O Frabjous Day!

150th Anniversary of *Alice's Adventures in Wonderland*

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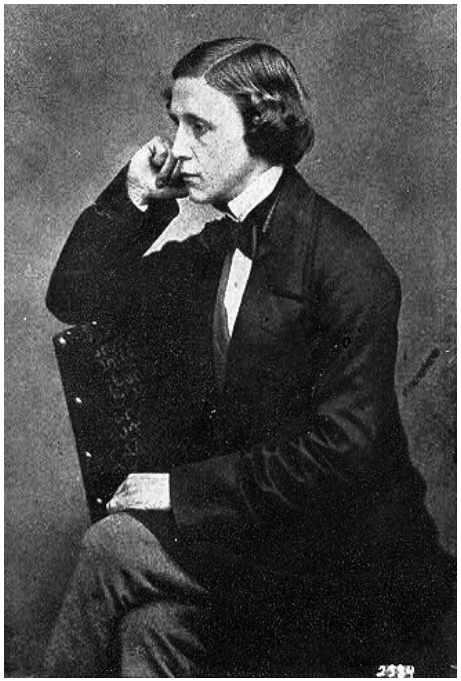
Charles Dodgson: 1832-1898



Dodgson the Mathematician

Mathematical Lecturer at Christ Church, University of Oxford, England

Areas of research: geometry, linear and matrix algebra, mathematical logic, probability

Big findings: First proof of Kronecker-Capelli Theorem (linear algebra, 1866), Dodgson's method (a voting system for candidates and committees, 1876), probability (*72 Pillow Problems*, 1893)

As a tutor and lecturer, he valued Euclid's *Elements* as the epitome of mathematical thinking – start with axioms and build up complex arguments through logical steps. Propositions are stated and proved (and signed QED)

In Dodgson's time: "new" mathematics started to appear – imaginary numbers ($\sqrt{-1} = i$) and abstract algebra

Mathematics & *Alice*

"Advice from a caterpillar"

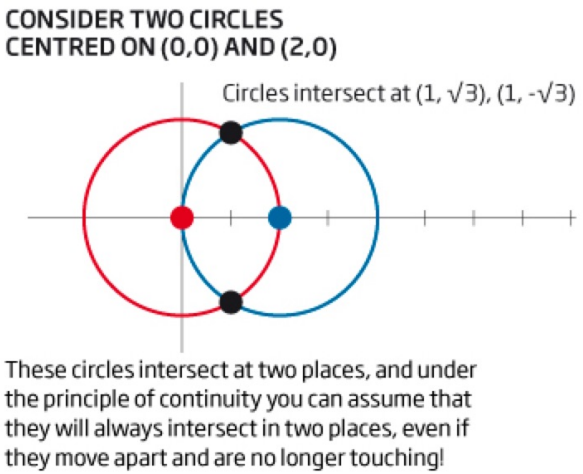
- absurdity of symbolic algebra?
- *Trigonometry and Double Algebra* – De Morgan, 1849
- Alice moves from a "rational" world to a land where numbers behave erratically (she forgets her multiplication tables)
- Alice is confused about her height fluctuations – perhaps bound by "conventional" math; The caterpillar's response: "It isn't" and "Keep your temper"

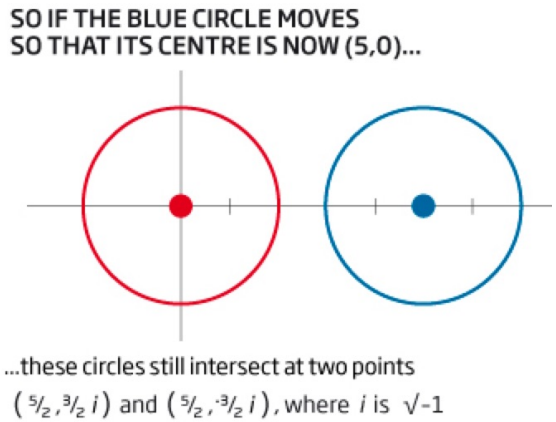
"Pig & Pepper"

Dodgson's target? Projective Geometry

- properties of figures that stay the same even when the figure is projected onto another surface
- Alice is her proper size and shape, shrinks herself down to enter a small house. The Duchess gives the baby to Alice, it turns into a pig

Jean-Victor Poncelet and the Continuity Principle – a mathematical figure should retain some of its original properties even under drastic transformations





The Tea Party

Dodgson's target? Irish mathematician William Rowan Hamilton and his work on quaternions

- A number system that extends the complex numbers (works with two terms: $a + bi$) to a number system based on four terms – one for each of the three-dimensions and a fourth for time
- The Hatter, the March Hare and the Dormouse are the three guests. Missing? The character Time!
- The guests are constantly moving around the table – this is based on Hamilton's early attempts to calculate motion
- Hamilton: in realm of pure time, cause and effect are no longer linked – nonsensical riddles like "Why is a raven like a writing desk?"
- The multiplication of quarternions are noncommutative ($a \times b \neq b \times a$) – "Say what she means" does not mean "At least what I say" – might as well say "I see what I eat" is the same as "I eat what I see"

Sources

Melanie Bayley (2009). "Alice's adventures in algebra: Wonderland solved", *New Scientist*, 16 December 2009, https://www.newscientist.com/article/mg20427391.600-alices-adventures-in-algebra-wonderland-solved

Eugene Seneta (1984). "Lewis Carroll as a Probabilist and Mathematician," *Math. Scientist*, 9, 79-94.

Robin Wilson (2008). *Lewis Carroll in Numberland: His Fantastical Mathematical Logical Life*, Allen Lane, London.