Book Review: The Seduction of Curves by Allan McRobie

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Synopsis

This review emphasizes, as does the compelling and beautiful book, *The Seduction of Curves* by Allan McRobie, the "lines of beauty" that link art and mathematics. McRobie and his collaborator on the indispensable visuals of the volume, Helena Weightman, succeed admirably in connecting theoretically and visually the mathematical field of singularity or catastrophe theory and its graphical representations on the one hand and the seemingly intersecting lines around the volumes of the human body in the artistic representation of the nude. This book thus constitutes a creative and illuminating overlap of mathematics and art that lets the practitioners on both sides see more deeply their conceptual commonalities.

The Seduction of Curves: The Lines of Beauty and Connect Mathematics, Art, and the Nude. By Allan McRobie, Princeton, NJ, Princeton University Press, 2017, 168 pp., $35.00/£27.95 (cloth)

To Wolfgang Pauli, theoretical physicist and pioneer of quantum theory, is attributed the statement that "God made the bulk; surfaces were invented by the Devil" (quoted in [1, page 291]). Humans act in both realms, volume and surface, acutely aware of their incongruity that is irrefutably on display in the difficulty in art to represent three-dimensional space in the two-dimensional plain of the paper, the canvas, or the photo. This territory, made famous by M. C. Escher's images of spatial impossibilities, is also what Allan McRobie explores—albeit in a conceptual direction that leads straight into what

mathematicians call a zone of catastrophe. It is the realm in which the French mathematician René Thom (1923–2002) reigned supreme after developing the matching theory of *singularity* or *catastrophe theory* in the 1960s. This field of mathematics analyzes the behavior of smooth dynamic systems at their critical points. In *Structural Stability and Morphogenesis* [2], Thom also linked catastrophe theory to biological forms in a reworking and extension of D'Arcy Wentworth Thompson's pioneering biological topological study *On Growth and Form* [3]. Thompson was asking why things in nature have the shapes they have. Biological forms, that is, blobs of all kinds, are shapes of curvature, such as the human body itself, far different and, in McRobie's view, much more interesting and beautiful than "the pristine curved shapes of classical geometry" (page 2) such as spheres or cylinders or other objects of straight-line geometry. Curves, then, as "lines of beauty" are the book's central theme. In their visual immediacy they bring this theme to light much more brilliantly than a verbal account ever can. Both beauty in mathematics, given through geometrical representations, and the mathematics behind this very beauty, the fascinating and dangerous spots, lines, and intersection in representations of volumes, first and foremost of the human body, is what this book is about.

Allan McRobie is a specialist in structural engineering in the Engineering Department at the University of Cambridge. The book project, he states, grew out of a proposal to the UK's *National Endowment for Science, Technology, and the Arts* to research links between engineering and, among other "soft" topics, beauty. It fits the foundation's program perfectly.[1] McRobie approaches his undertaking as an explication and illustration of Thom's basic "alphabet appropriate for curved geometry" (page 2) in nineteen brief chapters of explanatory prose and graphical and photographical illustrations. For this purpose, he draws on artworks from William-Adolphe Bouguereau to David Hockney, on modernist sculpture by Naum Gabo, for one, and the oeuvre of Salvador Dalí; and he guides the reader, who is very much also a viewer, through parts of optics, and points out how the ominous term "catastrophe theory" actually refers to "many beautiful things," from "the patterns of light on swimming pool floors . . . to boats moored in sunny harbors" and includes even the rainbow as "a fold catastrophe" (page 73).

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[1]Information on Nesta is available at https://www.nesta.org.uk/about-us/, last accessed on July 10, 2019.

The book would doubtless have had only a fraction of its illuminating power without the indispensable visual, photographic, and modeling support of Helena Weightman, whom McRobie acknowledges as a contributor of "many key insights and ideas" (page *vii*). Additionally, the Mathematical Institute of the University of Oxford put out an online video of a lecture by McRobie on the topic of the book that entertainingly illustrates and visualizes its central concepts for the math-imagination impaired.[2]

The Seduction of Curves, both by its title and its visuals, has the makeup of a coffee table volume—just with less brawn than many and more brains than most. It is also a book of translation, and as with all translation, of explanation and interpretation. Referencing Descartes and his system of coordinates, Thompson himself had acknowledged disciplinary transfers and translations and presented the Frenchman's, as well as his own, inquiry explicitly as a translation "of numbers into forms whenever we 'plot a curve'" [3, page 723]. McRobie, expanding this nexus, redirects central mathematical principles that underly biological evolution from Thompson's study explicitly and innovatively toward aesthetics. Translation is thus also his central quest. "The geometry of the senses is etched in the Book of Genes," he writes; it produces, in specific expressions, "the Seduction of Curves" (page 123). This is an allusive rather than a literal translation—the book of *Genesis*, the seduction *by* curves. . .

While the mathematical formulas for curves are unambiguous, plotting them out in two or three (or more) dimensions soon leads into the freer space of allusion, *illusion*, indeterminacy, Escher—in short: catastrophe. It is from the interplay of human (visual) perception and underlying mathematical principles that aesthetic experience emerges. This is, however, also the domain of catastrophe theory. Yet even humanists should not be surprised by this link between beauty and catastrophe if we chance to remember R. M. Rilke's lines from his first "Duino Elegy" (1923) that cannily recognize "the beautiful" as "the beginning of terror" (Denn das Schöne ist nichts als des Schreck-lichen Anfang, den wir noch grade ertragen, und wir bewundern es so, weil es gelassen verschmäht, uns zu zerstören"). Who knows what lurks just beyond the horizon line of that slope of fresh powder we are rushing down?

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[2]The video of this lecture is available online at https://podcasts.ox.ac.uk/seduction-curves-lines-beauty-connect-mathematics-art-and-nude-allan-mcrobie, last accessed on July 10, 2019.

We assume the slope continues, smooth, gently curved—but there is no guarantee that it doesn't suddenly break off, a cliff that we didn't see in time, catapulting us into the abyss.

McRobie's book is for interdisciplinarians willing to be seduced—fortunately a defining trait of interdisciplinarians. For many of us this seduction—here, aesthetic seduction—may happen more easily between some disciplines than others, but art, in many beautiful reproductions of the curvaceous human body, historically epitomized in the female nude, will make it irresistible for most. McRobie not only references but himself attends art classes as a central place to observe lines, curves, and their catastrophic and catastrophically beautiful intersections. It is in art where the attentive looking, sketching, drawing, painting, and photographing naturally links perceptual learning to mathematics and geometry. And to facilitate the process, McRobie provides the reader with the alphabet for phrasing these links, the elementary letters the *fold*, the *cusp*, the *swallowtail*, the *butterfly*. The *wigwam*—"four cusps collide at a single point, the actual wigwam catastrophe" (page 36)—is simply a rare constellation of cusps, as are *lips*, *beaks*, the *gull*, and the *goose*. The last five are less fundamental than the first four as they essentially involve collisions of a number of cusps page (37). Beyond the four elementary catastrophes that can be observed on the human body, there are three more that cannot be seen in life drawing: the *umbilics* of the *elliptic*, *hyperbolic*, and *parabolic*, because they involve surfaces that can pass through themselves (page 61).

"Cusps persist," McRobie writes (page 44); cusps are the key letter in the projection of points from one space onto points of another—precisely what life drawing does, as long as the artist's projection is smooth, that is, with lines that are continuously differentiable. "Catastrophes are the *singularities* of projections of manifolds," where the latter are, for example, "a smooth surface, such as the skin of the life model or the ski slope" (page 43). What in two dimensions appears as outlines, the contours of a volume, we know from personal, intimate, three-dimensional experience with full-bodied life to be hiding smooth, soft indentations, intriguing crevices, dimples, and warm, hand-huggable globes. In this perceptual contradiction catastrophe lurks. The lines we see and their seeming intersection is always a question of one's angle of vision, an optical illusion, a two-dimensional misunderstanding of three-dimensional life—or, as in the artwork, a deliberate play with indeterminacy.

"The only way to get rid of a cusp on an outline is to apply a non-smooth distortion. So, for example, catastrophe theory does not apply in cubism" (page 44).

The works of artists such as photographer Lucien Clergue's nudes provide rich examples of the incompatibility of voluminous smoothness and the "infinitely sharp spike" of the cusp (page 14). The science student-turned-artist Naum Gabo is another, whose acrylic-glass plate and nylon-string sculptures illustrate artistically and aesthetically McRobie's point of how "straight lines could create attractive curves" in their interplay (page 111). So is David Hockney, whose LA swimming pools in many of his 1960s paintings make the "catastrophe optics" of the flickering, intersecting patterns of light a recurring theme (page 67); or Salvador Dalí, whose last painting, significantly titled, *The Swallow's Tail* (1983), McRobie unambiguously reads as a visual representation of Thom's catastrophe theory (chapter 19).

Both immediate and analytical, beautiful and informative, *The Seduction of Curves* is a successful hybrid of art book, representation of descriptive geometry, and explanation of mathematical concepts. It lays bare the physics behind the two-dimensional representation of volumes, provides the mathematical logic for its shortcomings, and highlights the special beauty and seduction of its perceptual reality along systemic breaking points. It is, in sum, a book that entertains and teaches, pleases and challenges in equal measure.

References

[1] Bjørn Jamtveit and Paul Meakin, editors, *Growth, Dissolution, and Pattern Formation in Geosystems*, Kluwer Academic Publishers, Dordrecht, 1999.

[2] René Thom, *Stabilité structurelle et morphogénèse: Essai d'une théorie générale des modèles*, Benjamin, New York, 1972. Translated into English from the French edition, as updated by the author, by D. H. Fowler, and published as *Structural Stability and Morphogenesis: An Outline of a General Theory of Models*, (Benjamin, Reading, 1975).

[3] D'Arcy Wentworth Thompson, *On Growth and Form*, Cambridge University Press, 1917.