Fractals and chaos – further examples

David Walker (*Micscape Lite* note: First published in *Philamath*, Vol. XXXIX, No. 4, 2018. The journal of the Mathematical Study Unit, sadly now disbanded.)

Philately related items on the theme of fractals and the mathematicians associated with them e.g. Cantor, Mandelbrot and Sierpiński have been reported regularly in previous issues.

Three stamps reported showing fractals are issues from Hungary 1996 (3D Sierpiński triangle), Israel 1997 (Mandelbrot set) and Italy 2000 (Julia set) [1 - 3].

A website www.computer-stamps.com by Vito Galgano has catalogued further examples issued to date [4] and my own examples are described and illustrated below in chronological order of issue.

Finland in 2000 issued a miniature sheet and accompanying first day cover that has multiple elements of mathematical interest including fractals (Figures 1 - 3). The sheet is illustrated and themes described in Bjelkhagen's splendid book 'Holography and Philately' [5]. He notes that it is named the 'Mathematical Thinking Science Sheet' with the Heureka Science Center shown. The sheet and postmark takes the form of the ancient Chinese tangram puzzle and includes a stamp with a parallelogram shape. The square stamp features a Sierpiński triangle, a theme continued on the cover. The perforated triangle in the sheet is not a formal stamp but shows a striking form of this fractal as a hologram. This form is often called the Sierpiński gasket as holes are 'punched' into a solid rather than an open triangle repeating element (the first hole shown as dark blue in the hologram).

Sweden's Christmas stamps for 2000 included two featuring a von Koch snowflake with the designs credited to A. Kornestedt (Figures 4 - 5). The first day cover shown continued the theme on a cachet to show early iterations of the snowflake fractal and a snowflake postmark.

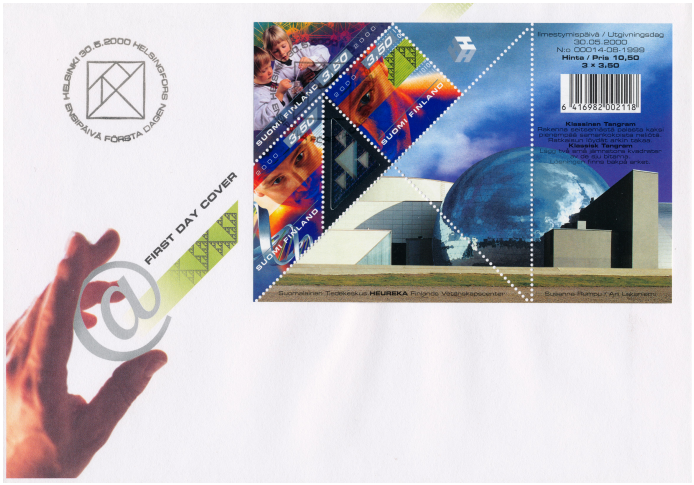

Figure 1. *Finland 2000*

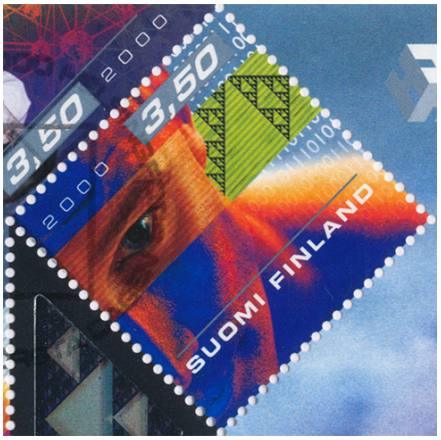

Figure 2. *Finland 2000 detail.*

Figure 3. *Finland 2000, hologram. Lit by a spotlight on vertical axis.*

Figure 4. *Sweden 2000 cover*

Figure 5. *Sweden 2000 stamps*

Spain in 2001 issued a stamp showing a part Mandelbrot set (Figure 6). The stamp theme was 'International campaign against family violence' but unclear why a fractal was chosen to illustrate it. Poland in 2001 issued a stamp on an Internet theme which showed a fractal background (Figure 7).

Figure 6. *Spain 2001*

Figure 7. *Poland 2001*

Macau in 2005 issued two very attractive sheets on a 'Science and Technology - Chaos and Fractals' theme. Figure 8 shows the sheet featuring a detailed rendering of a Mandelbrot set and associated equation with the inset stamp showing a Julia set (Figure 9). The second sheet shows two examples each of six fractals with sheet background featuring themes of these fractals (Figure 10). The stamp designs are credited to 'Carlos Gonçalves des'.

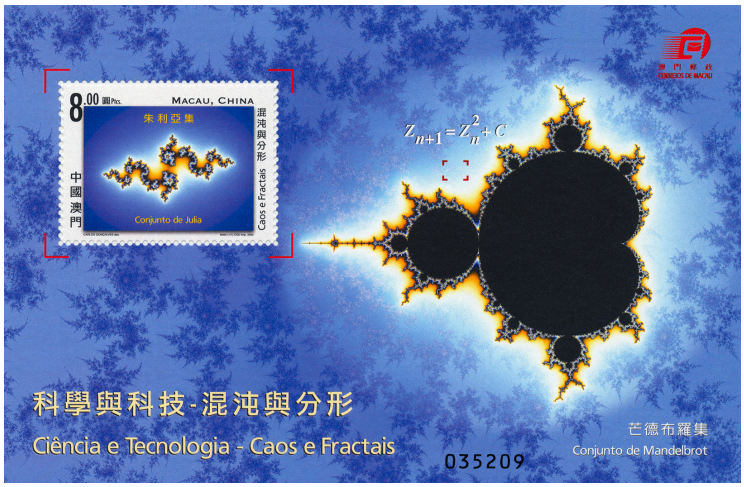

Figure 8. *Macau 2005*

Figure 9. *Macau 2005 inset stamp.*

The individual fractal stamps each show early iterations with associated background designs (Figure 11). The titles on each stamp are as follows (translation from the Portuguese).

The Hilbert Curve. This issue has been previously shared with an accompanying postmark in Dieter Egelriede's comprehensive article on David Hilbert [6].

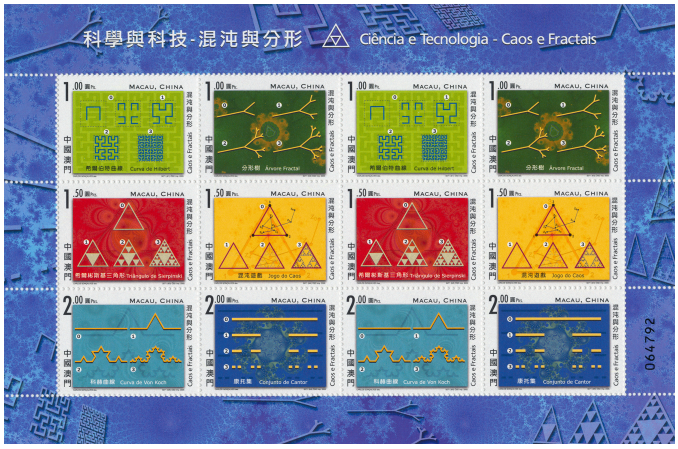

Figure 10. *Macau 2005*

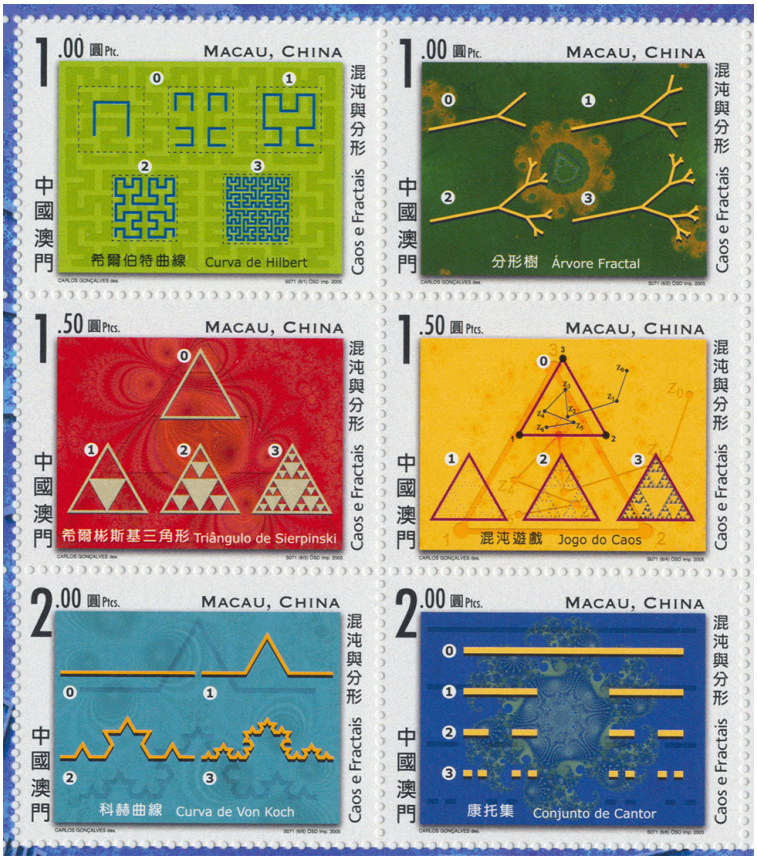

Figure 11. *Macau 2005 detail.*

Tree Fractal. One of the particular appeals of fractals to a wide audience is how some types by iteration of simple fractal elements can generate very lifelike natural forms including landscapes and plants, notably the Barnsley fern.

Sierpiński triangle. This is the gasket form as the initial element uses a solid rather than an open triangle.

Chaos game. Illustrates the construction of a Sierpiński triangle using this method [7]. The first few iterations of the sequence of points are plotted (Figure 12).

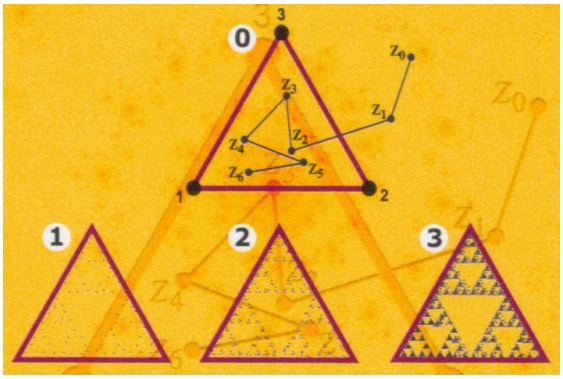

Figure 12. *Macau 2005, 'Chaos game' stamp detail.*

von Koch curve. The hexagonal form features as the Koch snowflake shown in the Swedish issue (Figure 4).

Cantor set. With an attractive background fractal. The multi-dimensional variant is often known as Cantor dust.

In 2005 Palau issued a sheet celebrating 'Nature's Wisdom', the theme of the World's Fair at EXP 2005, Aichi, Japan. 'The Cosmos' was represented by detail of a Mandelbrot set (Figures 13 and 14).

Figure 13. *Palau 2005*

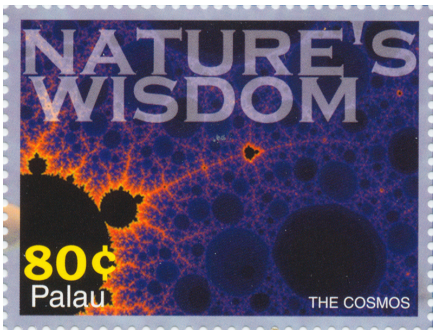

Figure 14. *Palau 2005 inset stamp.*

In 2008 the Republic of Guinea issued a sheet celebrating the work of Edward Lorenz on the year of his death (Figure 15). The American mathematician and meteorologist is noted as a pioneer of chaos theory. The background design features a Lorenz attractor (top right) which Wikipedia notes 'is a set of chaotic solutions of the Lorenz system which, when plotted, resemble a butterfly or figure eight' [8].

Figure 15. *Republic of Guinea 2008.*

The inset stamp (design credited to P. Puvilland) shows his portrait with a butterfly representing the so-called 'butterfly effect'. This now well known and widely used term he coined to illustrate how the tiniest changes in starting conditions can have a diverging effect on the outcome of a process. He identified this phenomena in early computer modelling of weather patterns.

The sheet's background design elements of the satellite for a 'Tropical Rainfall Measuring Mission' and satellite image pick up on this theme. A biography of Lorenz is included in French which notes his seminal paper of 1963 and mentions Henri Poincaré who was an early proponent of chaos theory.

The public interest in chaos theory / fractals and visual appeal of associated imagery was such by 1990 that it inspired Gregory Sams to open a shop devoted to marketing products on the theme: 'Strange Attractions' advertised as 'the world's only chaos shop' opened in London [9]. I still have the catalogue which included books, software, posters, jigsaws, postcards, clothing and mugs. The advertising rubber stamp imprint on the envelope is shown in Figure 16.

Figure 16. *1992 'Strange Attractions' shop catalogue envelope.*

Acknowledgements:

I'm indebted to Vito Galgano for his careful cataloging of 'Fractal postage stamps' on his website [4] from which all the above stamps were identified and my own examples obtained.

References:

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[2] Cardoto, Nuno Gaspar. 'From the Collections of', Philamath, Vol. XXI, No. 1, July 1999, 33.

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http://www.computer-stamps.com/category/15/fractal/

[5] Bjelkhagen Hans I., 'Holography and Philately: Postage Stamps with Holograms', Hansholo Consulting Ltd, 2017, 2nd edition.

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[7] 'Chaos game' Wikipedia entry accessed Nov. 25th 2017.

https://en.wikipedia.org/wiki/Chaos_game

[8] 'Lorenz system' Wikipedia entry accessed Nov. 24th 2017.

https://en.wikipedia.org/wiki/Lorenz_system

[9] Sams, Gregory, 'Strange Attractions. Having designs on a natural new order' - provides an illustrated retrospective of the former shop on his website accessed Oct. 12th 2017.

http://www.gregorysams.com/strange-attractions.html

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