FRACTAL ART(ISTS)

Marco Abate and Beatrice Possidente

1 Introduction

"Fractals are everywhere." This has been a sort of advertising line for fractal geometry (and for mathematics in general) since the Eighties, when Benoît Mandelbrot discovered the set now known as Mandelbrot set, and brought fractals to the general attention (see, e.g., [1, 2] for the story of his discovery, and [3] for an introduction to fractal geometry). As most good advertising lines, though not completely true, it is not too far from the truth. Possibly they are not exactly everywhere, but fractals are frequent enough to guarantee you will meet at least one as soon as you leave your full-of-straight-lines man-made-only office space and take a short walk in a natural environment. When you start thinking about it, this is not surprising. Fractals are easy to generate: it suffices to repeat over and over (infinitely many times in the mathematical world, but in the real world ten times is often close enough to infinity) the same simple process to create a complicated object; and tinkering with just a few parameters allows to obtain an amazingly wide range of different shapes, that can be easily adapted to specific requirements. It is quite an efficient scheme, and nature loves efficiency; complex structures can be created starting just from simple (but nonlinear!) tools. Coastlines and mountain lines; leaves arrangements and lightning; fractures and clouds; all examples of fractally generated shapes.

And fractals are beautiful, there is no denying that. Something in their intricate shapes, in their repeating of similar forms at different scales, resonates deeply into our (fractal-shaped) brain, evokes our aesthetic senses, let us admire infinity easing our painfully perceived finiteness. Furthermore, fractals are incredibly easy to produce; it suffices to use that old high-school friends (or foes), quadratic polynomials. By now there are around tens of computer (and tablet, and smartphone) programs that allow you to draw fractals; just choose at random a couple of parameters and *presto!* a beautiful intricate fractal image appears in front of your eyes, with convoluted shades of color swirling around in unexpected (and yet deeply familiar) ways.

Beautiful images, yes. But is this art? Ok, this is a very difficult question, to say the least, and we are not going to even try and answer it. It is a question artists, philosophers, historians, art buffs and simple people like you and me are grappling with since… well, since the very first cave graffiti. At least. It is not just a matter of (technical or otherwise) complexity: Fontana's cuts are extremely simple, and yet they are art. It is not a matter of meaning: contemporary art museums are full of (so-called) *meaningful* art which says nothing relevant about its subject and is plainly ugly — but they are also full of abstract works with no meaning whatsoever and yet incredibly beautiful and definitely art.

And it is not (just) a matter of beauty either. A plain zoom of a detail of the Mandelbrot set is beautiful, but it cannot be considered art. Indeed, there is no human intervention; its beauty in a way is intrinsic to the subject and somewhat independent of

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the guy/gal who generated the image pressing the *Enter* key on the computer keyboard (or the suitable spot on the tablet screen). Of course, this is a gross simplification; even the most basic user of a fractal generating software has to make some choices, at the very least the choice of the detail to zoom in and of its framing. But it is a process more akin to taking a tourist snapshot than to taking an artistic photograph of the same subject.

The internet is full of tourist snapshots of fractals (and one of us too is guilty of this particular computer-age sin). But if you look carefully, you will also find fractal images that are not only beautiful or complex: they are real art. The computer program (or, more often than not, programs) used to generate the image is like a brush-paint-canvas-all-rolled-into-one tool used by the artist to bring forward what was in her/his mind, to create (and not merely reproduce) something that was not there before, making the world a better (and more beautiful) place in the process.

Because, whatever your definition of art is (unless you are so strict as to exclude from the world of art anything which is not created with the same tools our ancestors used for their cave paintings), there undoubtedly are fractal artists out there. And some of them are producing works that do not look like anything else you have seen. And others are producing works that do look like something else you have seen — and yet at the same time they are completely unique and their own, as any work of art is.

This note is about them. We contacted a few (particularly interesting, in our opinion) fractal artists, and asked them a few questions, about who they are, about the way they work, about art in general and fractal art in particular. They turned out to be a pretty diverse bunch of people (as artists are wont to be); some of them have a scientific background, some of them definitely not; some of them make a living inside the arts, most of them not; some of them are young, some of them not anymore; but all of them are artists.

It comes as no surprise that different artists have (very) different styles. Very roughly speaking, fractal works can be subdivided in three (or four, as we shall explain momentarily) categories, according to the amount of post-production on the raw fractals and the use of them in the final work. The first category, the *pure fractals,* consists of images mostly based on a single fractal, and where post-production (that is, the adjustment of colors and lighting) is aimed to enhance the characteristics of the particular fractal chosen. The importance of the post-production cannot be underestimated; it is exactly the step where a fractal illustration becomes fractal art. Artists with particularly good works of this type (but most artists have works in most categories, only a few specialize in a single category only) are Leonardo Mancini (see Fig. 1 for an example of his work) and Joseph Zazulak (see Fig. 2).

The second category can be dubbed *art from fractals*. In this case, one or more fractals (usually more than one) are combined in a single image, and the post-production aims to melt them together obtaining a final work that is more than the sum of its parts, but still clearly preserving fractal characteristics and containing almost no other ingredients. Very good representatives of this category are due to Jessica Darling and Janet Parke (see Fig. 3).

The third category (but the borders between different categories are of course very vague) might be called *art with fractals*. The works belonging to this category use fractals just as one of the elements in the composition of the image, with an amount of post-production that can vary from almost nothing to so much that the fractals become almost indistinguishable as individual entities in the image. Particularly good works of this kind are by Maria K. Lemming (see Fig. 4) and Elio Pastore (see Fig. 5), and also again by Jessica Darling (see Fig. 6) and Janet Parke (see Fig. 1 in color).

Fig. 1 Leonardo Mancini: *Black and white*. (Reproduced by kind permission of the artist)

Another artist whose work can be ascribed to the category of art with fractals is Johan Andersson (see Fig. 2 in color), but his work also belongs to the fourth category, *3D-fractals.* The difference in this case is due to the kind of fractals used in the construction of the image; instead of plane fractals, that is fractals created by the iteration of a mathematical process living in a plane and thus only two-dimensional, 3D-fractals are used, coming from mathematical processes occurring in a 3-dimensional (and sometimes even higher-dimensional) space, and part of the post-production (like in photography or painting) consists in deciding how to represent the 3-dimensional fractal object stored in the computer on a 2-dimensional screen. The net result is that the appearance of works created using 3D-fractals is often very different from the appearance of works created using 2D-fractals, as you can see for instance examining the (fantastic) work of Johan Andersson (see Fig. 7), Tom Beddard (see Fig. 8), Matthew Haggett (see Fig. 9) and Jorge Abado (Fig. 10). 3D-fractals tend to be very realistic, as they were representations of really existing organic objects or mechanical (or even alien) landscapes. And this should not be a surprise: the fractals being

everywhere we mentioned at the beginning of this note clearly are 3D-fractals, since we live in a three-dimensional world.

Fig. 2: Joseph Zazulak: *Fingers holding secrets* (Reproduced by kind permission of the artist)

The next step in fractal art will be going from fractal painting to fractal sculpture, using 3D-printers to print 3D-fractals. Johan Andersson (see Fig. 11) is pioneering this road; who knows what kind of new fractal art will emerge in a few years…

In the rest of this article we shall leave the stage to the artists. Of course, the best way would be letting their art speak, showing more of their works. But unfortunately we only have a limited amount of space at our disposal, and most of it in black and white (which severely limits the kind of images we can sensibly reproduce); however, at the end we have listed the addresses of the web sites where you can find a selection of their work. We urge you to go and visit their sites; you are in for a real treat.

2 Backgrounds and beginnings

The first four questions we asked ("What is your (artistic, scientific, professional) background?", "How and why did you become a fractal artist?", "Is your work only digital or do you work with other media too?" and "Have your works been used in other contexts (fashion, design, etc.) too? Would you like them to be?") allowed the artists to describe themselves — and, as we anticipated above, the answers were wildly diverse:

Jessica Darling: "I don't have much formal training in either art or math, though I've always been interested in them. I studied English Literature and creative writing in college. I first learned of fractals in middle school at a math/science day camp for girls.

A few years later, I found fractal art on the internet, and I liked the work so much that I decided I wanted to make some myself. I do get occasional freelance jobs incorporating fractals into design projects, such as a card game, but it's relatively infrequent. I'd like to pursue this more."

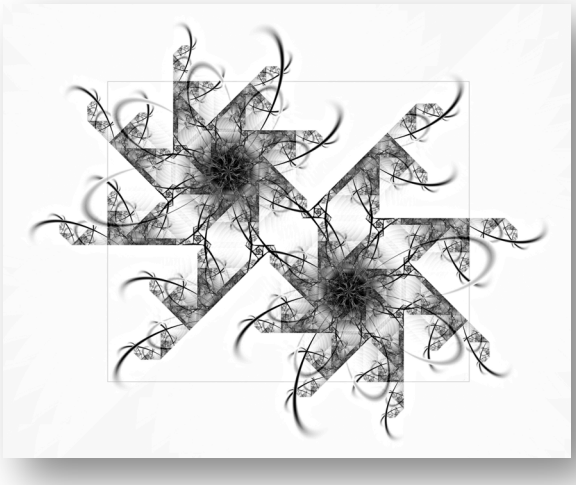

Fig. 3 Janet Parke: *Ammon*. (Reproduced by kind permission of the artist)

Matthew Haggett: "I was a competitive mathematician in high school and have been a long-time math and science enthusiast. I pursued art rather than math, and work in graphics. I was first introduced to fractals when the Mandelbrot set was popularized in the mid 80's, and have had a conceptual fascination with fractal geometry and nonlinear dynamics since then. In 2012 I began experimenting with 3D fractals, and I became immediately fascinated with the visual results as well as the mathematical foundation of the work. At this point, I've largely stopped doing traditional art and am focused on 3D fractal rendering. I've explored various output methods as well, using fractal designs on phone cases, laptop skins, messenger bags, coffee mugs, and the like; I'm also interested in the video and 3D printing possibilities of the work."

Maria K. Lemming: "I had of course heard of fractals in high school but not really taken interest in them until many years after. I was working with Danish Public Television and one day I interviewed a Danish composer, Carl Aage Rasmussen, who had just written a new, modern symphony. I asked him what had inspired him and he answered with great enthusiasm: 'Fractals!' So I went home and on the internet soon I found several fractal communities and programs and started trying to make them. One of my earlier pictures has inspired an American fractalist to create a poem. I think my works would do great as design for many objects: fabric of any kind, porcelain, umbrellas, night linen, pillows, pc covers, you name it."

Johan Andersson: "I am an engineer who has been into art since I was young. I have painted surreal oils and sculptured for many years, and work as a system manager in a magazine. It wasn't until the discovery of the mandelbulb (see [4]), and shortly later of the mandelbox (see [5]), that I felt there was something in fractals which I could use artistically. I had been fascinated by the zooms of the Mandelbrot set for many years, it is beautiful and thought provoking because of its infinite nature and eternal swirls—on the other hand there is not much else than that… Inside 3D fractals, instead, the possibilities to find your own dispositions and coloring before rendering the final image gave me free hands to interpret these worlds filtered through my own ideas and imagination. I also have made jewelry and espresso cups so far, more is in the pipeline, and I think it is a good thing fractal art is represented in fashion nowadays, it needs all platforms it can find to reach out to a wider audience."

Fig. 4 Maria K. Lemming: *Stressbird*. (Reproduced by kind permission of the artist)

Tom Beddard: "I trained as a physicist and completed a PhD in laser physics in 2001. Since then I completely changed course and moved into web application development, digital interactive installations for museums and app development. I've always been interested in art and design (it was a close call choosing between art and science at college!). I found that creative computing—writing software to produce generative graphics—produced a nice cross over between science/math and art. Fractals are the truest form of this. It is my way of scratching my creative itch. I have had my animations used as backdrops for fashion and stage shows. There have been many other proposals for collaborations but most seem to be unrealistic, or trying to get a commercial job done for free."

Joseph Zazulak: "When I began learning how to create fractals (about 15 years ago), I had no background in art and only the math curriculum taught in high school and college. I happened upon some fractals on the internet in the 1990's and was amazed at how beautiful they were. I only create digital art, although recently I have become very interested in short real life filmmaking as well. I create art largely for my own pleasure and as a hobby. I have no desire to commercialize my art."

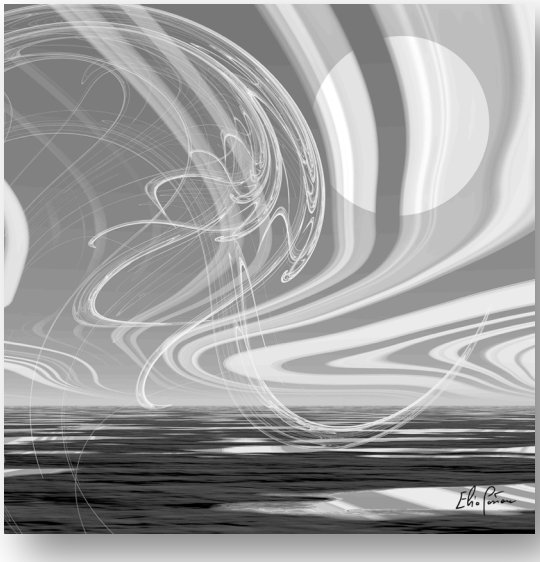

Fig. 5 Elio Pastore: *Sognando l'alba*. Laser etching on aluminum. (Reproduced by kind permission of the artist)

Janet Parke: "I have spent my life involved with the performing arts—primarily dance and music. I have been a ballet teacher and choreographer for more than 30 years. I like to say that Fractal Art found me, even when I didn't know I was looking for another means of artistic expression. I was, I thought, a happy and productive ballet teacher and choreographer who had plenty of opportunity to create. But I was intrigued by some early fractal images, and once I got connected to the internet, exploring and investigating others' fractal galleries became my first major internet search project. I have used my work as a design element for dance costumes (see [6]). I am also currently working on a new style of fractal animation that I hope will have more in common with choreography in its ability to express music than just swirling shapes or deep-zooms."

Elio Pastore: "I began creating art in 1992. Professionally I have always worked in communication and graphics, and this surely helped me, even though my studies were on a very different subject: I graduated in Law. I discovered fractals almost by chance, with the first software allowing to generate fractal forms, simple plug-ins of programs I was using for work. At the time my work was mostly figurative; the impact with fractals had been decisive in changing my art. Now a characteristic of mine is the contamination

between different techniques, both digital and traditional. Images of mine have been used as cover for books, periodicals and posters. Some would work perfectly for design and fashion apparels, but, even though this might flatter me, maybe it would degrade them to mere decorative art."

Fig. 6 Jessica Darling: *Propellers over Dresden*. (Reproduced by kind permission of the artist)

Leonardo Mancini: "I graduated in Electronic Engineering; I now work in the fashion industry. In the Eighties I ran a code for producing the Mandelbrot set in a Commodore 64, and after 36 hours I could admire that black and white low resolution image: it was love at first sight! I went on producing fractal images with the first PCs for most of the Nineties, but even the low resolution mono-layer images needed several hours to be completed; hence zooms were very limited, and I stayed very much 'on the surface'. Then I stopped completely for about 10 years. I started again in 2008, and I realized that with the new technologies my old experiments could be computed at a very high resolution in a few seconds."

Jorge Abalo: "I was surrounded by art since I was a child, my father is an occasional oil painter, and I grew up drawing everywhere! I am fascinated by the infinite power of computer applied to art, and by the potential of fractals for generating beautiful patterns on computers."

3 Techniques and goals

Fractal art is created using (a lot of ingenuity and creativity and) computer programs for generating the raw images, and more programs for post-production and final rendering. Typical programs used are *Apophysis*, *Chaotica*, *Ultra Fractal*, *FractalViZion*,

SterlingWare, *GrafZviZion*, and *Fractal Explorer* for 2D fractals; *Mandelbulber* and *Mandelbulb 3D* for 3D-fractals; and *Photoshop*, *Fiji*, *Meshlab*, *Sculptris*, *Netfabb*, *Blender*, *Terragen* and *Bryce* for post-production and rendering. For getting a better understanding of the process, and of what the artists aimed to achieve with their work, we asked four questions: "What is your method for producing a work?", "How do you proceed in the post-production phase, that is going from the initial fractal to the final image?", "When you start working do you already have some idea about the aim you would like to reach with the image you are creating?", and "What kind of ideas, feelings, emotions would you like to convey with your art?". Here is a selection of their answers:

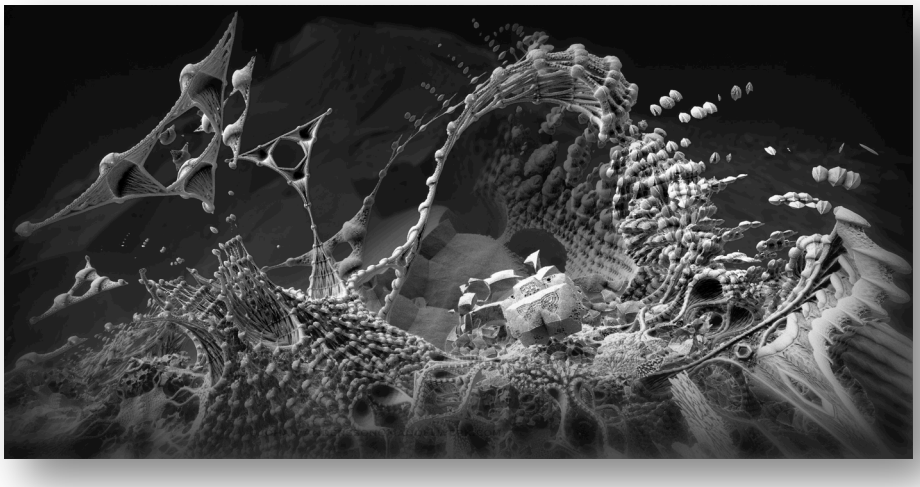

Fig. 7 Johan Andersson: *The box with the tsunami of impressions*. (Reproduced by kind permission of the artist)

Jessica Darling: "Sometimes I have no particular goal at all and am just exploring. Often I have a very vague idea along the lines of "I'd like it to be highly structured" or "I'd like it to be painting-like." Occasionally I have a very specific or technical idea, e.g., tiling a disc/wedge combo in a hexagonal pattern and applying a foci final transform, but even then my exploratory nature sometimes leads to unplanned additions. I'd like for my art to instill a sense of infinity, bigness, magnificence in the viewer. It is like when you look at the ocean and feel small... I often attempt to emulate the same feeling in fractal art."

Matthew Haggett: "I tend to work on images for a long time, making a lot of tiny changes in order to set up a shot. I rely on traditional aesthetic/art concerns to compose images: color, mass, line, dynamic arrangement within the composition. I start without preconception of the final image, often exploring fractal formulas that I've used before looking for interesting and engaging scenes. The work is rather like photography: finding scenes and setting up shots. In post-production, I balance and enhance colors,

but I seldom do specific manipulation of images. I try to create compositions that evoke moods and emotional states—often striving for a feeling of familiarity and strangeness at the same time, the kind of awe one feels in the presence of nature… I try to create strong senses of space and place, to keep the viewer engaged and wondering about the images they're looking at. Rather than trying to evoke preplanned emotions, I let the fractal forms guide my process—if the object feels calm and spacious, I will play up that aspect—if it feels dark and mysterious, I will push the work in that direction."

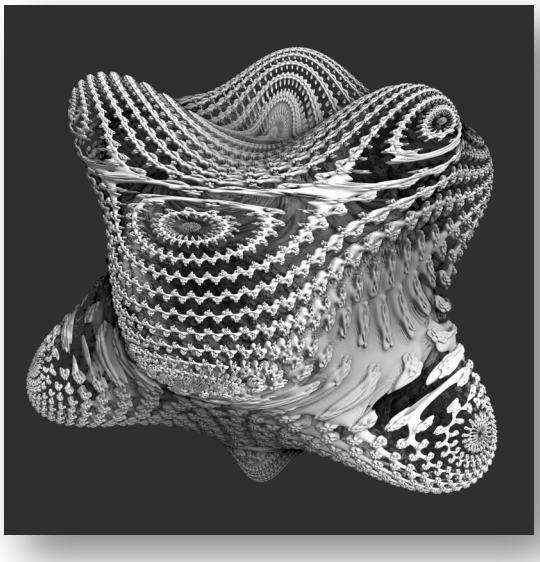

Fig. 8 Tom Beddard: *Hybrid 3*. (Reproduced by kind permission of the artist)

Maria K. Lemming: "I have no special method for the creation of a fractal picture; I just start and try my way and see what comes. I pick out details by intuition and keep working on them until I find a result I like. The outcome seems to vary quite a deal according to my mood. I like to listen to music when I work and maybe even light a candle. Next step is finishing post-production in other picture programs where I twist, turn, zoom and work with colors, lighting, spots and sometimes draw on it with a digital pen. Many of my works are non-figurative—and then again…. Many people see different things in them anyway and that is a great result for me. Especially kids tend to insist that 'This is a dizzy whale', 'This is a stork, right grandma?' of just 'This is a happy/crazy/scary pic'. I've also noticed that if I'm a bit tired or sad I intuitively make pictures that stimulate me in some way, such as expressing energy or tenderness."

Johan Andersson: "Most of the time I get the inspiration from the fractals themselves, filtered through my weird brain cells of course. The rendering period gives you time to contemplate around the idea. In the post-production sometimes I only adjust the colors and sometimes I add (my own) images of skies, objects or figures. It depends on what I feel I need to add to express my idea. Now that I have a huge library of saved

parameters I have also started to work in the other direction, getting an idea and find the old parameter needed to envision it. I am a defeatist with some hope and I think that shines through in many of my works. Inspiration and imagination to the beholder!"

Fig. 9 Matthew Haggett: *Inside the chaos engine*. (Reproduced by kind permission of the artist)

Tom Beddard: "A key feature of the software I wrote and use for my art is that it is real-time interactive. By having a real-time system it is possible to quickly explore a parameter space, something that is important with fractals as a tiny parameter tweak can open up a whole new visual vista. Once I have something interesting I will then try and refine that 'gene' until I have a result I like. Often the trickiest thing is knowing when to stop as there might be a multitude of equally good or interesting results! People often comment on a mesmerizing effect they feel viewing some of my animations. It is nice if it captures and holds the viewers attention, especially in a relaxing, meditative way."

Joseph Zazulak: "It might sound strange but I never have any specific design or colors in mind when I create a fractal or when doing my post-processing work. It is more of an 'organic feeling' that I have for the final outcome. I like that different people find many different aspects of my art that appeals to them. I enjoy creating bold, colorful pieces as well as softer, more 'minimal' types of fractals."

Janet Parke: "I begin every image in grayscale, selecting a base calculation formula to use, then finding an interesting structure with which to work. Next, I apply coloring algorithms to the base structure, looking for shapes or effects that show potential. Once I have collected several potential layers, I slowly begin adding color by manipulating the gradient, and by changing the merge modes of the layers. I use transparency in the gradients, in the merge modes, and also by judicious use of masking in order to create different areas and gradations of color and texture. I think it's difficult to truly be able to plan an image in advance. I often have a vague goal in mind, and I'm getting better at achieving those goals, but I do still enjoy the aspect of serendipitous discovery."

Elio Pastore: "Fractals are not work of arts *per se*, but provide suggestions for generating art: navigating fractals it is possible to isolate single details that, elaborated at length in a `painting-like' second phase by adding color gradients, shadows and lights to give them relief and depth, become autonomous subjects that fascinate the observer and get the dignity of art. Since 2004 I mainly used fractals as one of the several elements in the composition of a work, together with digital painting, traditional painting, rendering 3D… I start with a very clear idea of what I want to realize and I proceed in stages. I strongly believe that art should always express beauty and an interior force, even when it express disturbing or difficult concepts. It should interact with the observer and create new meanings. I like to quote the famous phrase by Burke-Jones: 'I mean by a picture a beautiful, romantic dream of something that never was, never will be—in a light better than any light that ever shone—in a land no one can define or remember, only desire'."

Fig. 10 Jorge Abalo: *Perennial bloom* (Reproduced by kind permission of the artist)

Leonardo Mancini: "I definitely do not like to create fractals representing something real; in my opinion a fractal is something abstract that should not mimic photography but show the harmony and beauty of mathematics. I only rarely use layers, sometimes I am too minimalistic, but I prefer to devote much care to the choice of colors and to the general frame composition trying to give a photographic feel to the image. Light and color are fundamental in the creation of the fractal. With my work I would like to express the feeling of harmony and peace given by losing him/herself into a fractal, that harmony which is part of mathematics itself."

Jorge Abalo: “Every image is unique and requires a unique preparation too! There is always a lot of serendipity involved in fractals, but knowing what patterns you are able to obtain from one formula in particular can give you an idea. It is a mix of finding and intention. The more you know about how it all interacts the less serendipity you get. If an artwork can transmit you something, an emotion for example, then the work is accomplished. Normally a sensation of the unknown... a mystery produced with mathematical formulas!”

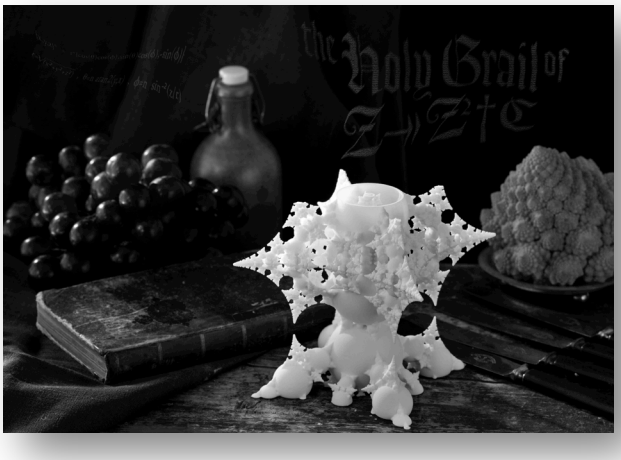

Fig. 11 Johan Andersson: *Holy grail* (Reproduced by kind permission of the artist)

4 Art and nature

Another subject we were interested in was the relationships between fractal art and other kinds of (more traditional) art. So we asked: “In your opinion, what are the main characteristics telling fractal art apart from other artistic movements?” and “In your work do you find inspiration in (or connections with) other arts, for instance primitive art (like, e.g., Australian aboriginal art)?”. Furthermore (remember, fractals are everywhere), we wondered whether working with fractals changed the way the artist perceived the natural world, and so we asked: “Has fractal art changed your way of considering nature, or of thinking about time (or space)?”. And here are some of the (quite interesting) answers:

Jessica Darling: “Honestly, I'm not sure there are any characteristic typical of fractal art. Fractals have a lot more flexibility that most people would guess, and it's relatively common for me to get comments along the lines of ‘I never would have guessed this was a fractal!’ I'm also always urging fractal artists to study general artistic principles like color theory and composition because I believe they are just as applicable to fractal art as they are to, e.g., painting, and it's relatively common for fractal artists to think only about the formula but not about the presentation of the final image, which is a

shame. I think the fractal art scene could benefit from knowing more about other artistic movements and incorporating those into our work instead of being insular. I look at a lot of art and am inspired by a wide variety of different things! Music is a common inspiration for me, since I almost always have music playing in the background while I'm on my computer. Mosaics, such as those used to decorate the insides of mosques, are another frequent inspiration because of how geometric they are. However, I also find inspiration in more 'organic-looking' types of art, such as abstract expressionism. Last but not least, I am frequently inspired by nature and space. However, fractals did not really change my way of looking at things. It's a bit of a pet peeve of mine when people get too mystical about fractals. I would not be surprised if fractal math does have applications in analyzing nature, time, space etc. but frankly most of the people blabbing about how 'the universe is fractals!' or whatever do not have the rigorous science/math background to actually explore those ideas in a meaningful way."

Matthew Haggett: "Fractal art is a form of *generative art,* where the artist does not start with a blank canvas and unlimited choices, but rather relies on existing formal constraints to guide image generation, and works within these formal constraints to create a final piece of art. It also strikes me as being related to photography, where the artist captures images of objects that exist independently. Unlike traditional photography, 3D fractals exist in mathematical space. And also unlike photography, the artist has a range of controls over the forms of objects, surface characteristics like color and reflectiveness, and environmental aspects like light and depth effects. But the process resembles photography in the process of setting up shots, framing compositions, and applying some traditional photographic effects like depth-of-field focus. 3D fractals end up being very evocative of traditional patterns, architectural motifs, and natural forms. My work is inspired by these connections, and I often seek to emphasize the connections I see between 3D fractals and man-made as well as natural patterns in art—applying organic colors to organic looking forms, working architectural-looking surfaces to resemble stone, wood, or metal. 3D fractals are frequently evocative of science fiction motifs—alien looking technology and otherworldly environments. If a fractal form leans towards such a 'sci-fi' look, I will often play up that connection with color and atmospheric effects. As a long-time fractal enthusiast, I've been aware of the omnipresence of fractal geometry in the world around us. Working with 3D fractals has heightened my awareness of the underlying processes that guide natural forms, and the many kinds of divergent complex forms that can arise from similar, simple initial states. I will often catch a glimpse of some natural form and feel like I recognize the underlying equations present in the rendering applications."

Maria K. Lemming: "I find inspiration in the fractals themselves. Sometimes combined with certain kinds of music, often meditation or especially Michael Stearns' *Planetary Unfolding*, my favorite CD. I guess fractals have contributed in some way to my tending to believe 'there is more to life than meets the eye' and that souls might live forever, somehow, somewhere. You could say that fractals have made me comprehend the idea of infinity."

Johan Andersson: "I think many of my own images would not be considered 'mathematical' or 'fractal' by an unknown audience. I see these worlds opened up by 3D hybrid fractals as surreality becoming reality and I have made many works inspired by the old masters of surrealism (and other arts) Dalí, Tanguy, Bellmer, Magritte, Vermeer and many others. I have ever since I was a child found a great pleasure and

calm thinking about myself as a small being on a planet which is an infinitely small insignificant dot in a vast universe."

Tom Beddard: "Fractal art is perfect complexity. The way you can have incredibly complicated patterns, like a spiral made of spirals, which in turn are made of even smaller spirals all perfectly interlocking together—it boggles the mind. However, the mathematical precision can also be its downfall. Lack of personal interpretation or consideration to the overall artistic and composition of the image is often missing from fractal art. It is all too easy to tweak a few numbers then hit render and be done, which is possibly one of the reasons why fractal art often isn't taken seriously in the wider art community. I even shun away from calling my work 'art' really. I just see it as my creative outlet. I take a lot of inspiration from architectural structures at one end of the scale and radiolaria type microstructures at the other end. Another area would be from the geometric patterns found in Islamic art. But in the end I am driven by a fascination for detail and complexity that arises out of very simple processes. When you start thinking about fractals you also begin to see fractal structures all around you in nature. Trees, rivers, mountains, leaf veins, cracks in the road, clouds… One of the big surprises I found was how some of my 3D fractals can sometimes create very natural looking structures resulting from iterating translations and rotations, effectively mimicking growing processes."

Joseph Zazulak: "The totally infinite variety of fractals, their shapes and viewer appeal seems to me to be what separates fractal art from more conventional art, even abstract art. I cannot say that my art is consciously inspired by other art forms except perhaps the abstract and modernistic movements. Simply stated I believe that fractal art is limitless in what kind of images can be produced. When using the Fractal Explorer program I feel that I am creating something almost organic in nature."

Janet Parke: "For me, the more important distinction is that I can create art without having to use my hands in a traditional way. The creative process allows me to use my sense of color, composition, and movement, but to bypass my hands—which were never adept at drawing, painting, sculpting, or any of the other traditional visual art techniques. I strive to achieve a man-made (with irregularities and imperfections) rather than machine-made (perfect curves, straight lines, etc.) look, but I think I mainly draw inspiration from other art forms (music, dance, poetry) rather than from visual art. More than anything, fractals have allowed me to recognize the self-similar patterns in my life—the choices I make regarding work, hobbies, people, etc., all demonstrate the cyclical and re-iterative nature of life."

Elio Pastore: "Fractal art is neither figurative nor abstract. Figurative art represents an objective and visible, verifiable, reality. Abstraction instead is the overcoming of the need of representing something actually visible, is wandering freely looking for forms and colors. With fractals one travels on an intermediate line: one gets apparently abstract shapes yet based on the same geometries and laws used to build the world around us. Thus the images so obtained preserve to our eyes a sort of familiarity suggesting, according to individual sensibilities and in various amounts, a figurative reading too. Connections with other forms of art exist for sure (for instance mandalas), and this comes as no surprise to me: the intuition that the shapes existing in nature do not answer to the law of chaos but to a universal law (and to a universal harmony) has always belonged to human sensibility, even though it has been mathematically proved only one century ago. Working with fractals has changed my way of looking at nature: today I very often discover fractals in it, and I appreciate even more its infinite beauty, because my way of looking is more aware, and the wonder even greater."

Leonardo Mancini: "The thing I love most about fractal art is the beauty of the shapes created by mathematical formulas. In a way, if one does not exaggerate with layers, it is like being led by the formulas. For someone this might be a constraint, but I find that having the possibility of shaping the formulas in images without the need to create anything is very interesting. By now I seem to recognize fractal forms in many things around me, in particular in nature where often I have the sensation that everything is governed by the self-similarity principle."

Jorge Abalo: "Fractal art remits us to our collective iconography, like Carl G. Jung stated decades ago. Everybody sees something familiar in it, but you don't know what it is exactly! I see a deep connection with all art in the past, from the intricate Celtic patterns, passing through the Indian millenary culture, the splendid Arabic legacy and many others. I see fractals everywhere! The whole universe works in a fractal way, and this is not metaphysical, it is maths! As Benoît Mandelbrot said, once you get in contact with fractals you will never see the world in the same way you did before!"

5 Contacts

We heartily thank the artists for finding the time to answer our questions—and for creating so much beautiful art, which you can find in the following sites:

Jorge Abalo: batjorge.deviantart.com
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Tom Beddard: www.subblue.com
Jessica Darling: fardareismai.deviantart.com
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Leonardo Mancini: theslider.deviantart.com
Janet Parke: www.infinite-art.com
Elio Pastore: www.eliopastore.it
Joseph Zazulak: www.renderosity.com/homepage.php?userid=27612

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[6] http://www.infinite-art.com/news/article/8

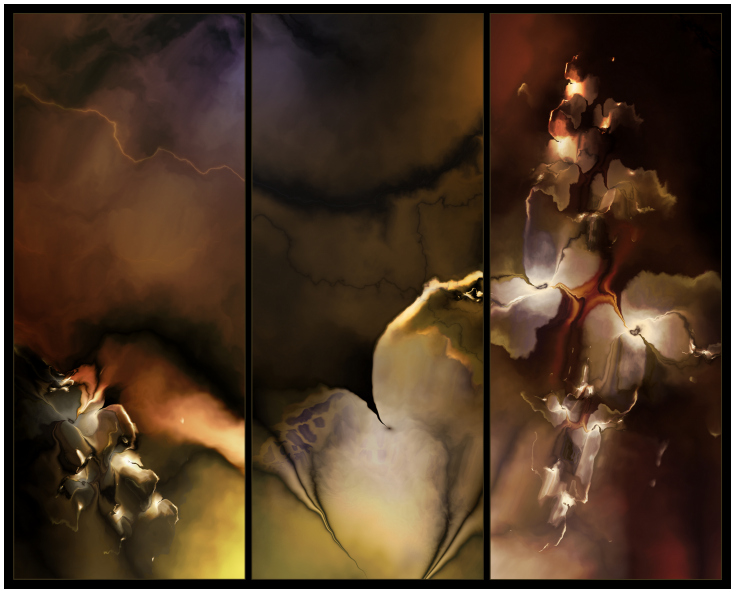

Fig. 1 in color Janet Parke: *Se-cyre*. (Reproduced by kind permission of the artist)

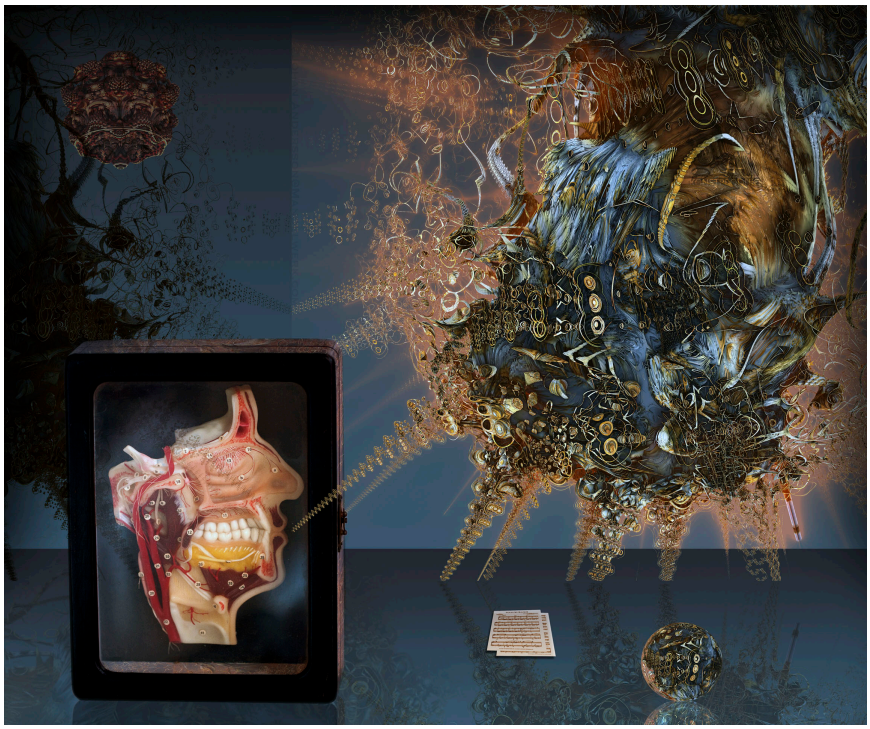

Fig. 2 in color Johan Andersson: *Composer's cerebral cortex*. (Reproduced by kind permission of the artist)