



Biography



William Rowan Hamilton

King of Quaternions

“On earth there is nothing great but man; in man there is nothing great but mind.”

His Life



Sir William Rowan Hamilton was born in Dublin, Ireland in the year of 1805, a son to Archibald Hamilton and Sarah Hutton. He was a child prodigy- by the age of five he had mastered Latin, Greek and Hebrew. But he didn't stop there. By the age of twelve, he had

learned French, Italian, Arabic, Syriac, Persian and Sanskrit from his uncle, the Rev James Hamilton, which is interesting, as he is known for maths and astronomy.

The turning point of his life was when he met the American Zerah Colburn. Colburn could perform amazing mental arithmetical feats and Hamilton joined in competitions of arithmetical ability with him. It appears that losing to Colburn sparked Hamilton's interest in mathematics, as he focused less on his languages.

College

Hamilton entered Trinity College, Dublin at the age of 18 and in his first year he obtained an 'optime' in Classics, a distinction only awarded once in 20 years.

In August 1824, Uncle James took Hamilton to Summerhill to meet the Disney family. It was at this point that William first met their daughter Catherine and immediately fell hopelessly in love with her. Unfortunately, as he had three years left at Trinity College, Hamilton was not in a position to propose marriage. However Hamilton was making remarkable progress for an undergraduate and submitted his first paper to the Royal Irish Academy before the end of 1824, which was entitled *On Caustics*.

The following February, Catherine's mother informed William that her daughter was to marry a clergyman, who was fifteen years her senior. He was affluent and could offer more to

Catherine than Hamilton. In his next set of exams William was given a 'bene' instead of the usual 'valde bene' due to the fact that he was so distraught at losing Catherine. He became ill and at one point he even considered suicide. In this period he turned to poetry, which was a habit that he pursued for the rest of his life in times of anguish.

In 1824, he presented a paper, *On Caustics* (in optics, caustics refer to bundles of light rays), to the Royal Irish Academy. Though it was not accepted for publication in its original form, the group acknowledged the merit of the paper and urged.

Hamilton to develop the subject matter further, which he did over the course of several years. In 1827, an expanded form of Hamilton's work with caustics was submitted to the Academy and was ordered to be printed. The important treatise entitled *Theory of Systems of Rays* described a theory that integrated optics, mathematics, and mechanics into a single characteristic function. By utilising this function, Hamilton was able to mathematically address in detail caustic curves, the density of the light in close proximity to caustic surfaces, and the foci of reflected light. Largely based on the strength of his theory of the characteristic function of an optical system, Hamilton won the position of Royal Astronomer of Ireland.

Family

When it came to women, Hamilton was very fickle. He had been rejected by many, often leading to illness and depression. In April of the year 1833, Hamilton married Helen Maria Bayly. He was the Royal Astronomer of Ireland at this point, so he and his newlywed wife moved into Dunsink Observatory in Dublin where he would spend the rest of his life. He fathered William Edwin Hamilton, Archibald Henry Hamilton and Helen Eliza Amelia O'Regan, née Hamilton.

His Achievements

In 1835 Hamilton was knighted by the Lord Lieutenant of Ireland in the course of a meeting in Dublin of the British Association for the Advancement of Science. Hamilton served as president of the Royal Irish Academy from 1837 to 1846. Hamilton had a deep interest in the fundamental principles of algebra.

On 16 October 1843 (a Monday) Hamilton was walking in along the Royal Canal with his wife to preside at a Council meeting of the Royal Irish Academy. Although his wife talked to him now and again Hamilton hardly heard, for the discovery of the quaternions, the first noncommutative algebra to be studied, was taking shape in his mind:

"And here there dawned on me the notion that we must admit, in some sense, a fourth dimension of space for the purpose of calculating with triples ... An electric circuit seemed to close, and a spark flashed forth."

Hamilton retained his faculties unimpaired to the last, and continued the task of finishing the

$$i^2 = j^2 = k^2 = ijk = -1$$

Elements of Quaternions which had occupied the last six years of his life. He died on 2 September 1865, following a severe attack of gout.

Discovering Quaternions

Quaternions are a non-commutative number system that extends complex numbers. While described in all but name by Olinde Rodriguez in 1840, Sir William Rowan Hamilton is credited with their discovery from 1843.

In 1843, Hamilton knew that the complex numbers could be viewed as points in a plane

and that they could be added and multiplied together using certain geometric operations. Hamilton sought to find a way to do the same for points in space. Points in space can be represented by their coordinates, which are triples of numbers and have an obvious addition, but Hamilton had difficulty defining the appropriate multiplication.

According to a letter Hamilton wrote later to his son Archibald: Every morning in the early part of October 1843, on my coming down to breakfast, your brother William Edwin and yourself used to ask me: "Well, Papa, can you multiply triples?" Where to I was always obliged to reply, with a sad shake of the head, "No, I can only add and subtract them."

On that day walking with his wife along Royal Canal, he realised that since he could not multiply triples, he could try multiplying quadruples. He worked out he could represent points in space using this system. In excitement, he carved the basic rules into Brougham Bridge,

now Broom Bridge, which still has a commemorative plaque.

Sir William Rowan Hamilton was both an incredible mathematician and astronomer. He had discovered Quaternions which are vital for the controls which guide aircraft and rockets, and in quantum mechanics. He was a very intelligent person and his life achievements will not be forgotten. ■