SUBLIME SYMMETRY: MATHEMATICS AND ART

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Introduction

This paper is a text of my talk at the opening of the Exhibition *Sublime Symmetry: The Mathematics behind De Morgan’s Ceramic Designs*† in the delightful Towneley Hall‡, Burnley, on 5 March 2016. The Exhibition is the first one in *Sublime Symmetry Tour*§ organised by The De Morgan Foundation¶.

I use this opportunity to bring *Sublime Symmetry Tour* to the attention of the British mathematics community, and list Tour venues:

- 06 March to 05 June 2016 at Towneley Hall, Burnley
- 11 June to 04 September 2016 at Cannon Hall, Barnsley
- 10 September to 04 December 2016 at Torre Abbey, Torbay
- 10 December 2016 to 04 March 2017 at the New Walk Gallery, Leicester
- 12 March to 03 September 2017 at the William Morris Gallery, Walthamstow

My talk at the event was improvised; I wrote it down next day and took the liberty to add some relevant illustrations.

My talk

*Opening statement.* Thank you to everyone who was involved in, or contributed to, setting up this magnificent exhibition. My special thanks go to Sarah Hardy, the Exhibition Curator, for an informative, analytic, and deep chapter in the Exhibition Catalogue. Her work is a proof that curating is an art form on its own.

I also wish to say cordial thanks to Sarah Hardy and Claire Longworth form the De Morgan Foundation who came up with a wonderful title for the Exhibition: *Sublime Symmetry*. It is a mathematical message: frequently the symmetry properties of an object, structure, or artefact, are not immediately obvious – but affect their deeper meaning and intrinsic value.

It is a privilege for me to represent the London Mathematical Society∥ at this

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event. Last year, the Society celebrated its 150th Anniversary; it was founded in 1865 by Augustus De Morgan, father of William De Morgan.

Augustus De Morgan obviously influenced his son’s world view, mathematical in its nature. This is why I will try to to explain the roles of symmetry in mathematics and in the Art – as we understand them now.

The most basic rule for public talks about mathematics is be brief. I promise to stick to it and never mention a single mathematical formula.

Symmetry in mathematics. Mathematics is the art of precision; it deals with mental constructions and procedures which can be reproduced with arbitrary (you may wish to say, absolute) precision. A theorem proved by Euclid (and William De Morgan was an admirer of Euclid) is just as true and valid now, two millennia after Euclid’s time. Transfer of mathematical knowledge from generation to generation has never resulted in schisms of the kind that triggered one religious war after another – and these wars continue to burn right now, as we speak here.

I’ll show you now a simple example of high precision reproduction of a mathematical object. As you see, I hold two paper napkins, and I’ll fold them for you in two different ways.†

I fold the first napkin that way‡:

As you can see, in the both napkins the point $O$, where the two creases intersect, is the same point, the centre of the square. And this is a mathematical fact: it was true 2,000 years ago, and it is true now. Please notice also that the resulting patterns of creases are very symmetric – moreover, they have well established symbolic meanings: for example, in the second napkin it is the distinctive St. Andrew’s cross.

And now I can formulate the main thesis of my talk:

1 I have actually showed this simple experiment to the audience, using two paper napkins borrowed from the table with delicious homemade cookies provided by Towneley Hall Society, http://towneleyhallsociety.co.uk/, volunteers for this particular occasion.

Symmetry of an object is a proof of precision of the process that led to its creation.

This is almost a banality; but this is a really important role of what I call “static” symmetry: it acts as a certificate of precisions of reproduction. We shall soon see that this principle equally applies in Mathematics, in Nature, and in Art.

But mathematics also has the concept of symmetry as a dynamic process: symmetry is a reversible transformation of objects and structures which preserve some of their properties. The word “reversible” is important here; it means that we can always check and correct the result of transformation.

Instead of further examples and explanations, I offer you a classical conundrum which deceptively appear to capture the essence of the problem but instead demonstrates that, frequently, symmetry is not what it appears to be:

Why does the mirror change left and right but does not change up and down?

Figure 1. Peacock Dish. William De Morgan. The De Morgan Foundation, used with permission.

Symmetry in Nature – and in Art. Let us have a look at one of the most elaborate objects of beauty in Nature: a peacock’s tail. It has attracted the attention of artists over millennia, and was not left unnoticed by William De Morgan, see Figure 1.

The wonderful ornament of a peacock’s tail makes sense only if it is appreciated by peahens. What kind of message does it send to a peahen? That a high precision,
high symmetry ornament of a feather (the famous “eye”) formed by thousands of individually colored hairs independently growing from the feather’s stem (see Figures 2 and 3) could be produced only by an exceptionally fine tuned copying mechanism. And this mechanism is encoded in peacock’s genes. Hence a peacock with an elaborate tail can be a good biological father of peahen’s chicks – her own genes will benefit from high precision copying.

**Figure 2. Close up of a peacock feather. Wikimedia Commons. Public domain.**

Why are peacocks’ tails attractive to humans? Because in humans as a species, biological beauty is a marker for healthy genes. A beautiful face is, first of all, a bilaterally symmetric face. A beautiful body is, first of all, a bilaterally symmetric body. And, not surprisingly, beauty as a biological stimulus is the basis of visual arts, bringing with it artists’ and spectators’ attention to (and maybe even obsession with) symmetry.

*Two archetypes.* And now I would like to mention two archetypal Greek myths which involve mirrors and reflections – that is, symmetry.

*Perseus and Medusa.* In the briefest possible retelling of a Greek myth, Medusa had poisonous snakes on her head and a petrifying gaze which turned into stones people who dared to look into her face. When Perseus was given an order to kill her, Athena provided the hero with a polished bronze shield which could be used as a mirror. Using it, Perseus killed Medusa by beheading her – and without looking at her directly, Figure 4. He successfully used the severed head as a weapon: the horrible gaze remained lethal.
De Morgan’s contemporary, the Pre-Raphaelite artist Edward Burne-Jones, gave a more delicate treatment to the same theme: in his painting *The Baleful Head*, Perseus shows the reflection of Medusas’ head – not the head itself – to his beloved Andromeda, Figure 5.

The mirror reflected Medusa’s shape and position, thus helping Perseus to aim his sword, but did not reflect the paralising horror that she irradiated. Perhaps, water in the well is seen as even better protection. Compare that with astronomy: it is dangerous to look directly at the Sun, but a simple pinhole projection of the Sun
onto a wall in a dark room (and projection is a form of symmetry) allows one to see sunspots in complete safety.†

This is similar to the use of symmetry characteristic for mathematics: the instrumental use, use as a tool, as a weapon, as a filter for properties which we wish to preserve in the image, while changing the others.

Narcissus. This one is a very different story – Narcissus (allegedly, as a punishment from the gods) fell in love with his reflection in the lake, Figure 6.

†See, for example, Pinhole Astrophotography, http://users.erols.com/njastro/barry/pages/pinhole.htm, and do not miss a striking observation: “the large sunspots, as well as those of moderate size, could easily have been viewed using pinhole projection by some ancient observers had they been so inclined.”
And this is the use of symmetry typical for art, and it transcends decorative art: *the mirror can reflect the soul.*

Even in the decorative art, *symmetry can be a medium for emotions,* and the latter is fairly obvious in works by William De Morgan.

**Conclusion.** Summarising the myths and the stories, I can claim that *Symmetry in art is the human face of mathematics.*

William De Morgan’s art shows that mathematics is human. From the bottom of my heart – thanks to everyone who helps to spread this message.

Thank you.

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The De Morgan Foundation kindly allowed me to use the image of *Peacock Dish* by William De Morgan, Figure 1, and provided a high resolution image file.

**Disclaimer**

The author writes in his personal capacity; his views do not necessarily represent the position of his employer or any other person, corporation, organisation or institution.

**About the Author**

I am a mathematician. I study symmetries (and have even co-authored a textbook *Mirrors and Reflections*†). More precisely, I study multi-mirror reflections, where mirrors get reflected in other mirrors, and reflections breed and multiply all over the place. I design mathematical methods for finding safe paths in the maze of mirrors, and for telling real objects from sneering phantoms.

If you expect to get involved in a shoot-out in a Hall of Mirrors (like the one in the famous scene from *The Lady from Shanghai*‡), I am happy to provide some advice.

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‡*The Lady from Shanghai*, Orson Welles, 1947. See a YouTube clip of the Hall of Mirrors sequence at [https://www.youtube.com/watch?v=_RdPVtcDeEI](https://www.youtube.com/watch?v=_RdPVtcDeEI).