

Science and Technology – Magic Squares I

Introductory Note: A more detailed explanation about the characteristics and definitions of some technical terms of **Magic Squares** can be obtained from Macao Post's website <http://goo.gl/IOHEqo>.

The interest in *Magic Square* is transversal in Chinese and Western culture. The importance of this theme in Chinese culture can be traced back to ancient times of its history which is shown by the myths illustrated in the **Souvenir Sheet** of this issue.

Magic Squares are the theme dedicated for this 6th issue of the **Science and Technology Series**, aiming not only to promote its scientific and cultural aspects, but to create also a unique product in the history of Philately.

Souvenir Sheet: Luo Shu Magic Square

The history of Chinese civilization is full of myths, legends and folk based on fabulous beings. Among these, **Divine Emperor Fu Xi** and **Sage King Yu**, were, respectively, witnesses of the visits of two mythical creatures: a “**Dragon-Horse**” and a “**Turtle**” showing different **Dot Patterns** on their backs.

Divine Emperor Fu Xi saw a “*Dragon-Horse*” creature emerging from **Yellow River** with a **Diagram** on its back, composed of **55 Dots**, in five sets. Before submerging, it also left its **foot print** with **8 Patterns** composed of **Line Segments**. The *Diagram* became known as **He Tu** or **River Map** and the *foot print* as **Pa Kua** or **Eight Trigrams**, which gave origin to the **Yi Jing 64 Hexagrams**.

Sage King Yu also witnessed a “*Turtle*” emerging from the **Luo River**, a tributary of *Yellow River*, with a **Quadrangular Diagram** on its shell made of 9 small quadrangular contours with a series of dots inside each one, representing numbers from 1 to 9 and each **Row**, **Column** and **Main Diagonal** of the *Diagram* contained **15 Dots**. The *Quadrangular Diagram* became known as **Luo Shu** or **Luo River Scroll**.

The *He Tu* (*River Map*) and *Luo Shu* (*Luo River Scroll*) are fundamental fabrics in the development of traditional Chinese culture extending its influence to religion, sociology, politics, philosophy, mathematics, medicine, civil engineering, etc.

Sheetlet

The **Sheetlet** presents a disposition for the facial values (1 to 9 “patacas”) equal to the disposition that the numbers 1 to 9 occupy in the **Luo Shu Magic Square**.

In this issue only 6 stamps are issued, corresponding to the first two *Rows*, with the third *Row* (presently without the corresponding 3 stamps) to be issued in the future.

First Day Cover: John R. Hendricks – Inlaid Magic Squares

An **Inlaid Magic Square** is a *Magic Square* that contains within itself other **Lower Order Magic Squares**. The *Lower Inlaid Magic Squares* can be formed by any number inside (unlike a **Bordered Magic Square**, where the border must contain the lowest and the highest numbers in the series). They can also contain other *Inlaid Magic Squares* within themselves.

The First Day Cover shows an **Inlaid Magic Square of Order 9** with three *Inlaid Magic Squares of Orders 7, 5 and 3*. Note that the *Inlaid Magic Square of Order 3* is rotated 45 degrees and is also referred as an **Inlaid Diamond Magic Square**.

The numbers used in the *Inlaid Magic Square of Order 9* are from 1 to 81, therefore it is a **Pure Magic Square**. The **Magic Sums** of the *Inlaid Magic Square of Order 9* and its *Lower Order Inlays* are: $S_9=369$, $S_7=287$, $S_5=205$ and $S_3=123$.

Stamp (6/3): Dürer – Melencolia I

Albrecht Dürer was born in 1471, in Nuremberg, Germany. He became famous as painter, engraver, printmaker, mathematician and academic, and is considered as the greatest Renaissance artist of Northern Europe.

With his talent and versatility, he exerted a strong influence on other artists and acquired a solid reputation that made him to be nominated as the court painter of Emperor Maximilian I. Among his famous works are the well known “master prints” (Meisterstiche) **The Knight, The Death and The Devil** (1513), **Saint Jerome In His Study** and **Melencolia I** (1514).

Melencolia I is an engraving that includes in the upper right corner, under the bell, a **Normal Associated Magic Square of Doubly-Order** with extraordinary mathematical properties. The *Magic Sum* is 34 and the two middle **Cells** of the bottom *Row* show the date of the engraving, 1514.

Stamp (6/6): La Loubère or Siamese Construction Method

There are several general methodologies to construct *Magic Squares* depending on the **Class** and **Order**.

Several methods for constructing Magic Squares have been created namely the following: **La Loubère** or **Siamese** – **Bachet de Méziriac** – **Philippe de la Hire** – **John Lee Fults** – **Ralph Strachey** – **Knight’s Move** – **Dürer**, etc.

La Loubère methodology was created by **Simon de la Loubère** (1693), a French mathematician that learned it as ambassador to Siam, reason why it is also known by *Siamese*.

La Loubère method is one of the most popular to create *Magic Squares of Odd Order*. The main characteristic of this method consists in filling the *Cells* of the *Diagonals* in numeric sequential order and moving upward and to the right.

Stamp (6/1): Sator – Palindrome

The **Sator Square** or **Rotas Square** is **Magic Words Square** that is composed of a **Latin**

Palindrome with the five words – **SATOR, AREPO, TENET, OPERA** and **ROTAS** – that can be read forwards, backwards, upwards and downwards.

The oldest inscription of this *Palindrome* was found in the ruins of Pompeii, which was destroyed in 79 A.D. by Vesuvius eruption of lava and ashes. Among other places, there is also a *Sator Square* in the museum at Conimbriga (near Coimbra in Portugal).

The correct translation and its meaning have been under dispute and speculation until the present. A word by word translation can be as follows:

Sator – Sower, seeder, planter, founder, progenitor, originator; *Arepo* – Without a clear meaning, probably a proper name (Arepo); *Tenet* – To hold, to keep, to possess, to master; *Opera* – Work, care, aid, effort, service; *Rotas* – Wheel, rotate.

As a sentence, dozens of translations were proposed, e.g., “**The sower Arepo holds the wheels with effort**” or “**The Creator (or Savior) holds the working of the spheres in his hands**”.

Some investigators have also speculated that if the five words are properly rearranged, a **Greek Cross** can be made, that reads horizontally and vertically **PATERNOSTER**, with the remaining letters **A,A** and **O,O** distributed by each of the 4 quadrants. This translates “**OUR FATHER, OUR FATHER**” with the letter *A* and *O* representing the **Alpha** and **Omega** – the **Beginning** and the **End**.

Stamp (6/2): Franklin – Bent Diagonals

Benjamin Franklin was born in Boston, Massachusetts, 17th January, 1706 and was one of the most influential “**Founding Fathers**” of the United States, earning the title of “**The First American**” for his fight for independence. He was a polymath, author, politician, scientist, inventor, musician, social activist, postmaster general, statesman and diplomat.

Being a man with a strong character and clear ethical values, he established for himself **13 virtues** that served as his guide during his life.

In addition to the numerous achievements, *Benjamin Franklin* also left his name associated to the “*Magic Squares*”. The “*Magic Square*” of *Benjamin Franklin* represented in the stamp shows the same sum for the *Rows* and *Columns* but not for the *Main Diagonals*, i.e., it is only a *Semi Magic Square*. However, it possesses other magic properties as those associated with **Bent Diagonals** either **Continuous** or **Wrap-Around** with sum 260.

In the stamp, several **Bent-Up-Rows Diagonals** can be seen in different colours, including **Bent Wrap-Around Diagonals**.

Stamp (6/4): Su Hui – Xuan Ji Tu – Palindrome

Su Hui (351 A.D. - ?) was a Chinese poetess that lived in **Former Qin** of the **Sixteen Kingdoms** period. She married Dou Tao, a government official who was sent later to defend the northern borders. Far away from her husband, she found out that he had taken a concubine. To console her unhappiness and try to bring him back she composed her **palindrome poem, Xuan Ji**

Tu, an array of 29 *Lines* x 29 *Columns*, with **841 characters**, that can be read at least in **2,848 different ways**, namely, forward, backward, horizontally, vertically and diagonally. After reading the poem, Dou Tao left his concubine and return to *Su Hui*.

This stamp is a square only with 15 *Lines* x 15 *Columns* extracted from the central part of the *Lines* and *Columns* that constitutes the full poem *Xuan Ji Tu*.

Su Hui used a lot of **Rhyme Characters** which are ingeniously arranged in the *Xuan Ji Tu*, and because of this arrangement, even when we start from different character and read in different ways, we still can extract a meaningful poem.

Stamp (6/5): Lee Sallows – Panmagic 3x3

Born in England in 1944, **Lee Sallows** moved to Nijmegen in the Netherlands in 1970 where he was employed by the Radboud University as an electronics engineer, until his retirement in 2009.

After developing an interest in recreational mathematics, he became an expert on the theory of *Magic Squares*, a topic to which he contributed several new variations, most notably **Alphamagic** and **Geomagic Squares**. *Sallows* has an Erdős number of 2.

Having become strangely attracted to a **formula** due to **Édouard Lucas** that characterizes the structure of every 3×3 *Magic Square* (among them the *Luo Shu*), *Sallows* speculated that it might contain hidden potential.

This speculation was confirmed in 1977 when he published a paper that correlated every *Magic Square* of *Order 3* with a unique parallelogram on the complex plane. In an improbable move, he then tried substituting the variables in the *Lucas formula* with **geometrical forms**, an eccentric notion that led immediately to the invention of **Geomagic Squares**. It turned out to be an unexpected consequence of this find that traditional *Magic Squares* using numbers were now revealed as **One-dimensional Geomagic Squares (1-D)**.

The stamp is a **Pandiagonal** or **Nasik 2-D Magic Square of Order 3**, or one in which, in addition to *Rows* and *Columns*, all six *Diagonals* are *Magic*, including the 4 so-called **Broken Diagonals**.

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