Preface

In my study of natural shapes, more specifically of bamboo, I started using the superellipses and supercircles of Gabriel Lamé around 1994 to study the shape of certain square bamboos. The first publication was in the Belgian Bamboo Society Newsletter in 1996 followed by a presentation by Prof. Freddy Van Oystaeyen in the same year at a meeting at the University of Louvain organized by the Belgian Plant and Tissue Culture Group and published in the journal *Botanica Scripta Belgica*. Three years later, in 1997, I was able to generalize these curves into what I originally called superformula, as a generalization of supercircles, following joint work with Bert Beirinckx on superellipses. In 1999, I founded a company with the explicit aim to disseminate these ideas in science, technology, and education, with better than expected results.

My first presentation on the more general use of Lamé curves in botany was in 1997 at the Symposium Morphology, Anatomy and Systematics in Leuven, in honor of the great German plant scientist Wilhelm Troll. The symposium was co-organized by the Deutsche Botanische Gesellschaft and by the Botany Department of the University of Louvain. The talk went quite well, and in the closing speech, Erik Smets remarked that it was hoped that I could bring fresh ideas to mathematical botany; the untimely death of the late Aristid Lindenmayer had left a deep gap in that field. On advice of Focko Weberling, one of Troll's students, I was contacted by Springer Verlag that same week to publish a book on my work. In a sense, this book is 20 years overdue, but *pauca sed matura* was Gauss' motto.

In 2003, the first major scientific paper was published in the *American Journal of Botany*, on invitation by the editor in chief, Karl J. Niklas. The title "*A generic geometric transformation which unifies a wide range of natural and abstract shapes*" expresses the gist of the matter. This publication attracted a lot of attention, and I still think it was a good timing and (hoped for but unexpected) strategy for dissemination. In the same year, the English version of my book *Inventing the Circle* was published, two years after the Dutch version in 2001. My journey took me from horticulture and plant biotechnology to geometry. The article "*Universal Natural Shapes*" with Stefan Haesen and Leopold Verstraelen in 2005 introduced the equation into the field of geometers, and also substituted the name superformula

by the names *Gielis curves, surfaces, (sub-)manifolds, and transformations*. In geometry, a whole new world unveiled before me. This, along with several publications by others ensured the adoption and absorption of the formula in mathematics, science, and education. Two of my main goals, formulated in 1999, have been or are being realized, along various paths.

Technology was my third, long-term goal, and many papers in science and technology have been published using the formula. In many cases (antennas and nanotechnology, for example), the formula allowed to go beyond the classical and canonical shapes, opening many doors. My own passion about technology is this: No matter what field we consider, I (with many others) think our current technology, no matter how advanced, is essentially a bag-of-tricks, aimed at deception (which is perhaps a major feature of our times and culture). We are working toward new applications following my dream of unifying and simplifying, at the same time appreciating complexity.

In this respect, it is important to note that my background is horticulture and plant biotechnology. I have been involved as researcher and research director in plant research for more than 25 years, and methods were developed in our team for mass propagation of plants, in particular temperate and tropical bamboos, the former for ornamental purposes, the latter for reforestation in the tropics. Over the past years, we have produced over 20 million bamboos that have been distributed and planted worldwide. Bamboo is indeed a multipurpose plant, a beautiful plant for our gardens but providing building materials, food, and much more for the poorest one billion humans on this planet.

Key to this was focused in-depth research using molecular markers and high-throughput determination of plant hormones, but never losing sight of the end goal: plant production. The same procedure of combining science with technology, we use now in the development of antennas, where optimization is an ongoing activity. We are now able to produce very powerful antennas, at costs which could be up to ten times less than existing ones, optimizing margin, while delivering the highest possible quality and efficiency. In all my (scientific and engineering) activities, this combination of wide interests, a generalist (rather than myopic) view, and stamina has always led to remarkable results.

Always keep focused on what you want to achieve. The current book is a combination of such focus, combining wide interests (nature and science) and a generalist (rather than specialist) attitude, inspired by the vision of natural scientists and philosophers from a long gone era. Along the way, I learned many other things, which one cannot learn but by a constant drive and strive to understand. My scientific education continues daily.

I wish to convey my sincere gratitude to my parents and all teachers, botanists, mathematicians, and engineers who played an enormously important role in my personal scientific development and the various developments described in this book: These include my teachers in high school Fred Verstappen (Greek) and Gerard Bodifée (sciences); in my professional horticultural and plant biotechnological life: Pierre Debergh (University of Ghent), Walter Liese (University of Hamburg, Germany), Tom Gerats (Radboud University, The Netherlands), and

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Antwerp, Belgium Johan Gielis
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