeply ingrained errors in decision-making under uncer-

tainty. It makes ample use of mathematics and is as 'hard' a science as anyone can hope to find in the elusive realm of mental mechanisms. In fact, it has even gained respectability in the world of pure economics and is routinely taught in the best business schools. All this is a far cry from the more traditional brands of the psychology of mistakes, such as that offered by Dörner.

What Dörner does mainly offer is a cogent plea for 'systemic thinking', for paying more attention to the connections, over and above the individual components. One of the problems is that in the complex scenarios modelled by Dörner there is no proper canon of normative sound decision-making. The discovery of cognitive illusions has taken place against the fertile background of inductive logic, probability theory, set theory, utility theory, the axioms of rational choice and other solid chunks of a theory of rationality. These normative canons do not explain why we recurrently fall prey to certain specific illusions: for that, we do need the experimental psychologist. But they allow us to identify on objective grounds which systematic mistakes we tend to make. It is not necessary to create complex scenarios to witness our dramatic decision traps; any garden-variety probabilistic judgement can show that we tend to fall into such traps. The logic of failure, it seems, is invariably tied up with some specific failure of our spontaneous logic. □

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Signs of the time

Tom Kirkwood

The Clock of Ages: Why We Age — How We Age — Winding Back the Clock. By John J. Medina. *Cambridge University Press: 1996. Pp. 332. £16.95, $24.95.*

ONCE upon a time, senescence was a privilege, the result of good fortune both in avoiding the ravages of diseases such as measles, diphtheria, typhoid, cholera, tuberculosis and pneumonia, and in escaping the multitudinous hazards of a harsh and often dangerous physical environment. Times have changed. Senescence is firmly on the agenda for most of us, first as individuals conscious of our own pending frailty, and second as members of a society undergoing a demographic revolution unparalleled in human history.

John Medina offers a tour of human ageing that aims to educate and entertain. Popular science writing depends for its success on getting the right blend of content and style. Medina's style strikes a jarring note for those not keen on puns. Some truly nerve-jangling wordplay is displayed and even the title is a pun. The young Medina, we are told, used to torment his apparently much-loved mother by singing the title words of this book to the tune of the classic Christian hymn "Rock of Ages" while she contemplated her wrinkles in the mirror. Chapter subheadings such as "The eyes have it", "For whom the smell tolls" and "Hair today, gone tomorrow" are further examples of the dubious treats in store. The scientific text is leavened with anecdotes borrowed either from the author's early life or from the lives and, more particularly, the deaths of illustrious figures from the past. Billy the Kid, Florence Nightingale, Giovanni Casanova, Jane Austen and Napoleon Bonaparte all feature in this eclectic collection. Some of these anecdotes work and some do not, the oddest being a tale about army ants and a paraplegic scientist where the entire point of the story appears to have been omitted.

But what of the science? The book is structured in three parts dealing first with the broad biological picture, including comparative and evolutionary biology, then moving to an organ-by-organ view of human ageing, and closing with an examination of the mechanistic theories. Predictably the book ends with a discussion of scientists' views of life extension; and, equally predictably, the views that are quoted are biased towards the sensational.

Part one gropes its way towards a definition of ageing, a goal that the author candidly admits is hard to accomplish. The slippery quality of this definition was recognized in the early 1950s by Peter Medawar, who then attributed it to previous neglect, but some of the slipperiness still remains, despite the efforts of Medawar and later authors to grasp the matter more firmly. The problem arises from the diversity of species' life histories and the many layers at which senescence and death may be encountered within the organism. Nevertheless, considerable progress has been made, chiefly from the application of evolutionary life-history theory to the problem, and Medina fillets the issue more or less correctly.

Part two is well written and packs a great deal of human biology into eight chapters covering skin, hair, bones, muscles, joints, brain, heart, lungs, digestive system, senses and the reproductive system. Like an efficient butcher, Medina leaves little unaccounted for. The text is well-illustrated with diagrams and could serve as a useful primer for many purposes. The ageing dimension in each section is something of an add-on, however, consisting of often no more than a paragraph or two under a subheading such as "How it ages".

An example of the somewhat limited penetration of the discussion on ageing in part two appears in the section on muscle. Muscle deterioration with age is attributed to loss of fibres, and three ideas are briefly mentioned to explain why this happens. One is through nerve death, leading in turn to inactivity, atrophy and death of muscle cells. The second is through age-related failure of the microvasculature. The third, briefly stated, is through breakdown in the mitochondria of muscle cells. An opportunity is missed here to discuss recent work on the mitochondrial theory of senescence, particularly as it concerns muscle. When eventually we get to mitochondria in more detail in a later chapter, Medina fails to mention the important point that mitochondrial changes happen most markedly during ageing of post-mitotic tissues, particularly muscle and brain. The hypothetical examples he mentions of cells affected by mitochondrial defects are from tissues with active cell turnover, where mitochondria alter much less with age.

The third part pits familiar opponents against one another. The 'stochastic damage' theories comprise one battalion of hypotheses proposing various types of random molecular damage as important contributors to senescence. These include oxidative damage, mutations, aberrant proteins and defective mitochondria. Medina reviews this camp adequately, and then lines up the so-called 'programme' theories against them. The programme theories are bolstered, at first sight, by various discoveries such as genes affecting rate of ageing in model systems such as the nematode *Caenorhabditis elegans* and premature ageing diseases in humans such as Werner's syndrome, as well as by the progressive uncovering of an intricate network of genes affecting cell division and programmed cell death. Shrewdly, Medina recognizes that this fight between programme and error theories is coming to seem increasingly artificial and that both kinds of mechanism have their place in the complex causality of human ageing.

So is it a good book or not? Like the proverbial curate's egg, it is good in parts. The science is adequate but too often fails to do real justice to this complex and challenging topic. The style is brisk and sometimes entertaining, although firmer editing for relevance would have helped. □

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