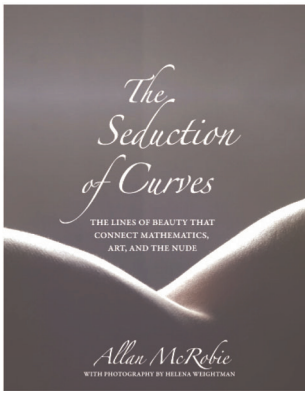

The Seduction of Curves: The Lines of Beauty that Connect Mathematics, Art, and the Nude. Allan McRobie. Princeton University Press, Oxford, UK. 2017. 159 pages. Price: US$ 35.

Einstein had remarked that to appreciate the universe one would need to understand curves. Not sure if he was seduced by curves, but it is clear that straight lines and square corners do not determine what we make of the universe. Like the human body, the universe is beautiful because of its magical patterns and exquisite shapes. Be it the human cell, the lowly creatures or the distant galaxies, the remarkable theory of curves is at work everywhere. Such is the magic of this theory that the entire universe manifests itself in curves, from the fold to a wigwam.

Reproductive biologists may consider the curve as a work of evolution, but for a structural engineer a curve is what connects mathematics with art. And, within this connection may lie insights on understanding why things are shaped the way they are. While we often take shapes for granted, deep within each must be a cause for the object to take a particular form. The author of this book, Allan McRobie a structural engineer from the University of Cambridge, UK, who previously designed boringly rectilinear bridges and towers, found that the stability of engineering structures is essentially governed by their smoothly curved energy surfaces. This is how an unexpected link between the world of careful engineering calculation and a freer graphical expression emerged, leading to a beautiful language of folds, cusps and swallowtails.

Nothing comes closer than 'human nude' to draw a connection between art and mathematics, as a large part of our fascination for curves originates there. Need it be said that evolutionary biology rests on curves, our genes guide us to like the body shapes of our mates. The pervasiveness of these curves is striking because human body is a one-stop object for viewing different types of curves, a perfect justification for a book connecting mathematics with art to have a seductive curve on the cover. The curve resembles a swallowtail, the essence of beauty depicted by two back-to-back cusps connected by folds. Beautiful though it may be, a swallowtail on the waist of a human body is nowhere near as profound as the immense organization required to create all the components of that living, breathing and thinking human. The question worth exploring is how biological shapes emerge to be those they finally become.

In some ways, the beauty in the swallowtail curve is indeed a precarious point of stability which engineers use to explain the catastrophe theory, the sudden change that induces abrupt outputs, developed by noted mathematician Rene Thom. However, the final shape of an object is on account of the energy of a protein that folds itself into any one of a number of possible configurations, indicating which stable pathway will eventually be followed. That is how some cells arrange to become bones and others into hair follicles.

This is a colourful and richly illustrated book in which human bodies are described through geometry, and connected to structural engineering, optical physics and more. The beauty of the book is that it pulls curves out from the confines of subjectivity, and situates them in the objectivity of mathematics. It is a book of mathematics nonetheless, which can be simply seen as a work of fine arts. By giving special attention to outrageous Spanish surrealist Salvador Dali's iconic painting *The Swallow's Tail*, McRobie brings together the theme of the catastrophe theory in understanding curves. Having met Thom towards the later part of his life, much of Dali's work then on was reflective of their intense association, 'everything I do from now on will be devoted to the phenomenon of catastrophes'.

Spread across 19 profusely illustrated chapters, the book is about seven curves, four from cuspoid (fold, cusp, swallowtail and butterfly) and three of umbilic family (elliptic, hyperbolic and parabolic), which are the basic building blocks, the fundamental components of curved form. These curves also represent a way by which something can suddenly change. This is the essence of the catastrophe theory, which studies how smooth and subtle changes in a system can result in sudden and abrupt outputs. Collapse of elevated roads or oil rigs provides classic examples of such drastic end results. Given the significance of curves, one wonders if as children we should have been taught alphabets of curved geometry beginning with fold, cusp, swallowtail and butterfly in place of straight-line Euclidean geometry sequence of terms like triangle, square, pentagon and so on. Will it begin to change anytime soon?

In many ways this is a remarkable book which has more visuals than text, and it will be a pity if it goes unread. Interestingly, the illustrations and pictures are a study in themselves providing depth, dimension and relevance of curves in our lives, making one wonder if there were no curves in our universe. At some point in reading through the book one begins to view straight lines and angles with disdain, much like well-known Brazilian architect Oscar Niemeyer, who was influenced by Le Corbusier but had developed an aversion for straight lines. Niemeyer was attracted to free-flowing, sensual curves and had remarked, 'I am attracted to curves that I find in the mountains of my country, in the sinuousness of its rivers, in the waves of the ocean, and on the body of the beloved woman'. Several of the famous architectural structures standing today bear testimony to the power of the curved form. The future seems to be in triggering sensuous resonances in the minds of observers.

This book is a bold attempt at evoking multiple feelings towards curves. Allan McRobie deserves praise for sensually drawing parallels between the natural and constructed worlds.

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