Beauty, Symmetry & Heart

by **Marcio Luis Ferreira Nascimento**

In this article I present a simple definition of mathematics, from a non-specialist, based on beauty and aesthetics. It is certainly not new, but rewritten and based on the platonic concept of *idea*, that has Pythagorean origins. The beauty is exemplified in terms of symmetry, more precisely by means of *ambigrams*, the *Rorschach inkblot test* and poetry. However, even considering all the elements of poetry, one cannot explain why some songs we like a lot and why it is possible to know all the words by heart. Part of the answer was quoted by Pascal in one of his *Pensées*.

From the author's point of view, one of the best definitions of mathematics was proposed not by a mathematician, but by a Brazilian painter: Wesley Duke Lee (1931–2010). His explanation, for a Brazilian TV series on Art & Mathematics, was simple and direct: "Mathematics is a knowledge that has a certain kind of *beauty*. A beauty different for example from music or painting. Different but equally *enjoyable*. The beauty of mathematics is in the *aesthetics of reasoning*" (Barco and Nascimento, 2001; Nascimento and Barco, 2010).

It is simply curious that one of the first men to discuss the aesthetics of beauty, according to historical literature, was the Greek philosopher and logician-mathematician Plato (*c*.428–348 BCE), disciple of Socrates (*c*.470–399 BCE), also a philosopher and mathematician, who was himself influenced by the ideas of Pythagoras of Samos (*c*.569–475 BCE). The Pythagoreans conceived the occurrence of beauty in universal terms, as the observed splendour in the geometric forms of nature on Earth or even in the Heavens. In fact, they observed a clear connection between beauty and mathematics, for example when discussing the nature of the numbers, or the occurrence of the golden number in many places, or even curious numerical relationships in musical notes. Plato defined beauty in his masterpiece *Phædo* (also known as "*On The Soul*") (Plato, 2008) as one evidence of *forms* or *ideas*.

The Brazilian mathematician, logician and philosopher Newton Carneiro Affonso da Costa (*b*. 1929) assumed: "It can be said that the intuition of a mathematician approaches the *female* intuition, noting differences that only women can observe. A mathematician sees the world beyond appearances, beyond the immediate forms. That's how he (or she) makes great discoveries" (Barco and Nascimento, 2001)

In fact, symmetry in everyday language refers to a sense of beautiful, balanced and harmonious proportions, but has a more precise definition in mathematics: what one can do on object is often invariant to some few transformations, these are: *rotation*, *reflection*, *translation* or *scaling*. Ancient Greeks defined symmetry as a *harmony of proportions*.

The German mathematician Hermann Klaus Hugo Weyl (1885–1955) wrote a popular book on symmetry (Weyl, 1952). Following his ideas, the American physicist Richard Philips Feynman (1918–1988, Nobel Prize in Physics in 1965) defined: "a thing is symmetrical if one can subject it to a certain operation and it appears exactly the same after the operation" (Feynman *et al.*, 1965). There are other interesting quotes such as those of the English mathematician Ian Nicholas Stewart (*b*. 1945) (Stewart, 2008), and Mario Livio (*b*. 1945) (Livio, 2006), an Israeli astrophysicist.

To illustrate these ideas, *ambigrams* are very interesting examples of symmetric elements, because it is possible to represent a word, an art form or other symbolic representation whose elements retain meaning when interpreted or viewed from a different perspective, orientation or direction. Figures 1 and 2 present some illustrations.

Curiously, to better understand a person's personality characteristics as well as emotional functioning, there is

ARE THERE OTHERS?

As you will notice, the slang word "chump," if written in the manner here shown, reads the same even when held upside down. I think it is the only word in the English language which has this peculiarity, and therefore hope you will consider it worthy of insertion in your "Curiosities" column.— Mr. Mitchell T. Lavin, 931, West Ninth Street, Cincinnati, Ohio, U.S.A.

Fig. 1   Early published ambigram by Mitchell T. Lavin in *The Strand* magazine, June 1908 (in public domain: **https://commons.wikimedia.org/wiki/File:TheStrand-chump-ambigram-june-1908.gif**)

a famous examination, the *Rorschach inkblot test*, created by the Swiss psychiatrist Hermann Rorschach (1884–1922). This exam has a striking characteristic: that is *completely* based on symmetric images (Fig. 3).

Fig. 2 The ABBA logo, from the famous Swedish pop music group from the 1970s (in public domain: **https://commons. wikimedia.org/wiki/File:Abba_logo.jpg**)
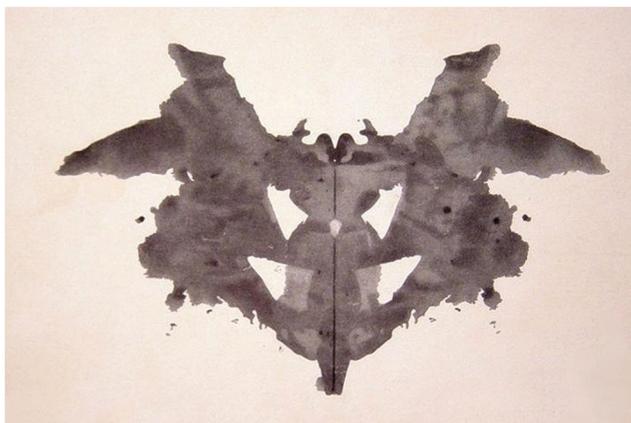

Fig. 3 The first of the Rorschach inkblot tests, around 1921

Finally one must note that the search for a soul's conditions of human hearts also follows platonic ideas…

Certainly, anyone can *hear* symmetry! By example, the elements of poetry such as *rhythm*, *rhyme* and *imagery* can explain why some texts and songs reach most of us. However, there are still mysteries; songs such as "Unchained Melody", by the American composers Alex North (1910–1991) and Hy Zaret (1907–2007) – a composition created in 1955 – reaches the hearts and souls of many still today (Fig. 4). In fact, it has since become one of the most recorded songs of the 20th century, most notably by *The Righteous Brothers* in 1965.

Surely, composers and poets seek the best rhymes and rhythms for all their lyrics and poems. But this cannot explain why some songs we like a lot and know all of them by heart. Some clue was written by the French mathematician, physicist, philosopher, inventor and writer Blaise Pascal (1623–1662): "*le cœur a ses raisons, que la raison ne connaît point*" (or "the heart has its reasons of which reason knows nothing"), a quote from his posthumous masterpiece *Pensées* (or "Thoughts"), in 1669.

Thus, following this particular quote, the best explanation why songs like "Unchained Melody" still remain a great success around the world could be: there are some hidden symmetries understood only by heart!!
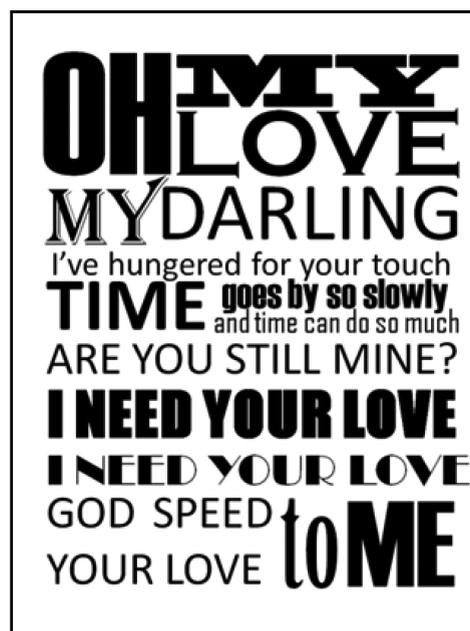

Fig. 4 "Unchained Melody" lyrics

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Author Marcio Luis Ferreira Nascimento, Department of Chemical Engineering, Polytechnic School, Federal University of Bahia, Rua Aristides Novis 2, Federação, 40210-630 Salvador, BA, Brazil; and Institute of Humanities, Arts and Sciences, Federal University of Bahia, Rua Barão de Jeremoabo s/n, Idioms Center Pavilion (PAF IV), Ondina University Campus, 40170–115 Salvador, BA, Brazil.
e-mail: **mlfn@ufba.br**