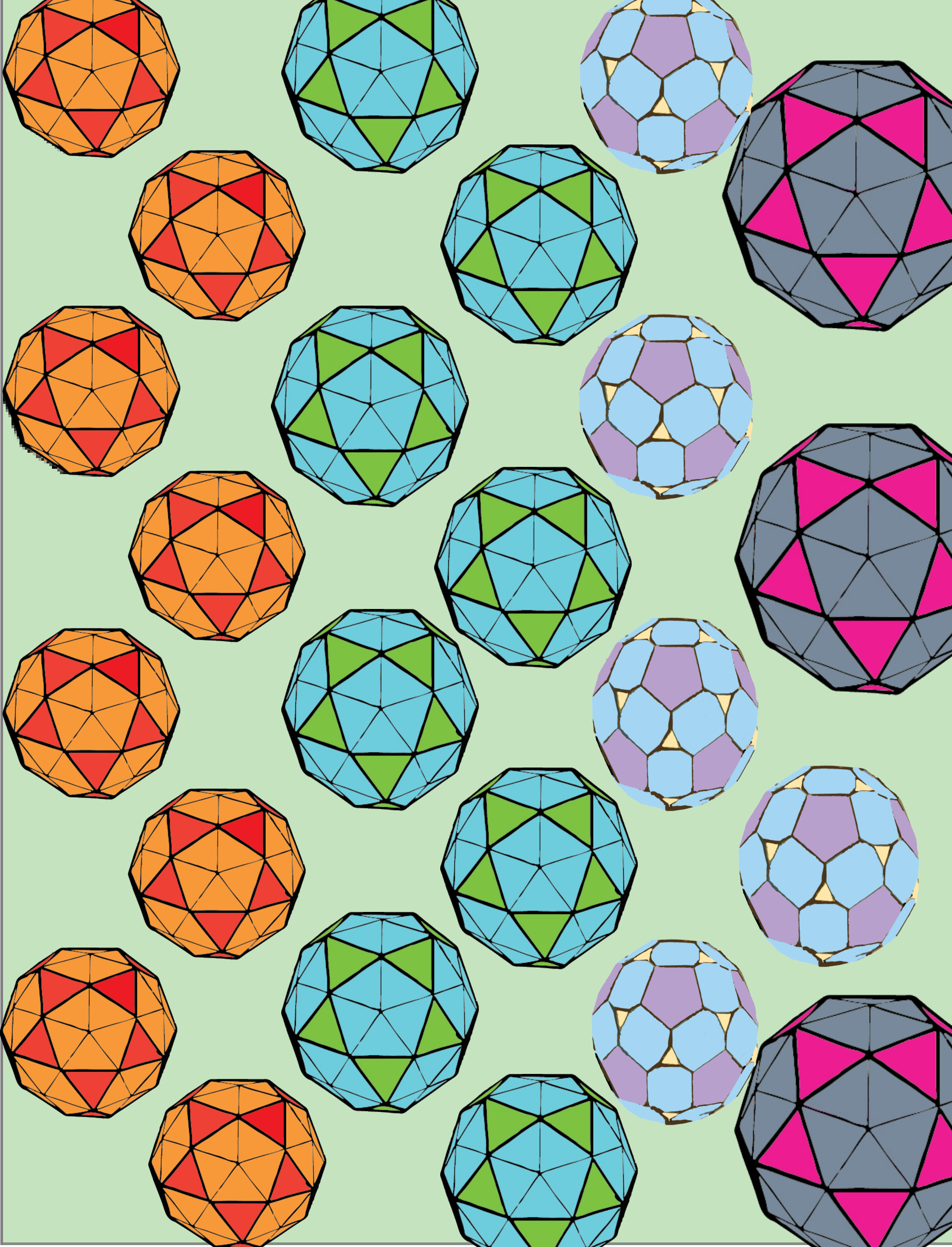

# Alicia Boole Stott Life in a Higher Dimension

By Hannah Chiu & Carly Medina

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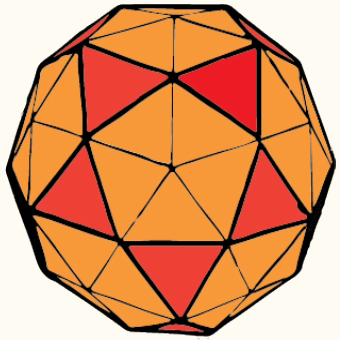
Alicia Boole Stott was born in Castle Road, Ireland on June 8th, 1860. Alicia was one of five daughters born to Georgle Boole and Mary Everest. George worked as a mathematician, studying how to solve complex puzzles. Sadly, when Alicia was only four years old, her father passed away. Mary and her five daughters had very little money after George died. So Mary moved to London with Alicia's four sisters. Alicia had to stay in Ireland with her grandmother. At the age of eleven, Alicia moved to London to live with her mother and sisters.

At a young age, Alicia had the support of both her mother and mathematician Charles Howard Hinton who also was very enthusiastic about teaching.[1] Her mother, Mary, had studied mathematics with her husband George.

Mary believed that "children should manipulate things in order to make the unconscious understanding of mathematical ideas grow."[2]

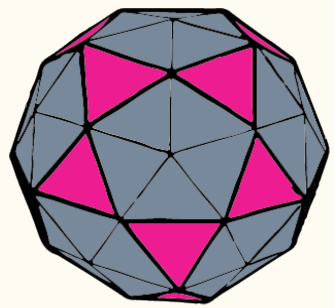
As a child, Alicia's geometric education began as soon as her hands could grasp objects. (Among Alicia's toy collection she had five regular solids and one cut cone.

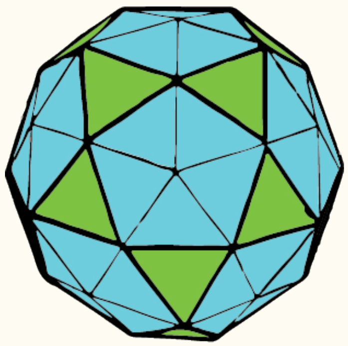
Throughout the 1800s, the idea of how people thought about shapes and their dimensions went through important changes. A polygon is a figure that lives on a flat-two dimensional surface, such as a piece of paper. An n-gon is a polygon with n sides; for example, a square is a polygon with four sides, so a square is a four-gon.



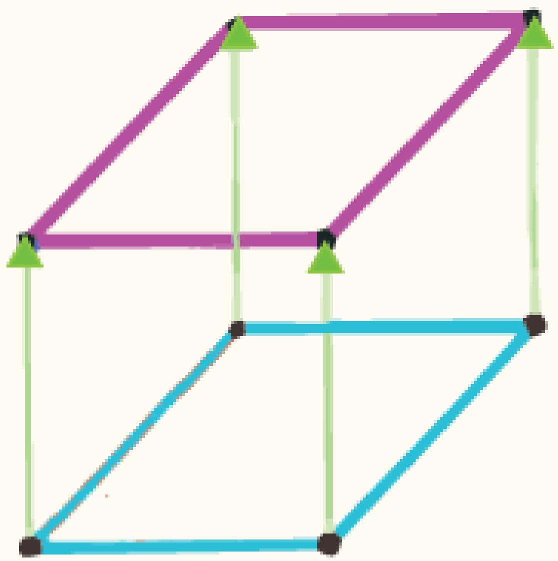
In three dimensions, polygons are commonly known as faces. These two-dimensional polygons, or faces, come together to describe three-dimensional figures, known as polyhedra. Polyhedra are three-dimensional solids.

For example, a cube is a three-dimensional solid that is bounded by six square faces. Polyhedron, such as the cube, live in the third dimension.

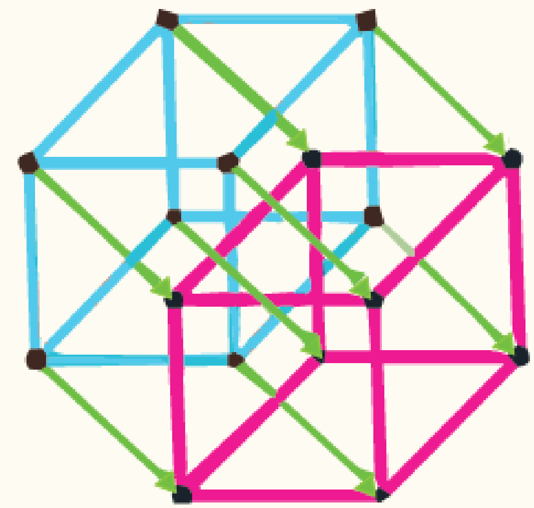




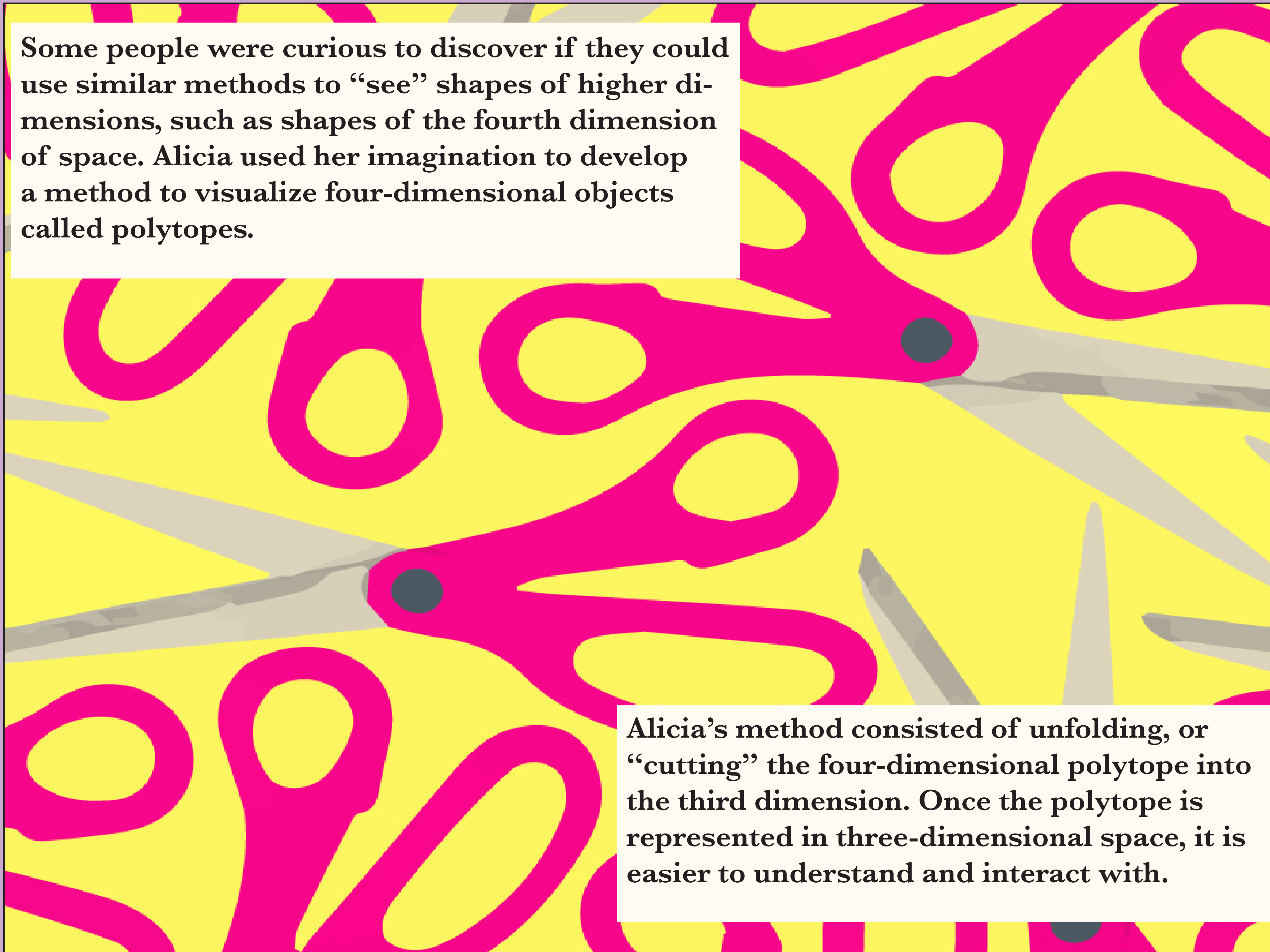
If you want to see a cube in three-dimensional space, you could take six squares and fold them together to have a cube.



A cube can be generated by translating the blue square vertically (in the direction of the green vectors). The blue square, in its translational movement to reach the magenta square, generates the cube.



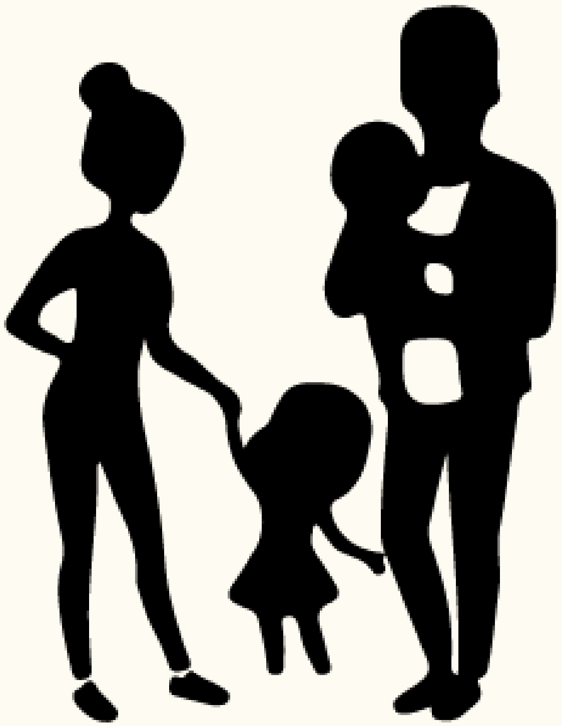
The hypercube is generated by translating the blue cube in the direction perpendicular to its space (along the green vectors). The blue cube, in its translational movement to reach the magenta cube, generates the hypercube.

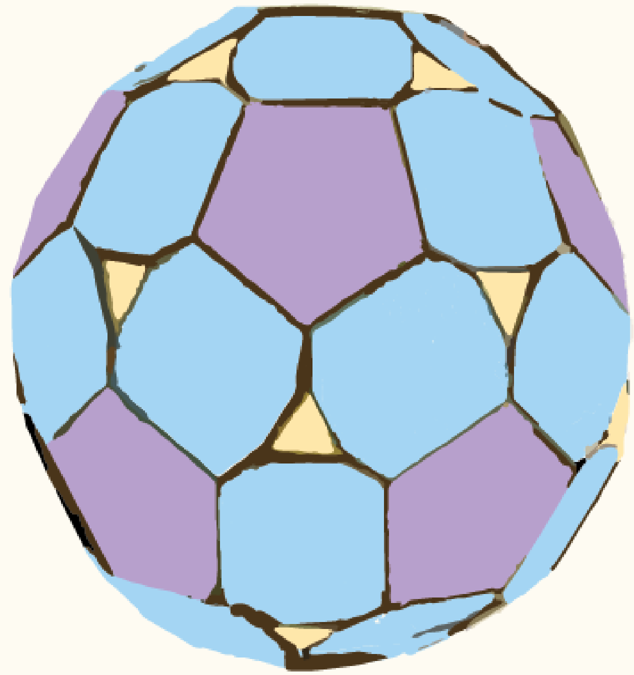


Some people were curious to discover if they could use similar methods to "see" shapes of higher dimensions, such as shapes of the fourth dimension of space. Alicia used her imagination to develop a method to visualize four-dimensional objects called polytopes.

Alicia's method consisted of unfolding, or "cutting" the four-dimensional polytope into the third dimension. Once the polytope is represented in three-dimensional space, it is easier to understand and interact with.

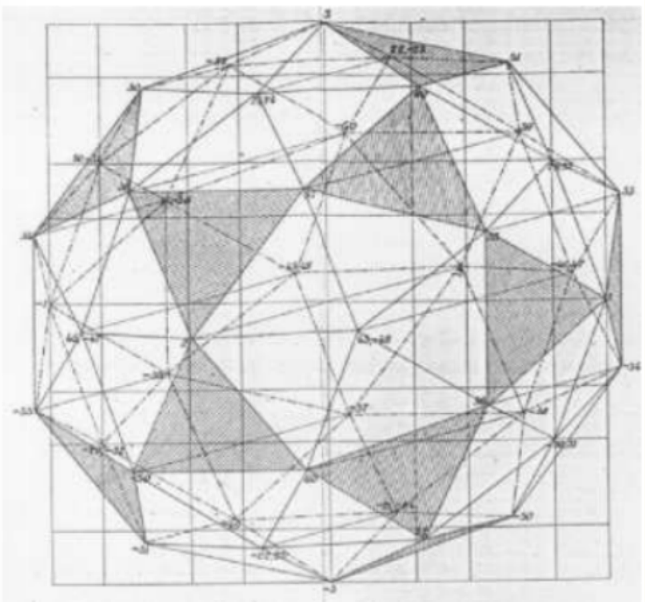
Alicia married Walter Stott in 1890 and had two children, Mary and Leonard.

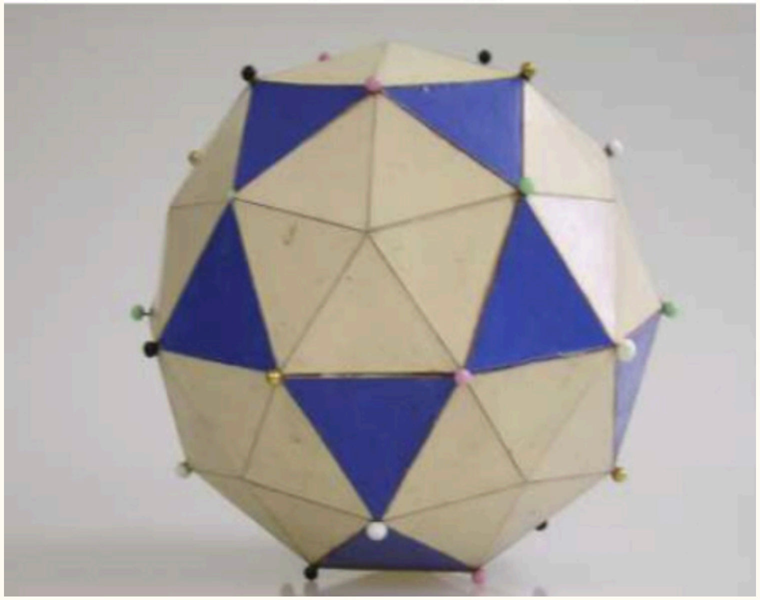




Walter was an actuary, which is a job for people who know how to use mathematics to figure out how much money businesses should charge for making promises to pay for something that may or may not happen.[3]

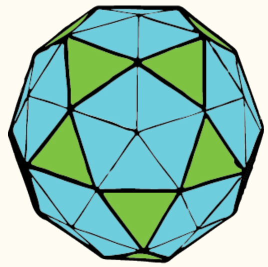
**Aside from Alicia's contribution to Charles' book, she worked alone until she started collaborating with the mathematician Pieter Hendrik Schoute on four-dimensional geometry.**
**Pieter loved drawing and was a Professor of Geometry at the University of Groningen in the Netherlands when he met Alicia in 1895. Alicia learned about Pieter through her husband Walter. Alicia realized that Pieter's drawings were identical to her cardboard models of three-dimensional sections of the four-dimensional polytopes and so Alicia and Walter sent photographs of her models to him.[4]**

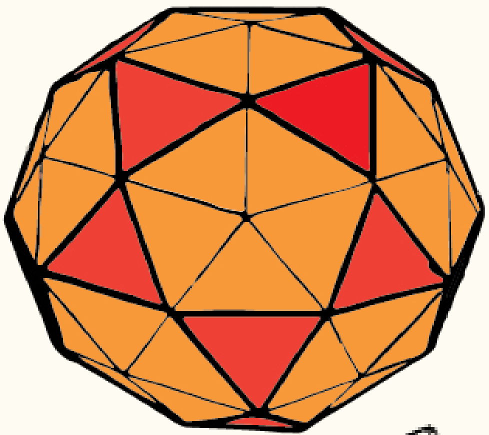




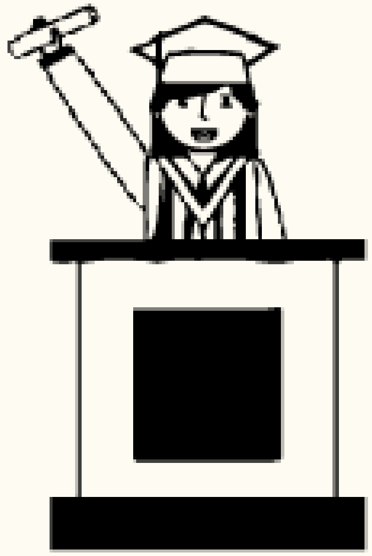
**The left is Pieter's 1895 drawing and the photograph on the right is Alicia's model of the four-dimensional polytope. Alicia's model is a three-dimensional representation and Pieter's drawing is a two-dimensional representation of the same central section.**

Alicia worked with Pieter until he passed away in 1913. Although Alicia published her results in a Dutch journal and a large collection of her models and drawings is present at the University of Groningen, it is unclear whether she ever visited the Netherlands.[5]

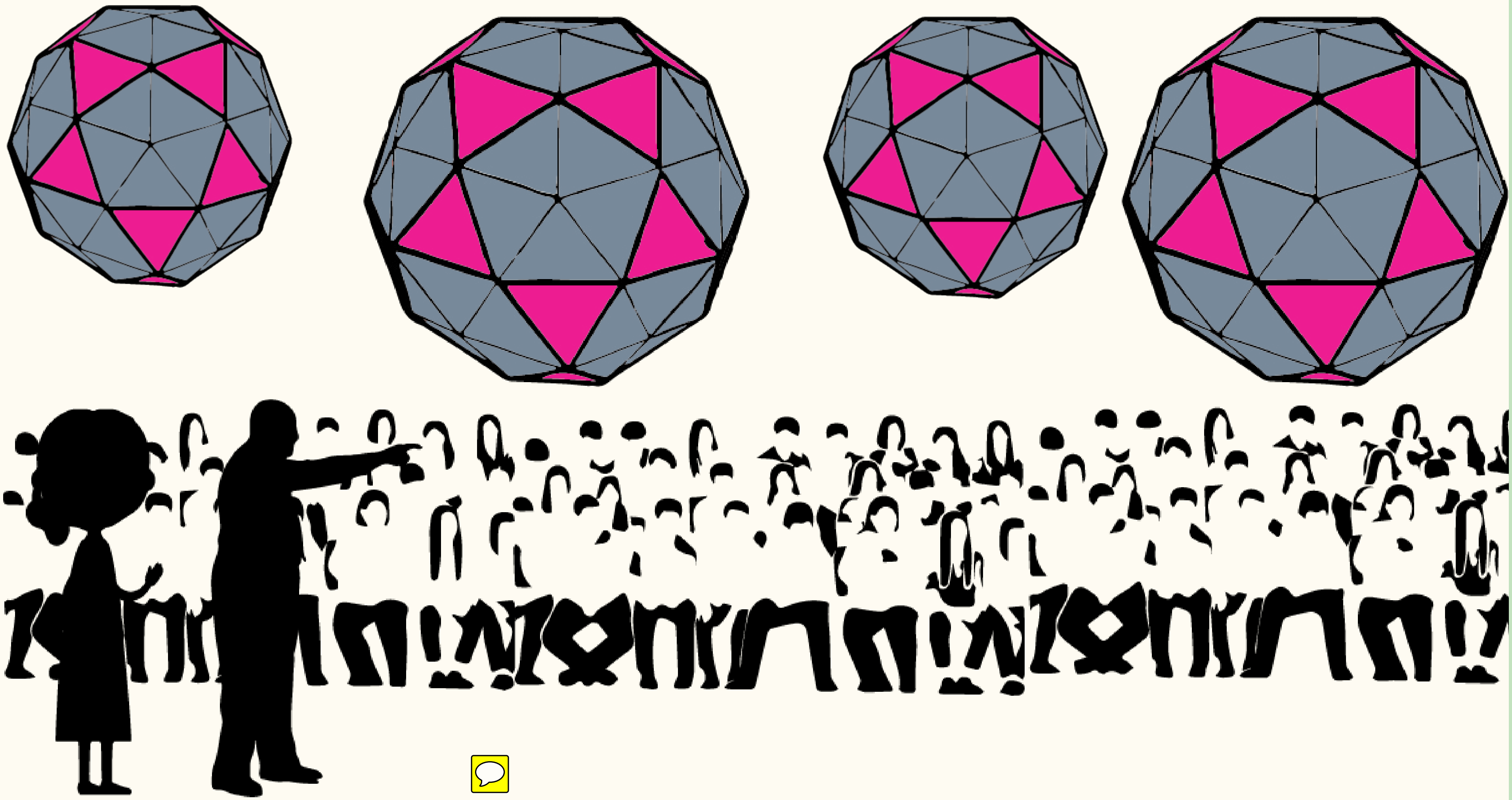




Because of Alicia's contributions to mathematics, at the celebration of the 300th birthday of the University of Groningen, Alicia was awarded an honorary doctorate!



**17 years later, in 1930 Alicia was 70 years old and was introduced to Donald Coxeter. Donald was 23 at the time and despite their age different, the two became best friends. While pursuing a graduate degree at Cambridge, Alicia collaborated with Donald on topics related to four-dimensional geometry.**



**Alicia Boole Stott represents a fascinating example of a young woman mathematician at the end of the 19th century. Her interest in the fourth dimension plays an essential role in Alicia's story, and it is reflected in the work of her teachers and mentors. Alicia's amazing ability to interact with the fourth dimension influenced the world's understanding of a challenging subject. Interest in Alicia continues to grow as historians learn more about her extensive collections of models and drawings.**

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Robbin, Tony. Shadows of Reality: The Fourth Dimension in Relativity, Cubism, and Modern Thought. Yale University Press, 2006. JSTOR, www.jstor.org/stable/j.ctt1npzrx. Accessed 14 May 2019.

# End Notes

*1* Hinton's interest in the fourth dimenson, see Rucker, R., 1980. Speculations on the Fourth Dimension: Select ed Writings of C.H. Hinton. Dover Publs, New York.

*2* Everest Boole, M., 1904. The Preparation of the Child for Science. Clarendon Press, Oxford. For more on Mary Everest Boole, see Cobham, E.M., 1951. Mary Everest Boole: A Memoir with Some Letters. C.W. Daniel Co. Ltd., Ashingdon, England.

*3* See Coxeter, H.S.M., 1948. Regular polytopes. Methuen and Co, London; 2nd edition. Macmillan, New York, 1963.

*4* Pieter and Alicia enjoyed a productive collaboration and as a result, in 1900, Alicia published her first paper, "On Certain Series of Sections of the Regular Four-Dimensional Hypersolids." In this paper, Alicia discussed three-dimensional sections of all six four-dimensional polytopes. In 1910, Alicia published her second paper, "Geometrical Deduction of Semiregular from Regular Polytopes and Space Fillings." Here, Alicia provided a method for obtaining semi-regular polyhedral and polytopes from regular ones. In both papers, Alicia's method for discovery consisted of unfolding the four-dimensional polytopes so that readers could visualize them in three-dimensional space.

*5* "Contrary to what Coxeter claims [Coxeter, 1948, 259], Boole Stott did not go to Groningen to attend the ceremony. The plan had been for Boole Stott to stay with Schoute's widow [Schoute, 1914]. However, the accommodation list for the 68 honoris causa candidates15 contains the remark 'does not come' besides Alicia Stott's name."- Irene Polo-Blanco (2008) "Alicia Boole Stott, A geometer in higher dimension." Historia Mathematica; 35:123–139.