

# Boole Shannon

## Symposium

### The Transatlantic Founders of the Information Age

A Symposium to Celebrate the Achievements of  
George Boole and Claude Shannon

**Friday, March 18, 2016**

**1:00 PM to 5:30 PM**

**Singleton Auditorium 46-3002 in MIT**

Reception to follow at the Pappalardo Room 4-349 at 6:00 PM

### Speakers Include:

**Philip Fleming**

CTO of North America, Nokia Networks

**Robert Gray**

Stanford University and Boston University

**Michael Murphy**

President, University College Cork

**Patrick O'Shea**

University of Maryland

**Barry O'Sullivan**

University College Cork

**Michael Sipser**

Dean of Science, MIT

**James Whelton**

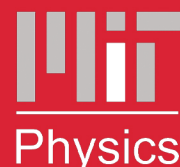
Co-founder of CoderDojo

More info at

[www.georgeboole.com](http://www.georgeboole.com) & [www.rle.mit.edu/booleshannon/](http://www.rle.mit.edu/booleshannon/)

**Symposium open to the public.**

*sponsored by*



**George Boole (1815-1864)** was born in Lincoln, England on November 2<sup>nd</sup>, 1815. He inherited his father's passion for science and by the age of 14 could read Latin, Greek, French and German. But Boole's family fell on hard times, and he was forced to find work to support them. Boole discovered and taught himself mathematics while teaching in local schools. The papers that he published in the Cambridge Mathematical Journal earned him respect as a capable mathematician. In 1849, despite lacking a university degree, he was offered the first Professorship of Mathematics at Queens' College, Cork (later to become University College Cork) in Ireland, where he taught until his death on December 8<sup>th</sup>, 1864.

In 1854, Boole published his greatest and most influential work: *An Investigation Into the Laws of Thought, on Which are Founded the Mathematical Theories of Logic and Probabilities*, in which he brilliantly combined algebra with logic. In 1937, Claude Shannon placed Boole's abstruse reasoning in an engineering context where it became instrumental in the development of the digital computer.

Boole was well liked and known to be extremely dedicated to his research, his students, and his family. He is remembered as a personable, congenial, kind-hearted teacher and a brilliant mathematician. His papers are preserved in the archives of the Boole Library at University College Cork. A lunar crater also bears his name.

**Claude Elwood Shannon (1916-2001)** was born in Petoskey, Michigan on April 30<sup>th</sup>, 1916. He graduated from the University of Michigan in 1936 with bachelor's degrees in mathematics and electrical engineering. In 1940, he was awarded both a master's degree in electrical engineering and a Ph.D. in mathematics from MIT. Shannon joined the Mathematics Department at Bell Labs in 1941 with which he became affiliated until 1972. He became a visiting professor at MIT in 1956, a permanent member of the faculty in 1958, and a professor emeritus in 1978.

In 1938, Shannon published a paper, *A Symbolic Analysis of Relay and Switching Circuits*, in which he demonstrated how to build logic circuits from electromechanical relays. The paper was hailed as brilliant and the ideas put forward were almost immediately applied to the design of automatic telephone switching circuits. After making the link between Boolean logic and switching circuits, he went on to undertake research at Bell Labs on the problem of transmitting information more efficiently. What is widely recognized as Shannon's masterpiece work, *A Mathematical Theory of Communication*, was published in 1948. Shannon's work led to him in his lifetime to be regarded as the founding father of digital communication.

Shannon is fondly remembered at MIT both for his groundbreaking contributions to science as well as for his interest in juggling, chess, and mechanical toys.

Adapted from **1+1=1 a tale of genius** at  
[http://intosaiitaudit.org/intoit\\_articles/18p54top59.pdf](http://intosaiitaudit.org/intoit_articles/18p54top59.pdf)

# **Boole-Shannon Symposium**

## **The Transatlantic Founders of the Digital Age**

A symposium to celebrate the lives and achievements of  
George Boole and Claude Shannon

*Friday March 18, 2016*  
Singleton Auditorium, 46-3002, MIT

Chair: Prof. Muriel Medard, MIT

- 1:00-1:05 Welcome by Chair  
1:05-1:30 **The Life and Legacy of George Boole (1815-1864)**  
President Michael Murphy, University College Cork  
1:30-2:00 **The Legacy of George Boole: from Boolean Satisfiability to Sustainability**  
Prof. Barry O'Sullivan, University College Cork  
2:00-2:30 **From Brú na Bóinne and G. Boole to R.A. Bailey**  
Prof. Patrick O'Shea, University of Maryland  
2:30-3:00 **Boole/Shannon and Edmund Berkeley**  
Prof. Robert Gray, Stanford University and Boston University

3:00-3:30 Coffee

Chair: Prof. Richard Milner, MIT

- 3:30-4:00 **Mathematics and the Communications Industry**  
Dr. Philip Fleming, NOKIA  
4:00-4:15 Remarks by Irish Government representative  
4:15-4:45 **Youth in Recursion**  
James Whelton, CoderDojo  
4:45-5:15 **Closing remarks**  
Prof. Michael Sipser, Dean of Science, MIT  
6:00-8:00 Reception to follow in the Pappalardo Room 4-349 hosted by  
Prof. Peter Fisher, Head, MIT Department of Physics

## PRESENTATIONS

### **The Life and Legacy of George Boole (1815 - 1864)**

*Michael Murphy*

2015 marked the bicentenary of the birth of George Boole, the mathematician who devised the mathematical framework describing the application of logic to human decision making, now known as Boolean Logic and Algebra. This presentation is designed to set out Boole's life story from self-education as a poor child in Lincoln, England, to his appointment as Professor of Mathematics at Queens College Cork in Ireland 1849, the publication of his seminal book, "An Investigation of the Laws of Thought" in 1854 and early death. The origin and impact of his intellectual legacy, ingeniously recognised by Claude Shannon at MIT in the 1930s will be set out. In addition to emphasising Boole's story as an exemplar of "useful useless research" the case for continued investment in curiosity driven "blue skies research" will be emphasised. Beyond his ingenuity, Boole bequeathed to the world a remarkable family of scientists and writers worthy of brief celebration.

### **The Legacy of George Boole: from Boolean Satisfiability to Sustainability**

*Barry O'Sullivan*

There are many problems in computer hardware design, production scheduling, timetabling, product configuration, planning, diagnosis, etc. that can be stated in propositional logic. Determining whether there exists a design that is bug free, or finding an acceptable schedule, timetable, configuration, etc., corresponds to determining whether the statement in propositional logic is true or false. These are some of the many applications of Boolean satisfiability that have been developed over the past few decades. In this talk we will give examples of how Boole's work leaves a legacy in solving extremely challenging and important problems in sustainability.

### **From Brú na Bóinne to G. Boole to R.A. Bailey**

*Patrick O'Shea*

A short history of the pioneering, unreasonable, entrepreneurial, irrational, revolutionary, relentless, daring and crazy spirit of Irish scientific exploration and discovery.

### **Boole/Shannon and Edmund Berkeley**

*Robert M. Gray*

Edmund Callis Berkeley was a co-founder of the ACM and a pushy proselytizer of Boolean algebra and Claude Shannon's 1938 paper within the nascent computing machinery community. In 1955 Berkeley hired Shannon as a consultant to Berkeley

Enterprises to help design and develop projects for small "computers" to be sold by mail for under \$20 to boys and hobbyists to learn about computers, logic, and Boolean algebra. This talk tells the story of Geniac, the resulting "electric brain" introduced in 1955, from the point of view of a former 13 year old who bought one in 1956 and began thereby a lifelong odyssey with binary numbers. Other facets of Berkeley's unusual life are touched upon.

### **Mathematics and the Communications Industry**

*Philip Fleming*

I will discuss how advances in mathematics impact the communications industry. This is a clearly a very big topic area, so I will select a few examples to demonstrate the way a new theorem or a new mathematical structure can change the direction of technology and, more generally, the business environment. The work of Boole and Shannon play a prominent role in this saga but there are other mathematicians (or mathematical engineers) whose work has had a major impact.

### **Youth in Recursion**

*James Whelton*

In modern software and hardware development, we stand on the shoulders of giants. The work by George Boole and Claude Shannon is being utilized by young people all over the world today, from Cork to Boston to Madagascar. We will reflect on how for the first time, we have a generation of (very) young people growing up knowing and putting into practice Boole's and Shannon's principles and examine the profound effect this will have on society as they grow up seeing a new dimension of solutions to problems, inefficiencies and issues, irrespective of what field they enter or create.

## SPEAKERS

**Michael Murphy** has been President of University College Cork since 2007. He is a graduate of UCC's Medical School and has previously held senior academic appointments in the U.S., U.K. and Ireland. He originated and has led the UCC-based international effort to recognize in 2015 the life and achievements of George Boole.

**Barry O'Sullivan** is the Director of the Insight Centre for Data Analytics and is Professor of Computer Science at University College Cork. He leads a large and active research group at UCC in the area of artificial intelligence.

**Patrick O'Shea** is Vice President and Chief Research Officer at the University of Maryland, College Park. He is a Professor of Electrical Engineering working in the areas of applied electromagnetics, nonlinear dynamics, and particle accelerator technology, and applications.

**Robert Gray** is the Lucent Technologies Professor of Engineering, Emeritus, Professor of Electrical Engineering, Emeritus, at Stanford University and Research Professor at Boston University. His research interests are in information theory and signal processing.

**Philip Fleming** is Senior Technology Advisor for *Nokia Networks* in North America. For several decades, he has led teams of researchers and advanced technologists in design and development of innovative advances in communications technology.

**James Whelton** is an Irish computer coder, venture capital advisor, and co-founder of *CoderDojo*, a network of free computer clubs for children.

**Michael Sipser** is the Dean of Science at MIT, the Donner Professor of Mathematics, and a member of MIT's Computer Science and Artificial Intelligence Laboratory. His research areas are in algorithms and complexity theory. He suggested the combined celebration of the lives of George Boole and Claude Shannon in this symposium at MIT.

**Symposium**

**Reception**

