

The Annals of Irish Mathematics and Mathematicians
presents
What Have the Irish Ever Done for Mathematics?

Colm Mulcahy,
Spelman College, Atlanta, GA & SETU Waterford

www.mathsireland.ie

Thu, 27 Aug 2026

Congratulations to the IMS on turning 50!

It was 50 years ago today...



The first fab four IMS officers: Michael Hayes, Ted Hurley, Finbarr Holland, Trevor West.

Definitions

“Mathematics” is taken in the broadest sense, meaning any of the mathematical sciences: pure and applied mathematics, mathematical physics, mathematical biology, statistics, operations research, and also mathematics education and history.

“Irish” refers to the whole island: those born and/or brought up here, regardless of where they trained or worked (e.g., Stokes), and also those from overseas who trained in or practiced mathematics for some period somewhere in Ireland (e.g., Boole).

Random Roscrea Recreation

A fun (planar) geometry problem from 1784:

proposed the following question in the same publication for 1784:—

“ Question 8. By Mr. Michael O'Reredon, of Roscrea.—A gentleman has a garden in the form of a plain triangle, whose sides are 50, 60, and 70 perches respectively; it is required to divide the same into four equal parts, by two right lines intersecting each other at right angles, in some point within the figure.”

A most elaborate solution to this problem was given in the Almanack for 1785.

Hint: maybe don't get bogged down in calculations involving 50, 60, and 70.

What to highlight from the past 400 years?

Publications in journals. Citation indices.

Academic appointments and promotions.

Prizes and awards.

Curriculum development.

However, we will largely resist this kind of accounting. Bear in mind that significant maths has sometimes been done by people whose careers have sidestepped the above.

Ireland & Britain populations 1841/1851 versus today

Ireland: 8.2/6.5 versus 7.2 million today.

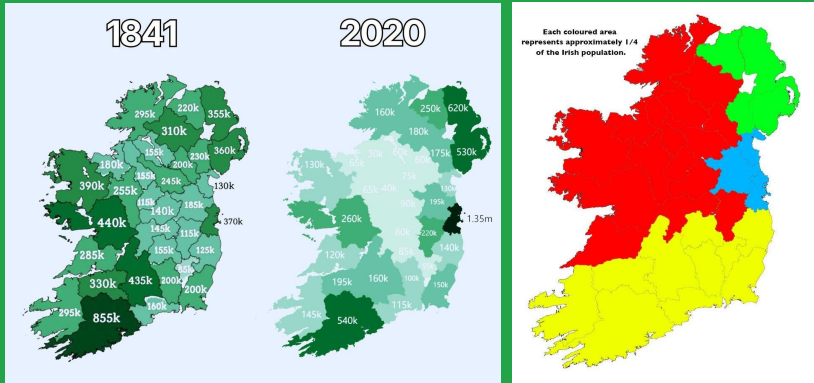
Scotland: 2.6/2.9 million versus 5.6 million.

Wales: 1.0/1.2 million versus 3.3 million.

England: 15.9/18.2 million versus 64.4 million.

Note the huge growth of England since the mid 1800s.

Pop dist: then and now, and now by quarters



Notice the hollowing out of the midlands since the 1800s, and the thinning of the west.

The dominance of the east and the north east now.

What have the Irish ever done for mathematics?

What comes to mind when one thinks of Ireland and contributions to maths?

Quaternions, many things Boolean, Stokes' theorem, and the student t-test.

And computus and pioneering astronomical work done at Dunsink, Armagh and Birr.

The Dublin Institute for Advanced Studies.
Started by Eamon de Valera.

Is there much more?

What have the Irish ever done for mathematics?

Boyle's law, Berkeley's criticism of calculus, angular momentum, method of least squares, Hamiltonian in mechanics, the ordered pair form of complex numbers, ∇ operator, quaternions, Icosian game, Hamiltonian paths, the Hamilton-Cayley theorem, octonions, Euclid colourised, inversion in a circle, Stokes' theorem, Navier Stokes equations, most of Boole's work, the Smith normal form of a matrix, Casey's theorem in geometry, Edgeworth series, the term polytope, Irish logs, Baker-Campbell-Hausdorff formula, Cullen numbers, limits arrow notation, the student t-test, Henstock-Kurzweil integrals, and the proof that Sudoku needs at least 17 clues.

The term electron, the Kelvin temperature scale, Lorentz-FitzGerald contraction, the idea of black holes as real physical entities, the no-go theorems of Bell and O’Raifeartaigh, and the Weaire-Phelan structure.

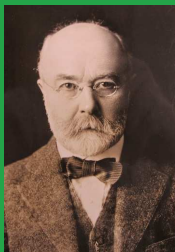
The annual Hamilton Walk (thank Tony O’Farrell) from Dunsink to the bridge where Hamilton carved $i^2 = j^2 = k^2 = ijk = -1$. WRH was the first foreigner elected to US Academy of Sciences.

Maths Week (thank Eoin Gill & Sheila Donegan of WIT/SETU), which until recently was the world’s largest national maths outreach programme.

Irish maths contributions in North America



Antrim's Robert Adrain (1775-1843) moved to NJ after 1798 rebellion. One of the leading lights of academic maths at Princeton & Rutgers early 1800s, publishing the method of least squares (1808) before Gauss. Editor/contributor *Mathematical Correspondent*, the first mathematical journal in US. Started journals *The Analyst or Mathematical Museum* and *Mathematical Diary*.



James McMahon (1856-1922) from Armagh, who had pursued metaphysics and classical studies at TCD, is likely the first Irish person to supervise a mathematical doctoral thesis, at Cornell, in 1888. He served as chair there too, wrote 3 books, and was an early member of what became the AMS.



Tyrone's Frank Murnaghan (1893-1976) was educated at UCD & Rice, built up the maths dept at Johns Hopkins (1920s-1940s), and wrote 16 books.

Dubliner John L. Synge (1897-1995) was educated at TCD. Career Toronto, TCD, Toronto again, then DIAS. Also stints at Princeton, Brown, Ohio State, Carnegie Inst, US Air Force (ballistics). Supervised many PhDs in Canada and Ireland; wrote 11 books.

Synge worked in mechanics, geometrical optics, differential geometry, and relativity.

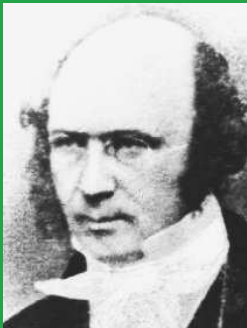
Credited with the introduction of a new geometrical approach to the special and general theories of relativity.

He worked tirelessly with colleague John Fields in the early 1930s to set up what became the Fields Medal.

Synge's daughter Cathleen Morawetz (1923-2017) was born in Toronto, and lived in Dublin age 2 to 7. Career at Courant (director in the 1980s). President of the AMS in the 1990s.

Jack Todd (1911-2007) from Belfast studied under Littlewood, and helped to secure the preservation of Oberwolfach in Germany after WWII, then worked at the US National Bureau of Standards and later spearheaded the use of computers to do numerical analysis at Caltech.

Back to Europe: P d'Arcy (1725-1779), W R
Hamilton (1805-1865) & J Graves (1806-1870)



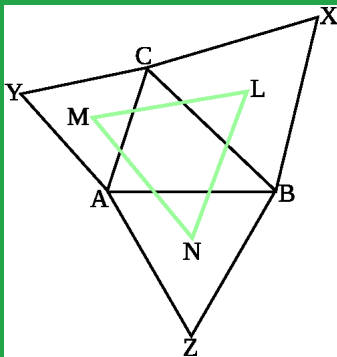
Angular momentum (Patrick d'Arcy, 1746).

From the Hamiltonian to Hamilton-Cayley theorem.

Octonions (John Graves, 1843).

Napoleon's theorem

On the sides of a triangle ABC , construct equilateral triangles, pointing outwards. Notice anything about the centres L , M , N of these new triangles?

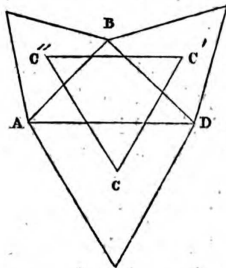


They form the corners of a new equilateral triangle!
First known appearance: TCD exam question, 1820.

Napoleon's theorem

The examinations papers were for getting a Gold Medal at the General BA Examinations.

10. Three equilateral triangles are thus constructed upon the sides of a given triangle, A, B, D ,



the lines joining their centres C, C', C'' , also form an equilateral triangle.

Who set this question? Maybe Bartholomew Lloyd.

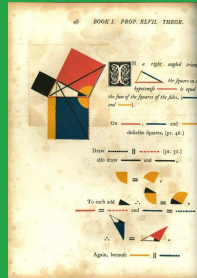
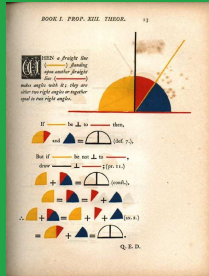
Thomas Kirkman (1806-1895): TCD BA 1833



The Lady's and Gentleman's Diary (1850): "Fifteen young ladies in a school walk out three abreast for seven days in succession: it is required to arrange them daily so that no two shall walk twice abreast."

(English) Kirkman had introduced pluquaternions in 1848; later treated as hypercomplex numbers.

Oliver Byrne (1810-1880)



Avoca-born nationalist. First published in Dublin at 20, spent most of career in England and the USA.

In 1847 issued an innovative coloured treatment of Euclid I-VI. Great Exposition 1851. Available today via Taschen. Recently extended to Euclid VII-XIII.

Foreshadows Mondrian, Bauhaus and De Stijl.

JJ Sylvester (1814-1897)



Liverpool man, earned degrees at Cambridge, but was denied them because of his non-Anglican faith. TCD awarded him BA & MA (1841), facilitating his taking up a position in Virginia, which turned out to be short-lived.

He coined the term “matrix” in 1850.

James Cullen (1867-1933)

Born in Drogheda, studied maths at TCD but left and became a priest. Then taught maths in England.

In 1905, he published about numbers of the form $1 + n \cdot 2^n$, now known as Cullen numbers. The list begins 3, 9, 25, 65, 161, 385,

Sixteen of them are known to be primes, starting with the cases when $n = 1, 141$, or 4713.

Are there infinitely many such numbers which are prime? This is an open question.

Percy Ludgate (1883-1922)



Born in Skibbereen, trained as an accountant, spent several years in the civil service. In his spare time, he worked on the design of a calculating machine which used multiplication as its base mechanism.

In 1909 he published a paper describing what are now called Irish logarithms.

Where are the WOMEN?

In 2021, we surveyed 150 years of Pioneering WOMEN

Women in Irish Maths Exceeding Norms.

From the first half century (up to 1920) when women first dared to pursue maths past secondary school level, to the last decade or two when some—but hardly enough—have made it to the highest levels of academia in Ireland (and overseas).

Before 1970, over 125 women in (or of) Ireland earned maths degrees, or were engaged in mathematical work of some sort. The very early ones were educated privately. Of those who excelled at university, many didn't officially graduate: TCD didn't give women degrees until 1904, Oxford didn't do so until 1920, and Cambridge held out until 1948.

Women in Maths—in and/or of Ireland

A panorama covering 1870-2020



Includes Irish mathematical women, regardless of where they were educated or practiced their craft, together with women from abroad who've worked in maths related fields in Ireland.

Very few of the pioneering WOMEN pre-1920 had the chance to enter academia.

A high proportion of them became teachers.

Some of the early ones pursued astronomy, and some of those settled for publishing under their husbands' names.

Those who did start relevant careers almost always had them cut short if they married.

The First 55 Females: blog at www.mathsireland.ie

We know of 55 relevant Irish women grads (or equivalent) pre 1921. Of those, 5 were “steamboat ladies,” who in the period 1904-1907 were awarded MA’s by TCD. (We are not counting another 7 non-Irish “steamboat ladies.”)

We know 14 of the 55 did research (7 via master’s theses).

21 = 9 + 12 got master’s (higher proportion than for men?).

40 of them taught in secondary schools, and 8 taught at third level, with some overlap. In total, 44 engaged in instruction.

We have photos of 19 of the 55 (so far).

27 of them were associated (at least in part) with Ulster.

26 of them are known to have married.

No career information is known for 7 of the 55.

Three key WOMEN



Mary Clerke (1842-1907) wrote numerous popular books on the history of astronomy, and contributed to the *Encyclopaedia Britannica* on both astronomy and mathematics.

Sophie Wilcock (later Bryant, 1850-1922) was the first woman in Britain to be awarded a doctorate, first woman to have a paper in the *Proceedings of the LMS* (1885).

Alice Boole (later Stott, 1860-1940) was a pioneer in the visualisation of 4D shapes, coined the term *polytope*, wrote book chapters (1888). In the 1930s she worked with Coxeter.

The first known Irish female maths PhD



Born in Kilmore, Wexford. Upon finishing school, she sailed to Texas to become a nun. Educated at Catholic Univ in DC (BA 1920, MA by thesis 1923, PhD 1931).

Her doctoral thesis in algebra was done under Aubrey Landry. She seems to be the first “Irish to secondary level” woman to get a doctorate in pure maths.

She taught at Incarnate Word College in San Antonio until 1943, and later worked for two decades as an accountant in Forth Worth.

The first known Irish female maths PhD



Margaret Gough (*aka* Sister Mary de Lellis)
1892-1983

From 1970 on

Very gradually, over the past half century, more and more WOMEN have started playing fuller roles in academia (and elsewhere, e.g., in industry) both in Ireland and elsewhere.

For those at universities, this includes publishing papers, getting grants, and supervising postgrad and postdoc research.

Also, to a lesser extent, editing/authoring books at all levels, being on editorial boards, and serving in leadership roles.

Analyst Pauline Mellon from Wicklow (education and career at UCD) was the first Irish woman to supervise a pure maths doctorate in Ireland (Michael Mackey, 1999). She recently served as president of the Irish Maths Society.

Is WOMEN's work being adequately rewarded and recognised?

Victor Meally (1911–1986)

A mathematician by nature—and an accountant by profession—with a double first from TCD in Maths & Philosophy (1933).

Editor of the “Encyclopaedia of Ireland” (Allen Figgis, 1968).

Corresponded with D. M. Lehmer, Coxeter, Golomb, Graham, Guy, Knuth, Sloane, and Gardner.

Guy: “Victor was a great experimental elementary number theorist.”

Victor Meally (1911–1986)

Neil Sloane: "His mathematical interests were very broad. He had the first book, *A Handbook of Integer Sequences* (Academic Press, 1973), plus copies of the Supplements that I issued from time to time. The database was stored on punched cards, and the descriptions of the sequences were necessarily very condensed. I had collected them from many libraries in the US and England.

Victor followed my footsteps, and visited the same libraries and many others, and his passion was to collect more complete descriptions, with formulas (which I had had to omit) in his notebooks. They were rather small notebooks, 6" x 8", say, quad ruled with tiny squares, and his handwriting was minute. He would occasionally ask me for more information about a sequence which he could not find in any library."

Victor Meally agus a chairde



HF Sandham (1917-1963)



Henry Sandham (Dublin/Sligo) was educated at TCD (BA 1939), and lectured there for over a decade, then moved to DIAS, earning a PhD with J L Synge. Final years were spent at Nelson Research Labs (Staffordshire). An active contributor to maths journals on topics ranging from hypergeometric functions, and partitions, to sums of squares. Spoke on “The Perimeter of an Ellipse” at the 1954 ICM.

The Weaire-Phelan Structure



In 1993 in Dublin, Denis Weaire & Robert Phelan showed that the 1887 William Thompson (*aka* Kelvin) conjecture about filling 3D space with bitruncated cubic honeycomb based shapes was wrong: the structure shown here (on display in TCD, photo by David Malone) is better.

It represents an idealised foam of equal-sized bubbles, but with two different shapes. It inspired the design of the Beijing National Aquatics Centre in the 2008 Summer Olympics.

Adrian Raftery

Statistician with TCD BA (1976), TCD staff 1980-1986, Univ of Washington (Seattle) since then, has supervised 36 PhD students.



Identified as the world's most cited researcher in mathematics for 1995-2005 by Thomson-ISI.

Donal O'Regan of UCG/NUIG/UG



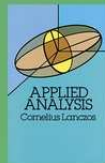
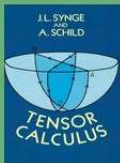
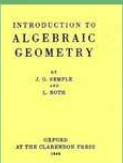
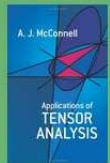
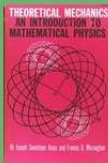
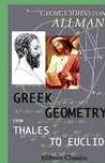
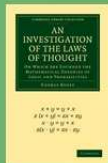
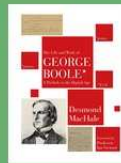
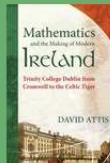
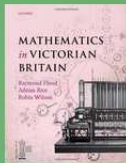
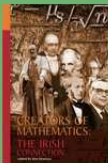
Works in nonlinear analysis, differential equations, and fixed-point theory. By end of 2012, he had published an average of one paper a week and one book a year since 1990.

He has not been idle since then, and has by now co-authored over 35 books.

People who have supervised Irish graduate research

Emile Picard, Wilhelm Röntgen, Frank Morley, E. T. Whittaker, J. E. Littlewood & G. H. Hardy, Max Born, Emil Artin, William Feller, Frank Smithies, Graham Higman, A. S. Besicovitch, William Hodge, Alfred Goldie, Walter Hayman, Olga Taussky, Gil Strang, Tom Banchoff, Ali Fröhlich, John H. Conway, Bob Fefferman, Karen Uhlenbeck, Kip Thorne, Vaughan Jones, Richard Stanley, Hans Schneider, Grace Wahba, George Lusztig, Richard Taylor, Goro Shimura, Peter Sarnak, Ingrid Daubechies, Bill Thurston, Hendrik Lenstra, Tim Gowers, Stephen Hawking, Fan Chung and others.

Three centuries of Irish maths books



Scope

In addition to documenting books in expected areas like number theory, geometry, real functions, DEs, fluid mechanics, relativity, quantum theory, and so on, we also feature actuarial science, and the following topics from the AMS mathematics subject classification system:

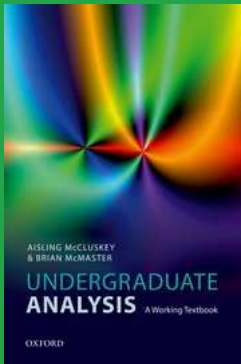
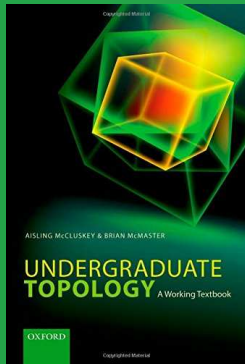
history, biography, geophysics, astronomy, maths education, biology and other natural sciences, operations research, mathematical programming and computer science.

The 1800s—popular text books and more

Prolific authors included James Thomson (6+), John Young (22+*), James MacGauley (4), Robert Graves (3), George Boole (4*), John Jellett (3), George Salmon (4), Matthew O'Brien (7), Joseph Galbraith (10), George Stokes (3), Samuel Haughton (10), Benjamin Williamson (4), Peter Tait (22*), Joseph Everett (4), Robert Ball (10*), William Monck (5+), Francis Tarleton (4), and John Casey (7).

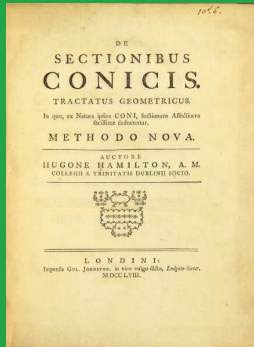
Many of those wrote popular texts in Ireland which were used worldwide and ran to several editions.

Modern Textbooks



Aisling McCluskey & Brian McMaster
(Oxford University Press)

Feature 1 of 5



The treatise *De Sectionibus Conicis: Tractatus Geometricus* (1758) by Dubliner Hugh Hamilton (1729-1805).

Hailed by Euler as “a perfect book”.

Feature 2 of 5

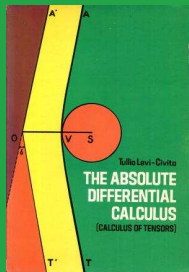


Volume and Surface Integrals Used in Physics
(1905) by Belfast's John Gaston Leathem.

On page 13 the arrow notation for limits was introduced by this Queen's College Belfast graduate.

G. H. Hardy enthusiastically adopted this usage in his book *Course of Pure Mathematics* (1908), crediting Leathem and Bromwich. (Leathem disputed the Bromwich attribution!)

Feature 3 of 5



Tullio Levi-Civita's *Absolute Differential Calculus* (1927) as translated by Marjorie Long.

Long was a University College Galway graduate (MA via study at Girton). She published "On Geiser's Method of Generating a Plane Quartic" in the Proceedings of the LMS in 1911.

After a Long search ...



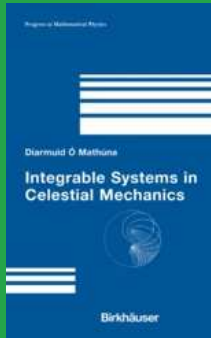
Chancel or

MISS MARJORIE LONG

Miss Marjorie Long, who was
equal to the fourth wrangler in
the recent tripos

Marjorie Long 1886-1937

Feature 4 of 5



Integrable Systems in Celestial Mechanics (2008) by Cork's Diarmuid Ó Mathúna, graduate of UCC.

Vincent Hart: "This book achieves the complete analytic solution to the problem of a body moving in the gravitational field of two fixed centres, thus completing Euler's solution. Not many items can improve on the great Euler."

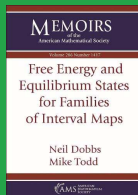
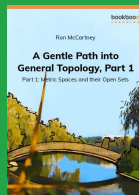
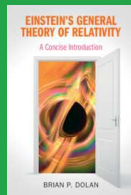
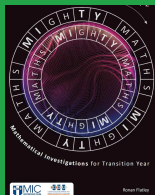
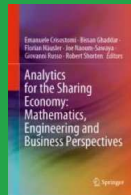
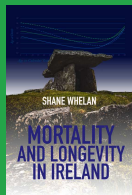
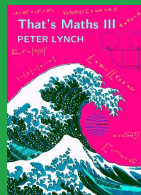
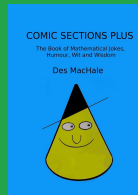
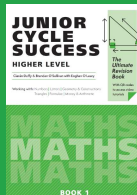
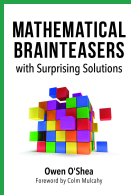
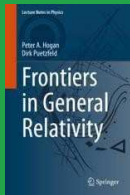
Feature 5 of 5



That's Maths (2016) by Dublin's Peter Lynch.

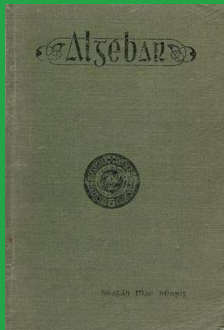
100 essays about how maths is everywhere. Many of these had appeared in the **Irish Times**. Some recall the wondrous spirit of Martin Gardner, others have more of an engineering bent. Lynch trained in pure maths and worked for 35 years as a meteorologist. More collections have been published.

The 2020s



Irish maths books

Maths books in the Irish language?



There are a few of those. . . but we are out of time.

Numerators and demoninators (Oct 2023)

The 5302 currently known people in AIMM includes many with non-mathematical careers and also non-Irish doctoral students with non-Irish careers. We estimate that 1548 of them are "Irish mathematicians."

How many of them have authored books?

We have yet to tease that information out of our data.

How many maths books have they authored? 1010.

Note that

$$\frac{1010}{1548} = 65\%$$

Special thanks to:

Tony O'Farrell, Sean Dineen, Ted Hurley, Mike Hayes, Tom Laffey, Dave Lewis, Phil Boland, Eugene Gath, Des MacHale, Mark McCartney, Tony Wickstead, Robin Harte, Richard Timoney, David Spearman, Olivia Bree, Finbarr Holland, Maurice O'Reilly, Rod Gow, Dan Dundas, David Malone, Elizabeth Oldham, Mary Cunneen, and many others, who helped to gather, evaluate and refine the information on which this project is based.

Congratulations to the IMS on turning 50!

