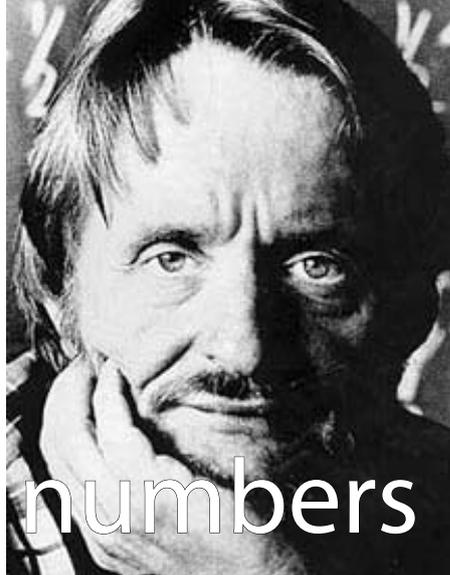# Games and surreal numbers

Princeton University Professor John Conway, a NZIMA visiting Maclaurin Fellow, spoke to a packed Auckland crowd about the Game of Life during his second visit in January 2007.

He developed the game with a group of graduate students in the late 1960s, in an attempt to create a simple mathematical model of the birth, life and death of an organism with as few rules as possible. They tried triangular and hexagonal lattices, rules that include two and even three sexes and used poker chips, coins and shells with reams of paper before they found a viable balance between life and death.

In the game, players create an initial configuration of live (black) and dead (white) cells on a square grid and watch how shapes evolve and replicate themselves.

When it was publicised in 1970 in Scientific American, the Game of Life instantly developed a cult following. Conway offered a $50 prize for the first person to generate a configuration that would repeatedly produce gliders - moving shapes - and it was won in a month. In the following two decades the game has supposedly consumed more computer time world-wide than any other single activity. It made Conway famous, especially among computer buffs, and it also opened up a new field of maths research called cellular automata.

Conway's fascination with games and puzzles has led him to important discoveries in areas of mathematics from number theory to geometry. His first serious mathematical success, the discovery of what are now called surreal numbers, came to him when he was analysing the game of Go.

He noticed that the end of a game appeared like the sum of a lot of smaller games, and that certain games behaved like numbers. This made him think of algebraic fields of real and infinite numbers as well as numbers between 0 and 1. These surreal numbers are written as {L|R}: the left set contains a set of numbers below the surreal number and the right contains a set above the number.

Surreal numbers are Conway's favourite among his many maths discoveries: "I felt like I was seeing an enormous new world, richly covered in structure, which no one had ever seen before. It gives you a tingly feeling; I walked around in a daydream for six weeks."

The breakthrough was followed by an intense week of writing. "I started typing about 8am and finished at midnight every day for a week with an hour off in the middle, and at the end of it I had a book, On Numbers and Games. It lay around for a couple of years until I wrote a

Jenny Rankine spoke with British mathematician John Conway.
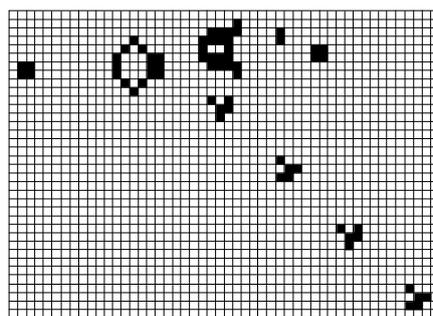
Top: A version of the Game of Life implemented in JavaScript. See http://bendiken.net/2006/02/26/game-of-life-in-javascript

Below: American mathematician Bill Gosper won Conway's reward for creating infinite patterns with this "gun" - the combination of shapes at the top - that creates "gliders", patterns move diagonally downwards across the board.

concluding chapter."

He had felt guilty whenever he studied some children's game instead of doing more serious work, but after real mathematical success came from playing with games he decided the guilt should stop. "And as soon as I stopped feeling guilty, I had this annus mirabilis in 1980 - all sorts of things came out."

Conway has broken new ground in number theory, geometry and sphere packing and discovered one of the so-called sporadic simple groups, now called the Conway group.

During his second New Zealand visit, he co-wrote what he calls "a fun paper" on counting groups of a given order using gnus, moas and other "fascinating functions" with University of Auckland maths professor Eamonn O'Brien and PhD student Heiko Deitrich.

He has also collaborated with the NZIMA co-director Marston Conder on what Conway calls the Monster group. "It's an amazing object in 196,884-dimensional space, like a Christmas tree ornament with approximately 1020 vertices. It can't be broken into combinations of smaller symmetries. I'd love to know why it exists before I die - but I probably won't."

Another highlight of his visit was seeing Comet McNaught from Mt Eden. "I'm keenly interested in amateur astronomy - I've seen half a dozen comets in my life and this was the best."

A stroke in late 2006 has slowed Conway only slightly - he now writes with his left hand. He's distressed that he can't do some of the tricks he used to illustrate points in his lectures, such as balancing a coin on a bent coat hanger.

Conway hopes to return in summer of 2009, escaping again from the sleet and slush of an east coast USA winter. They'll need a bigger lecture theatre.

See the Game of Life at http://en.wikipedia.org/wiki/Conway%27s_Game_of_Life

Workshop for women

A two-day workshop for women researchers in the mathematical sciences organised by the NZIMA in November attracted 35 doctoral students and early career researchers from around the country.

The workshop aimed to help women enter and build research careers, and provide opportunities for networking. Sessions covered the PhD years, promotion, work-life balance, mentoring, and cultural diversity. Di McCarthy, Chief Executive of the Royal Society of New Zealand, also spoke on the status of women in New Zealand universities.

Additional sponsorship was provided by the Kate Edger Educational and Charitable Trust.