Shockley attributes the invention of the transistor to Bardeen and Brattain, and to them alone. Bardeen had the key idea of minority carrier injection that made amplification possible, and Brattain had the skills to put the contacts close together. Yet without Shockley's participation and leadership, it is equally clear that the invention would not have occurred as soon as it did, and his later independent invention of the junction transistor was to emerge as the most practical embodiment of the device for the next decade.

Almost immediately after the discovery of the point-contact transistor, Shockley dissociated himself from many of his colleagues at Bell Labs, and eventually became disenchanted with the institution itself. Shurkin hints that this was the result of jealousy at not being fully involved in the final, crucial point-contact transistor experiments, and frustration at not progressing rapidly up the laboratory management chain. He had, in the words of his employees, an "unusual" management style.

For much of the early 1950s, Shockley was on leave from Bell Labs. His time was divided between teaching at Caltech and continuing to explore the statistical methods he introduced as a consultant to the military to help optimize naval and air-force tactical procedures in the Second World War. He adapted operations research techniques with the objective of maximizing damage to the enemy with the least expenditure in blood and money on his own side, a cost–benefit approach to conducting warfare.

Shockley's important wartime contributions have remained largely unknown, and Shurkin provides a rare focus on them. Unlike his better-publicized peers on the Manhattan Project and at MIT's Radiation Laboratory, Shockley was virtually on the battlefield and his recommendations had almost immediate effect. He was undoubtedly responsible for preventing many Allied casualties. He seemed to thrive in a leadership role within the command-and-control military culture. In some bizarre sense, he may have been cast in the mould of George Patton, Viscount Montgomery and Ulysses S. Grant — superb leaders of men in war, yet mostly dismal failures in times of peace.

After several years searching for an alternative career, Shockley finally left Bell Labs in 1956, returning to California to start the Shockley Semiconductor Laboratory, with financial backing from the industrialist Arnold Beckman. Once more, Shockley displayed an extraordinary gift for recruiting talent, along with total incompetence in managing them. Unlike Kelly, who gave his stable of thoroughbreds their head, Shockley attempted to micromanage, forcing his agenda on his new hires, whose ideas were in fact much better than his own. In 1957, Shockley's staff revolted, with eight — the 'traitorous eight' — resigning en masse. They were reunited by the inventor and financier Sherman Fairchild, and Fairchild Semiconductor was born. By 1961, Shockley Semiconductor had folded. Seven years later, two of the eight, Robert Noyce and Gordon Moore, with financial help from the other six, founded Intel.

Shockley's consolation prize was a professorship at Stanford, which gave him time to pursue his fascination with the possible connection between heredity and intelligence. This soon morphed into his much-sensationalized claim that African-Americans are statistically inferior in intelligence to those of European descent.

Had Shockley not been a Nobel laureate, his assertions would probably have been ignored. But a Nobel prize confers a 'bully pulpit', along with the perception, by people in general and the press in particular, of being an expert in everything. However, as the physicist and pundit Bob Park has observed, "A Nobel prize in physics is not an inoculation against silly behaviour," and there are plenty of examples to back that up.

With the discovery of DNA, physics met genetics, and the full impact of their engagement is just beginning to be glimpsed. If someday a gene sequence is found that determines intelligence, just as there are sequences for Tay-Sachs disease or thalassaemia, what shall we do about it? Will we have a future, as depicted in the film *Gattaca*, in which parents can selectively tailor the genetic structure of their children? If most choose intelligence as the dominant gene for their offspring, we might end up with a world full of Shockleys. Hopefully, this brave new world will have its share of those with the grace under pressure of Tiger Woods, the spine-tingling voice of Luciano Pavarotti, and the flashing fingers of rock guitarist Angus Young.

Variety is indeed the spice of life. ■

Paul Grant is an IBM research staff member emeritus and is currently visiting scholar in applied physics at Stanford University in California.

NEW IN PAPERBACK

Warped Passages: Unravelling the Universe's Hidden Dimensions
by Lisa Randall (Penguin, £8.99)
"The book's peg — the possible existence of extra dimensions in space — is easy enough to explain. But motivating the conjecture requires a grand tour of some of the toughest and most abstract topics in science." Paul Davies, *Nature* **435,** 1161–1162 (2005).

Madame Bovary's Ovaries: A Darwinian Look at Literature
by David P. Barash & Nanelle R. Barash (Delta/Bantam Dell, $14)
"Where most such books rely on scholarly papers and monographs to ground the various points within a shared and robust scientific knowledge [of evolutionary biology], these authors use literature sources as references." Michel Raymond, *Nature* **435,** 28 (2005).

Oxford Dictionary of Scientific Quotations
by W.F. Bynum & Roy Porter (Oxford University Press, £10.99)

Making sense of autism

Autism, Brain, and Environment
by Richard Lathe
Jessica Kingsley: 2006. 288 pp. £15.99, $24.95
Understanding Autism: From Basic Neuroscience to Treatment
edited by Steven O. Moldin & John L. R. Rubenstein
CRC Press: 2006. 526 pp. £92, $159.95

Francesca Happé

Are we witnessing an autism epidemic? The current prevalence estimates for autism, and for the wider range of autism spectrum disorders (ASDs), are around ten times greater than estimates from studies in the 1980s and 90s. About 0.6% of the population is thought to have an ASD, diagnosed on the basis of qualitative impairments in social interaction and communication, with restricted and repetitive interests and activities.

The claim that cases of ASD are on the increase is the first step in Richard Lathe's argument in *Autism, Brain, and Environment*. Based on the apparent increase, Lathe argues for an environmental explanation for what he terms "new phase autism". He recognizes the overwhelming evidence that autism is among the most heritable of psychiatric disorders, but argues for a two-hit mechanism, with genetic susceptibility and environmental factors combining to produce an ASD. His book is a clearly and accessibly written account of his proposal that environmental poisons, including heavy metals, interact with genetic vulnerability to cause damage to the limbic brain system and to physiological systems, including the gut and the immune system, resulting in autism.

This is a story that many readers will find plausible, and which Lathe supports with some good synthesis of established autism research. It is perhaps not surprising that he also cites less solid, unpublished research to support the hypothesis, nor that the limitations of such research, such as the lack of appropriate control groups, are little discussed. But this is, overall, a scholarly book providing a possible explanation of autism. It will be of interest to parents as well as professionals.

Lathe's story stands in marked contrast to *Understanding Autism*, a volume edited by

Steven Moldin and John Rubenstein. This excellent collection of chapters on ASD, and on basic research relevant to ASD, provides few answers, but, I fear, better reflects the truth about our understanding of autism. A detailed and thorough examination of epidemiological studies by Eric Fombonne, for example, casts real doubt on the claim that the rate of ASD cases is increasing. Instead, he concludes that truly comparable time-trend data do not exist; until these are collected, changes in diagnostic criteria and practices, greater awareness and improved services may be sufficient to explain the increase in identified cases. And if there is no big rise in prevalence, there is no need to invoke a major environmental contribution.

Similarly, the idea that autism can be explained by damage to the limbic system (the 'social brain') is probably too simplistic. The chapter by Schumann, Bauman, Machado and Amaral reviews evidence from human and animal lesion studies. They suggest that the amygdala is not the seat of social processing, but instead plays a role in regulating fear behaviour, with knock-on effects exacerbating social deficits in autism. Indeed, many examples in the book illustrate how much more complex the story of autism is likely to be, including epigenetic regulation (not involving differences in the nucleotide sequence) through DNA methylation or chromatin remodelling.

Should we be despondent in the face of such complexity and the paucity of answers regarding the causes of autism? I think the book by Moldin and Rubenstein gives as much reason for hope as for despair. The chapters reflect the diverse tools being called into the service of understanding autism, including neuroimaging, animal models, even the use of neurotropic viruses, which attack the nervous system, to trace chains of synaptically linked neurons.

Parents, teachers, clinicians and researchers are all searching for explanations, for a story that will help us make sense of autism and show us how to help. Lathe's book tells a fascinating tale, but Moldin and Rubenstein's may be closer to the truth. After all, the one thing that all those who study autism agree on is that no one really understands autism. ■

Francesca Happé is a reader in cognitive neuroscience at the MRC Social, Genetic and Developmental Psychiatry Research Centre, Institute of Psychiatry, King's College London, London SE5 8AF, UK.

Subterranean storage blues

Uncertainty Underground: Yucca Mountain and the Nation's High-Level Nuclear Waste
edited by Allison M. Macfarlane & Rodney C. Ewing
MIT Press: 2006. 416 pp. $72, £46.95 (hbk); $29, £18.95 (pbk)

Gordon MacKerron

Earth scientists generally have strong views about the deep disposal of radioactive waste. They all agree that deep disposal is the safest option, and that several suitable geologies exist, but it is difficult to gain consensus about the safety of any specific site. *Uncertainty Underground*, edited by Allison Macfarlane and Rodney Ewing, displays these viewpoints clearly. The individual chapters are not only well-written but also broadly comprehensible, even to a social scientist such as me. All the authors — who belong mostly to the Earth-sciences community and work variously in academia, industry, government and consultancy — are in favour of deep disposal. But they hold very different views on the suitability of the Yucca Mountain site in Nevada, which has been the chosen resting place for US high-level waste and spent nuclear fuel since 1987.

The editors have had an unusually strong influence on this collection. They selected authors and subjects to illustrate their main theme — that too much attention has been paid to the 'near-field' (broadly, the engineering of the repository and its contents) and not enough to the less-controllable issues of the geology and hydrogeology of Yucca Mountain and its surroundings.

The Yucca Mountain site is, in international terms, unique as a potential repository site because it is 'dry', being well below the surface of the mountain but, critically, well above the water table. Some authors argue that this 'advantage' is potentially problematic: hydrogeologists have concentrated on 'wet' sites, and have done little work on the hydrology of dry sites. Potentially major climatic, volcanic, seismic and other changes over periods of up to a million years in the future could in principle lead to substantially different hydrological regimes, with evident long-term safety implications.

D. MCNEW/GETTY

Deep divisions: the disposal of nuclear waste at Yucca Mountain has split opinion.

Many of the papers in this volume therefore review specific issues of hydrology and thermohydrology at Yucca, such as the risk of hot upwelling water from the water table flooding the site in the future, radionuclide transport in the unsaturated zone, and contaminant transport in the saturated zone. Varying degrees of reassurance emerge from this hydrology-based set of papers, from virtually complete (with regard to hot upwelling) to much more uncertain (transport in the saturated zone).

Another section covers waste packages and waste forms, for which the uncertainties seem considerably smaller (as the editors suggest) than for the geology and hydrogeology. However, a long-running debate rumbles on between advocates of glass versus ceramics as the best medium in which to contain high-level wastes.

For social scientists, the sections on policy and uncertainty are especially interesting. The debates about the standard of 'proof' of safety over timescales of up to a million years are well and clearly presented. Particularly good are the sections on the distinction between risk (the probability of something going wrong, from which decision-making at least has a starting point) and the inevitable uncertainties over very long periods into the future, for which precise risk levels are unknown and probably unknowable. This raises the issues of ethics and the way the rights of distant generations are balanced against those of the near future, although these are not covered here.

Finally, on policy, it is clear that the choice of Yucca Mountain, especially in the legislation of 1987, is severely clouded by a lack of political legitimacy that may yet prove highly problematic. This book shows clearly that a site such as Yucca Mountain can probably be made safe enough if the geology is sufficiently well understood and married to the right engineering. But the question of whether it will be perceived by the public as a good site depends on a political process that has, at best, been poorly handled in the United States. ■

Gordon MacKerron is chair of the UK Committee on Radioactive Waste Management, and director of the Sussex Energy Group, SPRU, University of Sussex, Brighton BN1 9RH, UK.