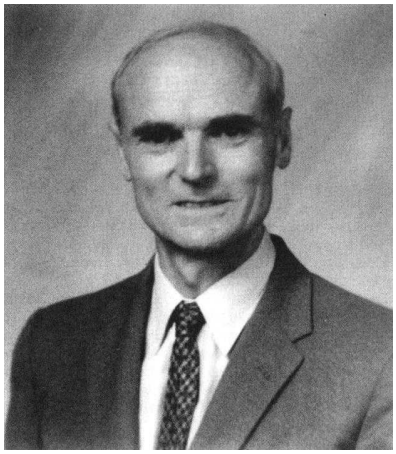
H.S.M. COXETER

H.S.M. Coxeter (February 9, 1907 - March 31, 2003), one of the foremost mathematicians of his generation, is noted for his study of polytopes, which inspired the drawings of M.C. Escher and influenced the architecture of R. Buckminster Fuller. Coxeter, whose childhood fascination with symmetry led to his career in mathematics, was born and educated in England. Shortly after finishing his doctoral studies at Cambridge University he spent two years as a research visitor at Princeton University. In 1936, he joined the faculty of the University of Toronto where he remained actively engaged for sixty-seven years. Coxeter, who was known as Donald, was first given the name MacDonald Scott Coxeter, but it was suggested that his father's name Harold should be added to the front of this. Someone noticed that he would then be known as H.M.S. Coxeter and might be confused with one of her majesty's ships. So Donald's parents settled on Harold Scott MacDonald Coxeter.



When Coxeter was only two or three his mother noticed that he was entranced with the columns of numbers printed in the newspaper's stock quotations. Soon thereafter he became captivated with cones, triangles and the symmetry of all geometric objects. As a fourteen-year-old, Coxeter's fascination with H.G. Wells' science story *The Time Machine* started him thinking about the fourth dimension and set him on his way to forming ideas about hyperdimensional geometries. He wrote an essay for school on the notion of projecting geometric shapes into higher dimensions. His father took his son to meet Bertrand Russell, who helped the Coxeters find an excellent mathematics tutor for Donald, enabling him to enter Cambridge University. His fascination with symmetry continued, convincing him that his

career should be devoted to the intersection of art, mathematics and science. He studied the mathematics of kaleidoscopes, describing the algebraic expression of how many images of an object may be seen in such a device.

Coxeter made discoveries about regular polytopes – geometric shapes that extend into the fourth dimension and beyond. Although these higher dimensional polytopes cannot be constructed in the three-dimensional world, they can always be described mathematically. The process of stretching geometrical shapes into higher dimensions is called "Dimensional Analogy". For instance, a line is a one-dimensional shape. If it is pulled into the second dimension, it becomes a square. If the square is pulled into the third dimension it becomes a cube and if a cube is pulled into the fourth dimension it becomes a hypercube. In 1954, with M.S. Longuet-Higgins and J.C.P. Miller, Coxeter published the definitive paper enumerating and describing the properties of generalizations of the Platonic and Archimedean solids, called uniform polyhedra.

Coxeter made important fundamental contributions to non-Euclidean geometry, discrete groups, and combinatorial theory. His more than 200 publications include 12 books such as the classic geometry books *The Real Projective Plane* (1955), *Introduction to Geometry* (1961), *Regular Polytopes* (1963), and *Non-Euclidean Geometry* (1965). Coxeter and the Dutch graphic artist M.C. Escher met in 1954 and became lifelong friends. Let Escher tell of Coxeter's influence:

> "I'm engrossed again in the study of an illustration, which I came across in a publication of the Canadian professor H.S.M. Coxeter, of Ottawa …, *A Symposium on Symmetry*. I am trying to glean from it a method for reducing a plane-filling motif, which goes from the center of a circle out to the edge, where the motifs will be infinitely close together. His hocus-pocus text is no help to me at all, but the picture can probably help me to produce a division of the plane which promises to become an

entirely new variation of my series of divisions of the plane."

Escher succeeded in achieving his objective without clearly understanding the underlying mathematics, using only simple drawing instruments and his artist's eyes. In April 2000, Coxeter gave a public lecture on *The Mathematics in the Art of M.C. Escher.* Coxeter's colleagues considered him an artist as well. In a letter in support of awarding Coxeter an honorary doctorate at York University, Robert Moody wrote:

> "Modern science is often driven by fads and fashions, and mathematics is no exception. Coxeter's style, I would say, is singularly unfashionable. He is guided, I think, almost completely by a profound sense of what is beautiful."

R. Buckminster Fuller cited the influence of Coxeter's ideas on the development of the geodesic dome, and dedicated his book *Synergetics* to him. In 1938, Coxeter revised and updated W.W. Rouse Ball's *Mathematical Recreations and Essays*, first published in 1892.

Coxeter attributed his long life to vegetarianism and exercise, which for most of his life included large numbers of daily push-ups. On his 95th birthday, the Fields Institute announced the dedication of a geometric polytope statue (a 4th dimensional dodecahedron), which was donated to the Institute in appreciation of Coxeter's lifelong contributions to geometry. He remained active to the end, giving an invited address at a conference in honor of János Bolyai on hyperbolic geometry, held in Budapest in July 2002. His wife died in 1999 and he died at his home in Toronto on March 31, 2003.

Quotation of the Day: "In our times, geometers are still exploring those new Wonderlands, partly for the sake of their applications to cosmology and other branches of science but much more for the

sheer joy of passing through the looking glass into a land where the familiar lines, planes, triangles, circles and spheres are seen to behave in strange but precisely determined ways." – H.S.M. Coxeter