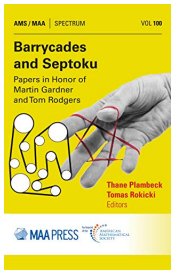
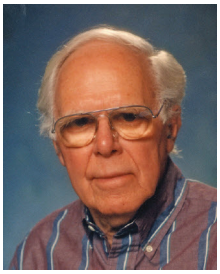
Barrycades and Septoku by *Thane Plambeck, Tomas Rokicki, (eds.)*, MAA/AMS, 2020 (xvi+217 p.), isbn: 9781470448707. Spectrum series vol. 100





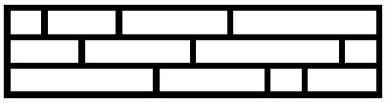
Martin Gardner



Tom Rodgers

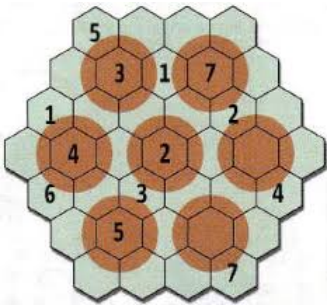
Martin Gardner (1914-2010) raised a whole generation of people interested in recreational mathematics, and puzzles, games and magic with a mathematiccal twist. It was an idea of Tom Rodgers (1945-2012) to bring the enthusiasts for these topics together in what became known as *Gatherings for Gardner* (G4G). The first G4G (G4G1) was held in 1993 and is organized since 1996 every 2 years. Tom Rodgers also came up with the idea of setting up every year local meetings worldwide, called *Celebration of Mind*, around Gardner's birthday.

In this book the editors have collected a number of papers that were contributed to G4Gn with $n \leq 11$ (that's up to 2014) and that are collected here in honor of Martin Gardner and Tom Rodgers, in particular of the latter. So it starts with a few 'remembrances' by people who have known Tom Rogers. The bulk of the book consists of papers in the style of other books that published some kind of proceedings of the G4G meetings that appeared on an irregular basis. Some of them were reviewed earlier in this Newsletter (issue 52, March 2005, issue 99, September 2014). The papers range over all the subjects of interest to the G4G lovers, whether they attended or not. There are 6 parts each with two or more papers by well known people in the field like N. Sloane, R. Guy, S. Golomb, T. Rokicki, B. Cipra, G. Bell, G. Hart, and E. and M. Demaine.



Barrycade for $n = 4$

Part 1 treats sequences, tilings and packings. The latter involve polyomino-based puzzles. N. Sloane presents some weird sequences from his *Online Encyclopedia of Integer Sequences* (OEIS) and R. Guy discusses the *Barrycades* of the title. It corresponds to arrange the integers from 1 to n in different permutations such that their partial sums generate all the numbers from 1 to $n(n+1)/2 - 1$ just once. For example $(1, 2, 3, 4)$ gives sums $1, 3, 6, [10]$, while $(2, 3, 4, 1)$ gives $2, 5, 9, [10]$ and $(4, 3, 1, 2)$ gives $4, 7, 8, [10]$. So these 3 permutations give all natural numbers less than the total sum 10 exactly once. Visually this is represented using bricks of length 1,2,3,4. When put in natural order give layer 1, using the second and third order gives layers 2 and 3, resulting is a rectangular brick wall, a barrycade, referring to Barry Cipra who started the problem. Of course many mathematical questions can be asked when this is generalized to numbers $1, 2, \ldots, n$ with $n > 4$, or if the bricks are placed in a circle, forming a corral.



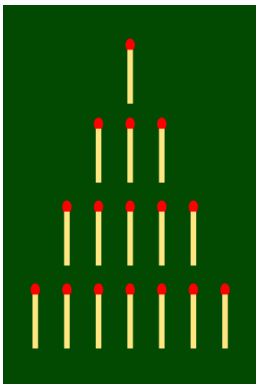
Credit: Wikipedia

Septoku

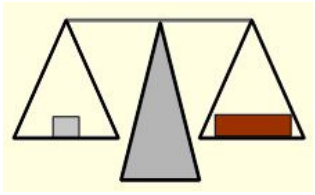
Part 2 has the general title 'Fun and games'. It starts with two papers about combinatorial games, which includes chess problems. The first is a tribute to John Horton Conway (1937-2020) who succumbed to covid-19 in April 2020. Another one introduces the other term of the book's title: Septoku. A septoku is sudoku-like problem, but instead of a square 3×3 grid of cells, with each cell consisting of 3×3 locations in which the numbers 1-9 have to be arranged and such that each column and row of the larger grid is a permutation of these 9 numbers. A septoku is played on an hexagonal grid. A cell consists of an hexagonal location surrounded by six other hexagonal locations. The whole grid consists of 7 such cells: one in the center and surrounded by six others which share with each of its neighbouring cells one hexagonal boundary location. The goal is to fill each hexagon with numbers 1-7 such that each cell, column, row and diagonal contain the 7 numbers exactly once.

In part 3, we find two history papers. One about the search of God's number during the last three decades. The paper is written by T. Rokicki who proved in 2010, together with his coworkers that God's number is 20. It is the minimal number of turns required to bring a Rubik's cube in its

starting position in the worst possible case. The other paper goes back to antiquity to look for the origins of Nim-like games. In those games, one has a number of piles (e.g. rows of matches). Each player can take away any number of matches (at least 1) from only one arbitrary pile. The looser (or winner) is the player who has to take (or can take) the last match.


Credit: Wikipedia

Part 4 has again a general title: 'Puzzles' and has 5 papers. I just mention 3 of them. Conway's *Game of Life* is played on a rectangular grid. Each cell can be alive or dead. There are few simple rules that define whether in the next step the status of a cell will change or not. That defines a cellular automaton, and the goal is to start from an initial situation that will generate certain patterns, like a group of alive cells flying off to infinity (in a spaceship). Here the problem is to play the game of *Retrolife*, that is, given a certain situation, find what could have been the previous status (with some restrictions). There is a coin weighting problem with n coins looking identical but with 3 different weights, and a balance which has one scale that can contain one coin, and another that can contain an arbitrary number of coins. The problem is to find out the weight category of each (or just one) coin in a minimal number of weighting instances. Here we find also a first rubber band puzzle. Take a rubber band and use your five fingers and wind the band around them such that it forms a pentagram. Do that with the other hand in your pocket!


Credit: Wikipedia

In the part on 'Art, sculpture, and design' we get two papers. George Hart is an artist who has produced a lot of geometric sculptures. Many are polyhedra-based sphere-like structures, formed by intertwining bands, which he calls orbs. You can admire them on his website. Here he describes the realization of *Comet!*, a work for the atrium of the Albion College in Albion Michigan. It consist of nine such orbs of different sizes hanging from the ceiling.

The last part has a paper about magic tricks. E.g. how the magician is predicting the permutation of coin flips that the public did outside the magician's view. Some coding theory can help to guess the most probably flips after a number of questions. There are several generalizations and different strategies to find the result.

We conclude that this is once more a collection of fun mathematics backed up with some true mathematics. Some of the games or puzzles are new, others are classic but generalizations are proposed or new mathematical questions are formulated and/or solved. Some of the mathematics is not so simple, but the book is still addressing a general public mainly interested in the result or the effect and perhaps less in the theory. Therefore the technical details are caught in other publications to which the authors refer. This is a true tribute to Martin Gardner and to Tom Rodgers.


Credit: George Hart

One orb of Comet!

Some other collections of G4G papers are

1. Elwyn R Berlekamp and Tom Rodgers (eds.). *The Mathematician and the Pied Puzzler*, A K Peters (1999)
2. David Wolfe, Tom Rodgers. *Puzzlers' tribute. A feast for the mind*, A K Peters (2002)
3. Barry Cipra, Erik Demaine, Martin Demaine, Tom Rodgers (eds.). *Tribute to a mathemagician*, A K Peters (2004)
4. Erik D. Demaine, Martin L. Demain, Tom Rodgers (eds.). *A lifetime of puzzles. Honoring Martin Gardner*, A K Peters/CRC (2009)
5. Ed Pegg Jr., Alan H. Schoen, Tom Rodgers (eds.). *Mathematical wizardry for a Gardner*, A K Peters/CRC (2009)

Adhemar Bultheel