on methodology — an "engineering way of thinking". This provocative book is full of ideas with heuristics as the centrepiece. Heuristics appear in many disciplines, from computer science and artificial intelligence to operations research, but rarely are they elevated to the exalted position they occupy in this book.

In the second part of the book, the author puts the case for expanding the engineering method into a 'universal method'. The book touches on so many topics that it is hard to imagine philosophers, mathematicians, linguists, physicists and scientists of all stripes not having an opinion about it.

At the centre are heuristics as an incremental and sure-footed driver of change. According to Koen, "the engineering method is the strategy for causing the best change in a poorly understood situation within the available resources". But clearly not all changes are equal, and some are certainly not sure-footed; some jumps seemingly come out of nowhere. Is this a claim of universality going too far? Is heuristics — from the Greek *heuriskein*, meaning to discover — a path to creation and invention as well? I'm not convinced, but Koen is unequivocal: all is heuristic.

Technology is about invention, making and building, which can be rather haphazard processes. The appearance of the video format VHS was not inevitable — we could have jumped straight to DVDs, or passed from Betamax to DVDs. The process is like playing with an ever-growing Lego set — some pieces are already there, and combinations of these lead to the creation of new pieces, which lead to yet more. There is no going back. But one can see how a growing heuristic may actually guide the process.

But can the processes of creation and discovery be viewed as a part of a heuristic? Immanuel Kant, stating his position on creation and its uniqueness, declared that science is ephemeral, and that art is permanent. The painting *Les Demoiselles d'Avignon* would not exist without Picasso. Not everybody agrees. The art of writing, Jorge Luis Borges argued, is actually discovery, revealing what was already there. Likewise, science can be viewed as discovery, and hence as an inevitable process: Newton's laws would have been revealed eventually, although possibly in a different form to that obtained by Newton. Parallel universes with the same physics and chemistry will have the same science, but may have different technologies.

But there is no inevitability in art. The history of modern art appears to be driven by replacing and disavowing heuristics. If any heuristic exists, it is one of replacing heuristics. One cannot help but wonder whether Koen's claim is simply too big. There are ways out: we are told that a heuristic may contradict other heuristics, and that use may depend on context. And even though the author takes pains to indicate that science is part of the heuristics, some who read the book superficially will equate engineering with a much narrower definition of heuristics.

Even if one only partly agrees with the main conclusions of the book, many of the arguments are thought-provoking. Breakthroughs can be seen as 'break-withs' the prevailing state-of-the-art. And the idea that a heuristic-based approach is much older than the scientific method is intriguing to say the least.

Is the method proposed in this book a good way to think about the crucial issues facing us today? One can think of many cases where one wishes that this mode of thinking had been followed. The first part of the book should be required reading in science and engineering departments. It has the potential to create a huge controversy — what it doesn't deserve is indifference. ∎

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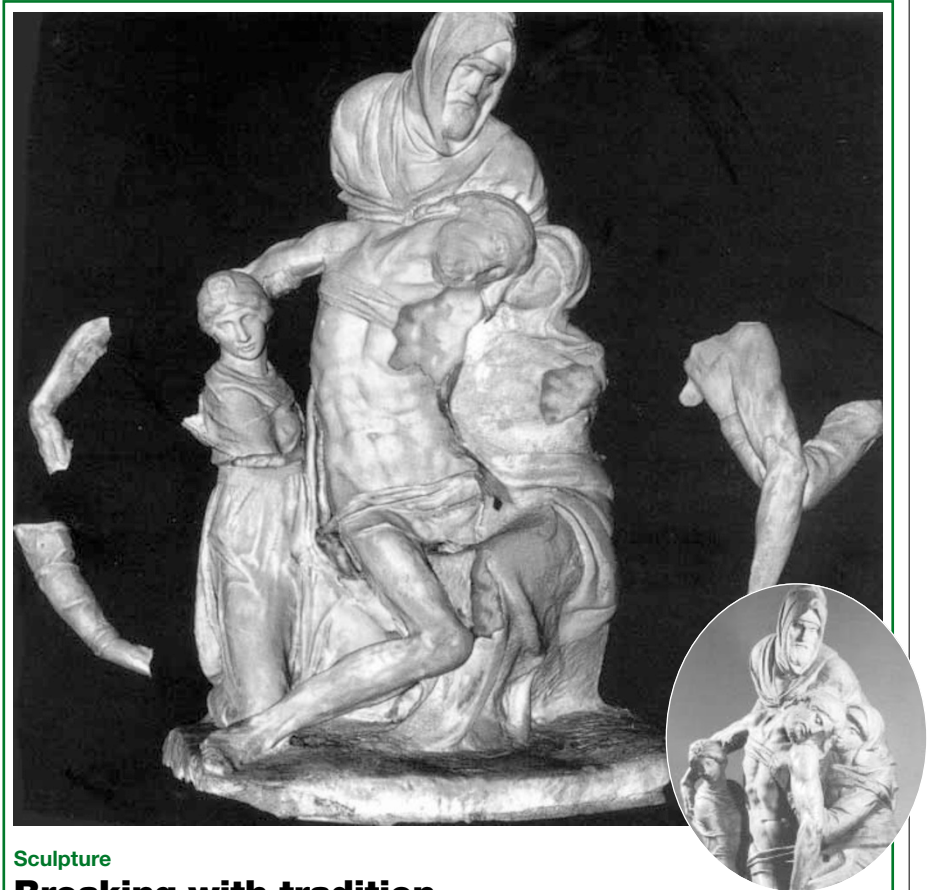
Sculpture
Breaking with tradition

Michelangelo's sixteenth-century *Pietà* in the Museo dell'Opera del Duomo in Florence, Italy, incorporates a mystery as deep as its expressive beauty. Having worked for a decade on the carving he intended for his own tomb, Michelangelo apparently attacked his 2.5-metre sculpture in a fit of rage, hacking limbs from the four carved figures. These were later re-attached by his assistant, apart from Christ's left leg, which remains missing.

Why did he do it? Did he fear it fell short of perfection? Was he angered by a flaw emerging in the marble? Had he been afraid that his positioning of the left leg across the Virgin's lap was immodest?

In a collaborative project with art historian Jack Wasserman, scientists have used IBM's most sophisticated three-dimensional imaging technologies to create a 'virtual *Pietà*'. This has enabled Wasserman to learn more about how the sculpture was physically carved and repaired. It has also allowed him to put forward his theory that Michelangelo was not intending to destroy his work in anger at all. By 'virtually dismembering' the re-attached limbs, and studying the carving from all angles, Wasserman concludes that the limbs had been detached selectively, and with care, perhaps to create a composition where Christ is being lowered from the Virgin's lap, rather than into it.

Wasserman's book *Michelangelo's Florence Pietà*, published by Princeton University Press ($75), describes the extraordinary technical analysis of one of the most important artworks of post-Renaissance Italy. It also includes a CD of the virtual *Pietà*.

Alison Abbott