STEPHEN WOLFRAM

OVERVIEW

Stephen Wolfram was born in 1959 in London to Hugo and Sybil Wolfram. He is a computer scientist, physicist, and businessman. He has spent a lot of his time working in areas of Computer Science, Mathematics and Theoretical Physics. Stephen is well known for being the founder and CEO of Wolfram Research, and is the main designer of the popular answer engine *Wolfram Alpha*, the technical computing system *Wolfram Mathematica*, and the author of the controversial book *A New Kind of Science.*

EDUCATION

As a young child, Stephen Wolfram had difficulties learning arithmetic. By the age of 13, he had received a scholarship to Eton College, and by 14, he had written his first book on particle physics (Communications, 2014). Wolfram never graduated from Eton College, but did go on to study at University of Oxford, where he also left, before finally settling in at California Institute of Technology. At 17, the scientific journal *Nuclear Physics* published a paper he'd written. At 18, he wrote a widely-acclaimed paper on heavy quark production. At the young age of 20, Stephen Wolfram received his PhD in theoretical physics, from California Institute of Technology.

PERSONAL LIFE

Stephen Wolfram was a child of two very intelligent and successful parents. Stephen's father, Hugo, was born in Germany, and was the Managing Director of Lurex Company, makers of the fabric Lurex. He also was the author of three novels. Hugo emigrated to England in 1933. When he was 15, Hugo left school as Wolrd War 2 broke out, and he was regarded as an enemy alien. Hugo then proceeded to take courses in Philosophy and Psychology. Stephen's mother, Sybil, was also born in Germany. After the Reichstag Fire in 1933, Sybil also emigrated to England. Sybil was a Fellow and Tutor in Philosophy at Lady Margaret Hall at University of Oxford from 1964 to 1993. Stephen himself is currently living in London, is married to a Mathematician, and has four children.

CAREER

Following his PhD at the age of 20, Wolfram joined the Faculty at Caltech, and became the youngest ever recipient of the MacArthur Fellowships in 1981, aged just 21. Wolfram moved from Caltech to Princeton in 1983 to focus on his studies of 'cellular automata' - structures governed by simple rules

that can result in complex behaviour (Communications, 2014). The papers Wolfram published had a major impact, and laid the groundwork for the field that Wolfram called 'Complex Systems Research'. In 1986 Wolfram established the

Centre for Complex Systems Research at the University of Illinois, where he was also a professor of physics, maths, and computer science (Craine, 2009).

However, in 1987, Wolfram had created 'Wolfram Research Incorporation', and left the University of Illinois the following year to concentrate on Matematica, a computer program he had devised that allowed complex mathematical equations to be manipulated and solved algebraically, rather than using numerical analysis to find approximate solutions (Craine, 2009). He released Matematica on June 23, 1988, and by 1990 he had over 100,000 users! By 1990, Wolfram Research had already generated $10 million in revenue. During this year, Stephen Wolfram also created Wolfram Research Europe, where he appointed his brother, Conrad Wolfram, as the CEO. This was shortly followed by Wolfram Research Asia.

From 1992, Wolfram Alpha was working on a book called *A New Kind of Science,* which talks about the inadequacy of math-based science as a means of unlocking the secrets of the natural world. The book was launched in 2002, where it quickly became a bestseller, and Stephen Wolfram spent the next couple of years giving talks and holding conferences about the subject. He also started a Summer school devoted to this topic.

Since this launch, alongside the talks and other activities surrounding the book, Wolfram continued to update and release new and improved versions of Mathematica. In 2009, Stephen Wolfram then launched *Wolfram Alpha,* an answer engine designed to compute mathematical questions, that can be expressible in equations (Craine, 2009).

Wolfram's most recent development was the announcement of the *Wolfram Language* in 2014. Although this programming language was the language used in Mathematica for over 25 years, it was only officially announced in 2014 to coincide with the use of Wolfram Language on every Raspberry Pi computer. Since this release, Stephen Wolfram is continuously working on improving the Wolfram Research Inc. as a whole, with regular new developments to keep pace with the modern world, where technology plays a significant part in every human's day to day activities.

WORK & INFLUENCE

Wolfram Mathematica

Wolfram Mathematica (usually termed Mathematica) is a modern technical computing system spanning most areas of technical computing — including neural networks, machine learning, image processing, geometry, data science, visualizations, and others (Wikipedia). Mathematica was launched in 1988, and uses the programming language called Wolfram Language, which was officially launched in 2014. There have been numerous versions of Mathematica released over its lifetime, currently spanning about 30 years. Mathematica contains a large variety of unique features, including matrix and data manipulation tools, multivariate statistics libraries, data mining tools, directed and undirected graph analysis tools and many, many more. There is currently a free and a paid version of this software available.

Wolfram Alpha

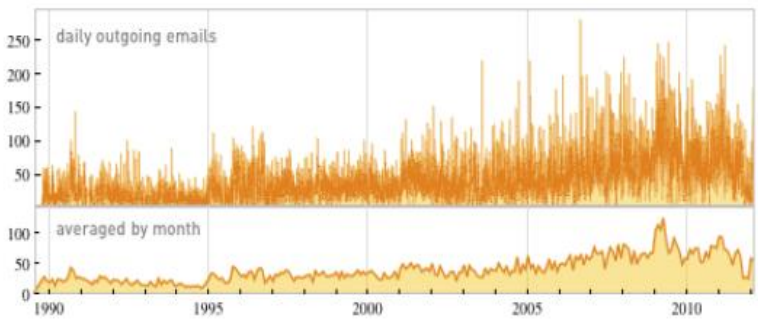
Wolfram Alpha was launched on 18th May 2009. Wolfram Alpha is a computational knowledge engine, that can answer factional queries, based on externally sourced. Wolfram Alpha produces a specific answer, rather than providing links or references to the correct answer. The questions asked can produce a categorical answer, for example, who invented the telephone, and also numerical answers, such as how much did the first computer cost. Wolfram Alpha's unique selling point is its ability to correctly compute mathematical equations, and produce graphs. Wolfram Alpha can perform basic mathematical computations, such as addition and subtract, along with more complex questions, for example, differential calculus and limits. Wolfram Alpha is currently a huge asset for students worldwide to assist them with their studies.

A New Kind of Science

In 2002, Stephen Wolfram launched one of his most successful pieces of work, which was his book called A New Kind of Science. This book contains an empirical and systematic study of computational systems such as cellular automata. Wolfram calls these systems *simple programs* and argues that the scientific philosophy and methods appropriate for the study of simple programs are relevant to other fields of science (Wikipedia). Since its beginning, in the 1930s, computation has been made up of two areas: engineering and mathematics. In 1970, the definition of computation has changed to being at the crossroads of mathematical, engineering, and empirical traditions. A basic summary of this piece of work is that Wolfram introduces a third tradition that seeks to empirically investigate computation for its own sake. He believes that an entirely new method is needed to do so because traditional mathematics fails to meaningfully describe complex systems. The book became a bestseller at the time, with Wolfram holding numerous talks and conferences as a result. Wolfram also began a Summer School, which involved teaching his beliefs. These schools took place at some of the most prestigious universities in the world, such as Brown University. There have been further publications from people who have conducted research into this topic for their Masters or PhD theses. The book got a great reception, with plentiful news articles written as a result. One of these came in the New York Times. At the start of the article, the journalist said "Now, weighing in at 1,263 pages (counting a long, unpaginated index) and 583,313 words, the book could hardly be more intimidating. But that is the price one pays for a first-class intellectual thrill" (Johnson, 2002). This shows the impact this book had on the world when it was published over 15 years ago.

PERSONAL ANALYTICS

In 2012, Stephen Wolfram created his own blog. In this blog, he outlined how he analysed data about himself, and published findings on this analysis. This allowed Wolfram's audience to get a greater insight



into how he went about his work. It also shows the sheer love and enjoyment that Wolfram got out of statistical analysis. On his blog, Wolfram provides a wide range of graphs, and interpretations of these graphs, to see how his regular daily activities were impacted by the projects, or pieces of work he was involved in during that period of his life. The following graph shows his email output since 1990. His low level of output in the 1990s is due to his work on his book, and therefore less communication with the outside world. The peak around 2009 is due to the launch of Wolfram Alpha. Wolfram believes there is a large importance on personal analytics, and with the advancements of technology, this importance will continue to grow. In his blog, he quoted 'Some of it will focus on large-scale trends, some of it on identifying specific events or anomalies, and some of it on extracting "stories" from personal data' (Wolfram, 2012).

CONCLUSION

To conclude, I feel as though Stephen Wolfram's impact on the world has been huge in the evolution of mathematics and physics. I highly admire his self-belief, with his strong dedication and determination to proving his ideas. Wolfram is not afraid to pursue what he believes in, which is a highly admirable trait. In the words of Mr. Wolfram himself, 'It has been proven that the universe is computationally equivalent to my ego' (Wolfram, A-Z Quotes).

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