Book Review Spring 2011

Tom Marsh
t.marsh@nhs.net

Elegance in Science: The Beauty of Simplicity

by Ian Glynn (Oxford University Press, 2010)

Georges Charpak, who died on 29th September 2010, won the Nobel prize for physics in 1992 for his work on particle detectors. His inventions and their offshoots are integral to the high-energy particle physics experiments taking place at the CERN Large Hadron Collider. He also worked on detectors that allow a reduction in the radiation dose delivered by digital X-ray systems. In his obituary published in the Guardian, he is quoted as saying, "I have worked on many detectors. Some were very elegant and useless".

This draws our attention to a problem with the word 'elegance' in the context of scientific discovery. Charpak was employing a particular definition of the word – refined and charming, yes, but rendered redundant by an ugly, reliable alternative. Ian Glynn, Emeritus Professor of Physiology at Cambridge University, uses a slightly broader definition. He has collected in this book several episodes from the history of science that he feels capture something of a spirit of "elegant economy". Part of their appeal is their utility; they all explained previously bewildering phenomena, and led directly to further advances. Whether or not they are objectively 'true' is perhaps less important - Newton's classical laws of motion have been exceedingly fertile, even if quantum mechanics has shown them to lack universal application.

Glynn's set of elegant scientific advances also possess clarity and succinctness. Inclusion demands the capacity to be made appealing to a non-specialist. He describes a particularly beautiful visual proof for Pythagoras' theorem that can be appreciated in a trice, even by a committed mathematophobe. This is because nothing gets in the way of the dropping penny. There are no signs, symbols or syntax to interfere and overawe. The inviolable "A-ha!" of the proof just leaps out of the page. Even the thickets of the second law of thermodynamics (banished to an Appendix because of their perceived thorniness) are made distinctly appreciable. Here, right at the tail end of the book, Glynn summarises his thesis. Describing the Carnot cycle, he writes, "a thought experiment that is simple, ingenious, concise, and persuasive, and that leads to conclusions that are both startling and satisfying, deserves to be called elegant". Look up Carnot, and you will see how accurate this is.

The selections that Glynn makes start in rather predictable territory. After a clear restating of the well-covered history of the great men of Renaissance cosmology, Copernicus, Kepler, Galileo and Newton, the more interesting part of the book begins with chapters on heat, light and electricity. The study of heat, and the superseding of the caloric theory of 'liquid heat' by the advances of Rumford, Mayer and Joule, is full of vivid ideas and characters. A large-scale, noisy experiment involving boring out a brass cannon and measuring the heat produced is perhaps pushing the definition of elegance a bit far. The result was unequivocal, however, a flat contradiction of the prevailing caloric theory, and was the pinnacle of Rumford's achievements. The pick of this bunch, though, was Joule – uncovering subtle connections between chemical, electrical, thermal and mechanical effects and revealing the laws of conservation of energy. You have a sense reading this chapter that Glynn is truly in awe of Joule's genius.

Glynn's own reputation is founded on his work on the sodium pump, part of the molecular machinery of the cell. He focuses on his own field in the chapter 'How Do Nerves Work?' which is appropriately authoritative. As examples of elegant science, the experiments performed in the mid-nineteenth century to quantify the speed of transmission along a nerve, first of a signal, and then of an action potential, take some beating. The achievements of Helmholtz and Bernstein in measuring and monitoring processes occurring over a few milliseconds, using clunky galvanometers that took about ten seconds to respond to electrical stimulation, are supreme. Glynn gives such a satisfying account that it is a pity he only devotes thirty pages to the subject. In contrast, the final two chapters on 'Information Handling in the Brain', and 'The Genetic Code', are relatively sparse in detail, and rather unsatisfactory. Being left hungry for more on semi-permeable membranes is probably best seen as a measure of the author's success, however.

The examples Glynn chooses are all fundamental to modern scientific understanding. Throughout, he is reasonably good at contextualising the intellectual world in which the discoveries were made. Re-imagining the state of play before the paradigms were shifted is near impossible, though, and perhaps requires a novelist's empathy and scope. What you also don't get much of here is a sense of the personal turmoil the scientists went through. Although Glynn doesn't explicitly frame it in these terms, one unifying principle of his selections is the bravery of the scientists involved. The theories contain vast inductive leaps, and they often flew in the disbelieving face of contemporary scientific understanding. In the odd phrase such as "Joule's early experiments with voltaic cells were almost completely ignored", we get a sense of the crushing professional disappointment that must have dogged the careers of some of the protagonists mentioned here. It was certainly felt by lots of their less feted, forgotten contemporaries. We don't learn much about the wrong turns taken, and so the advances sometimes acquire an undeserved aura of inevitability.

Glynn is clearly delighted by the sense of wonder that did greet these new and outlandish ideas on the occasions they were taken seriously by the establishment. What is pleasing is the astonishment they can continue to produce for the reader today. Overlooking the profundities hidden in commonplace phenomena is easy to do. Yet when, in one of the book's most satisfying passages, Thomas Young's wave theories of light are illuminated by Glynn's writing, they are made fresh and invigorating. And as a standout example of what must have been a most unexpected outcome for the scientific community of the day, Faraday's demonstration that the plane of polarised light is rotated by a magnetic field still causes a mental intake of breath.

Ockam's razor is the law of parsimony, expressed by Newton as "we are to admit no more causes of natural things than such as are both true and sufficient to explain their appearances". Glynn's conception of elegance owes something to this dictum, but perhaps more to Einstein's modification of Ockam; "Everything should be made as simple as possible, but not simpler." *Elegance in Science* obeys this advice.