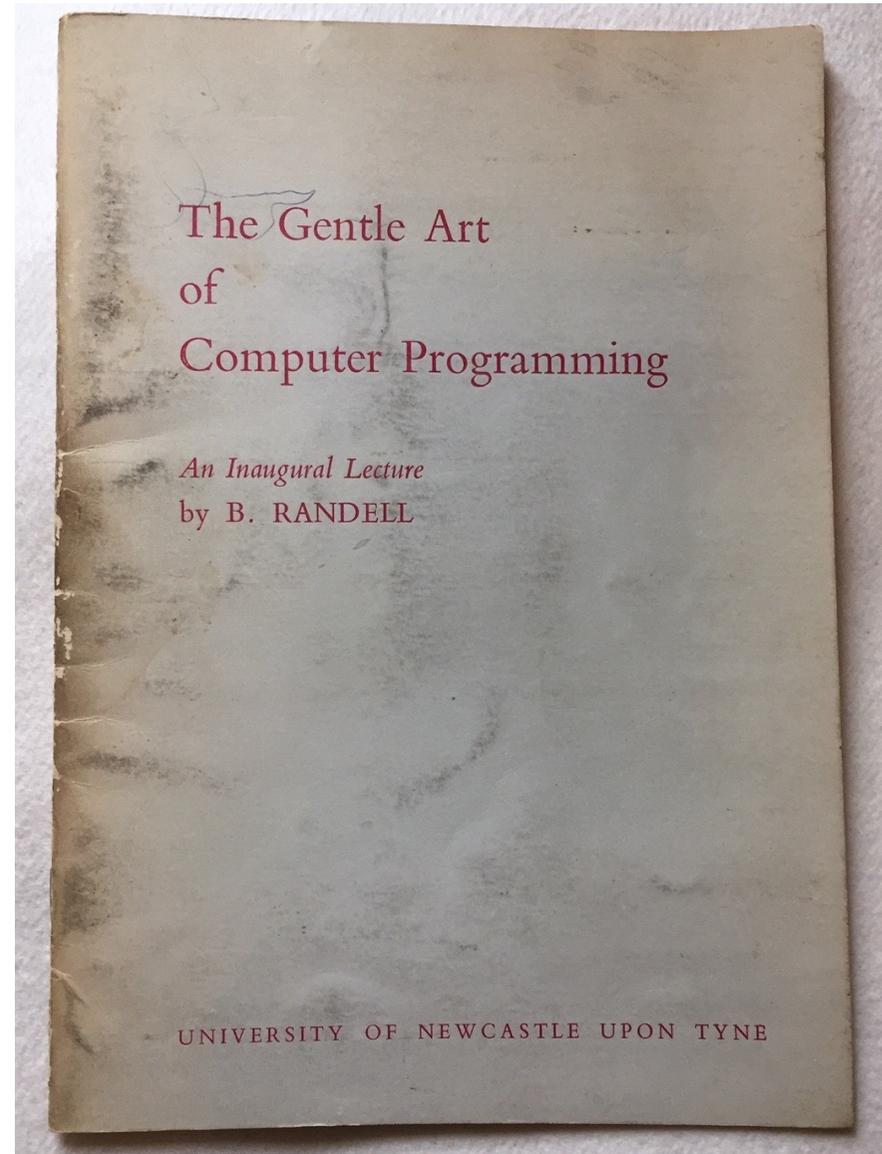# Investigating the Work and Life of Percy Ludgate (1883-1922)
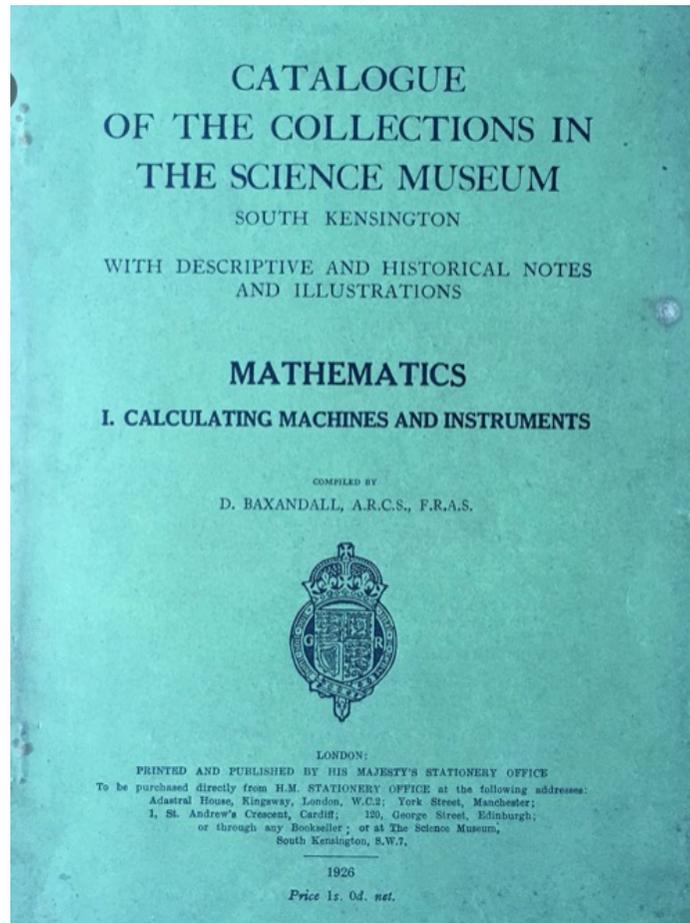
Brian Randell

Newcastle University

Percy Edwin Ludgate

<u>The Beginning</u>: I stumbled across Ludgate in 1970 shortly after I arrived at Newcastle University, while I was preparing my Inaugural Lecture and was looking for interesting things to say about Ada Lovelace and Charles Babbage.
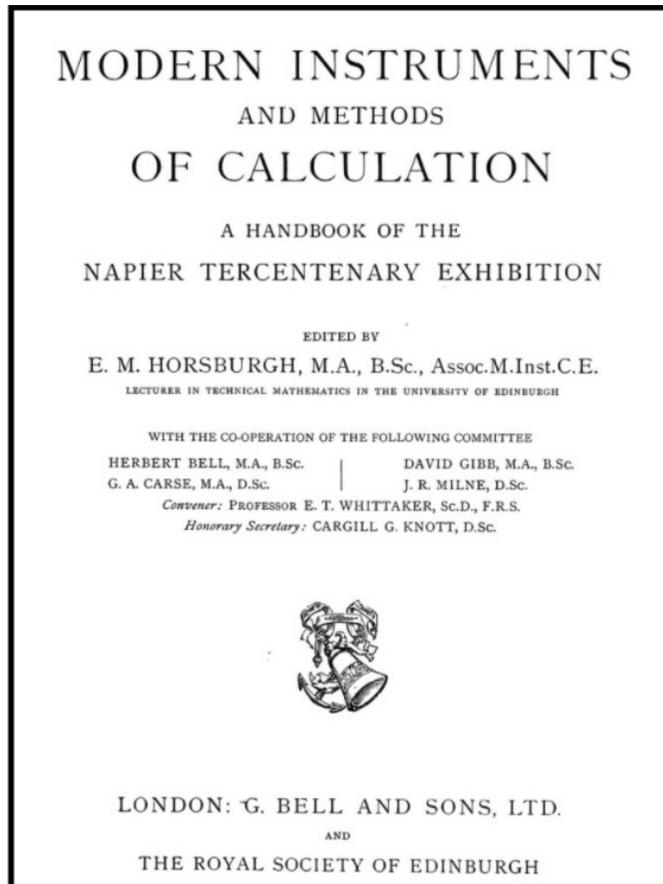

The Gentle Art
of
Computer Programming

An Inaugural Lecture
by B. RANDELL

UNIVERSITY OF NEWCASTLE UPON TYNE

The 1926 Science Museum Catalogue

CATALOGUE OF THE COLLECTIONS IN THE SCIENCE MUSEUM

SOUTH KENSINGTON

WITH DESCRIPTIVE AND HISTORICAL NOTES AND ILLUSTRATIONS

MATHEMATICS

I. CALCULATING MACHINES AND INSTRUMENTS

COMPILED BY

D. BAXANDALL, A.R.C.S., F.R.A.S.

LONDON:
PRINTED AND PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE
To be purchased directly from H.M. STATIONERY OFFICE at the following addresses:
Adastral House, Kingsway, London, W.C.2; York Street, Manchester;
1, St. Andrew's Crescent, Cardiff; 120, George Street, Edinburgh;
or through any Bookseller; or at The Science Museum,
South Kensington, S.W.7.

1926

Price 1s. 0d. net.

I noticed that their *Calculating Machines and Instruments* catalogue mentioned that a **Percy Ludgate** had designed a Difference Engine – a name that was not familiar to me.
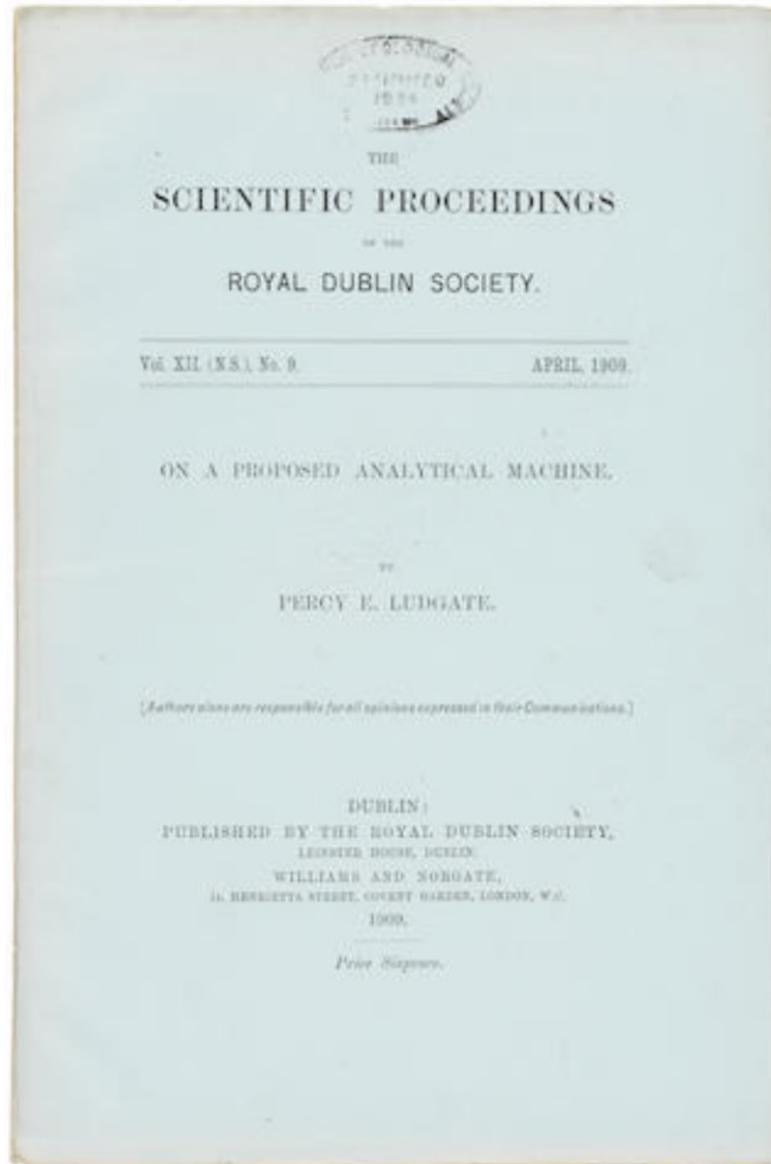
Other difference engines were designed and made by Martin Wiberg (1863) in Sweden, G. B. Grant in the United States; others were designed by Léon Bollée in France, and Percy E. Ludgate in Ireland, which, however, were never constructed.

MODERN INSTRUMENTS
AND METHODS
OF CALCULATION

A HANDBOOK OF THE
NAPIER TERCENTENARY EXHIBITION

EDITED BY
E. M. HORSBURGH, M.A., B.Sc., Assoc.M.Inst.C.E.
LECTURER IN TECHNICAL MATHEMATICS IN THE UNIVERSITY OF EDINBURGH

WITH THE CO-OPERATION OF THE FOLLOWING COMMITTEE

HERBERT BELL, M.A., B.Sc.   DAVID GIBB, M.A., B.Sc.
G. A. CARSE, M.A., D.Sc.   J. R. MILNE, D.Sc.
Convener: PROFESSOR E. T. WHITTAKER, Sc.D., F.R.S.
Honorary Secretary: CARGILL G. KNOTT, D.Sc.

LONDON: G. BELL AND SONS, LTD.
AND
THE ROYAL SOCIETY OF EDINBURGH

The 1914 Edinburgh Exhibition Handbook

I was led to the splendid *Handbook of the 1914 Napier Tercentenary Exhibition*, in which **Percy Ludgate** had a Chapter: "**Automatic Calculating Machines**" which ended with a. startling claim.

I have myself designed an analytical machine, on different lines from Babbage's, to work with 192 variables of 20 figures each. A short account of it appeared in the *Scientific Proceedings, Royal Dublin Society*, April 1909. Complete descriptive drawings of the machine exist, as well as a description in manuscript, but I have not been able to take any steps to have the machine constructed.

THE

SCIENTIFIC PROCEEDINGS

OF THE

ROYAL DUBLIN SOCIETY.

Vol. XII. (N.S.), No. 9.   APRIL, 1909.

ON A PROPOSED ANALYTICAL MACHINE.

BY

PERCY E. LUDGATE.

[Authors alone are responsible for all opinions expressed in their Communications.]

DUBLIN:
PUBLISHED BY THE ROYAL DUBLIN SOCIETY,
LEINSTER HOUSE, DUBLIN.
WILLIAMS AND NORGATE,
14, HENRIETTA STREET, COVENT GARDEN, LONDON, W.C.
1909.

Price Sixpence.

The Royal Dublin Society Paper:

PERCY E. LUDGATE:

ON A PROPOSED ANALYTICAL MACHINE (1909)

(Preprints of Ludgate's original paper cost sixpence in 1909 – this copy fetched $1000 at auction in 2015.)

The 1909 Paper's Opening

ON A PROPOSED ANALYTICAL MACHINE.

By PERCY E. LUDGATE.

(COMMUNICATED BY PROFESSOR A. W. CONWAY, M.A.)

[Read FEBRUARY 23. Ordered for Publication MARCH 9. Published APRIL 28, 1909.]

I PURPOSE to give in this paper a short account of the result of about six years' work, undertaken by me with the object of designing machinery capable of performing calculations, however intricate or laborious, without the immediate guidance of the human intellect.

Ludgate's Disclaimer

In order to prevent misconception, I must state that my work was not based on Babbage's results—indeed, until after the completion of the first design of my machine, I had no knowledge of his prior efforts in the same direction. On the other hand, I have since been greatly assisted in the more advanced stages of the problem by, and have received valuable suggestions from, the writings of that accomplished scholar. There is in some respects a great resemblance between Babbage's Analytical Engine and the machine which I have designed—a resemblance which is not, in my opinion, due wholly to chance, but in a great measure to the nature of the investigations, which tend to lead to those conclusions on which the resemblance depends. This resemblance is almost entirely confined to the more general, abstract, or mathematical side of the question; while the contrast between the proposed structure of the two projected machines could scarcely be more marked.

Ludgate's Program-Controlled Computer

- Ludgate credibly claims little prior knowledge of Babbage - the three main components (store, arithmetic unit, sequence controller) of his machine all show evidence of <u>considerable ingenuity and originality</u>.

- Each 20-digit signed decimal number was represented by a set of sliding rods in a shuttle; the set of 192 shuttles were arranged around two concentric cylindrical shuttle boxes.

- The planned arithmetic unit was based on what the 1909 review in *Nature* of Ludgate's paper delightfully termed "**Irish Logarithms**".

- Multiplication involved representing <u>all the digits</u> of the multiplicand, and a <u>single digit</u> (at a time) of the multiplier, as "logarithmic" <u>index numbers</u>; the multiplier index number was simultaneously added to each of the 20 multiplicand index numbers (by additive linear motion).

- The results were then converted back to give a set of two-digit decimal partial products, and added into the decimal accumulator (the "mill").

"Irish Logarithms"

- Ludgate introduced a brand new concept, that he called an "Index", to do multiplication based on a form of logarithm, now known as <u>Irish Logarithms</u>.

- The core of his machine did not just do additions; it did multiply-accumulate (MAC), i.e. multiply followed by add to any previous result in the Mill.

- For two (single-digit) operands Z_J and Z_K, Ludgate's <u>index numbers</u> ensure $Z_{J*K} = Z_J + Z_K$.

- Some example indexes are:
  $Z_1 = 0$, $Z_2 = 1$, $Z_3 = 7$, $Z_4 = 2$, $Z_5 = 23$,

- **$Z_3 + Z_5 = 7 + 23 = 30 = Z_{15}$.**

- (Ludgate perhaps found his set of index numbers by 'trial and error'.)

The Tables of Irish Logarithms as printed in Ludgate 1909

TABLE 1.

Unit.	Simple Index No.	Ordinal.
0	50	9
1	0	0
2	1	1
3	7	4
4	2	2
5	23	7
6	8	5
7	33	8
8	3	3
9	14	6

TABLE 2.

Partial product.	Comp. Index No.	Partial product.	Comp. Index No.	Partial product.	Comp. Index No.
1	0	15	30	36	16
2	1	16	4	40	26
3	7	18	15	42	41
4	2	20	25	45	37
5	23	21	40	48	11
6	8	24	10	49	66
7	33	25	46	54	22
8	3	27	21	56	36
9	14	28	35	63	47
10	24	30	31	64	6
12	9	32	5	72	17
14	34	35	56	81	28

Comp. index numbers of zero :—50, 51, 52, 53, 57, 58, 64, 73, 83, 100.

TABLE 3.

Comp. Index No.	Partial product.	Comp. index No.	Partial product.
0	1	34	14
1	2	35	28
2	4	36	56
3	8	37	45
4	16	38	—
5	32	39	—
6	64	40	21
7	3	41	42
8	6	42	—
9	12	43	—
10	24	44	—
11	48	45	—
12	—	46	25
13	—	47	63
14	9	48	—
15	18	49	—
16	36	50	0
17	72	51	0
18	—	52	0
19	—	53	0
20	—	54	—
21	27	55	—
22	54	56	35
23	5	57	0
24	10	58	0
25	20	59	—
26	40	60	—
27	—	61	—
28	81	62	—
29	—	63	—
30	15	64	0
31	30	65	—
32	—	66	49
33	7		

Ludgate's Tables

Decimal operand	Simple index	Ordinal number	Partial product	Compound index	Partial product	Compound index	Partial product	Compound index
0	50	9	1	0	(15)	[30]	36	16
1	0	0	2	1	16	4	40	26
2	1	1	3	7	18	15	42	41
(3)	[7]	4	4	2	20	25	45	37
4	2	2	5	23	21	40	48	11
(5)	[23]	7	6	8	24	10	49	66
6	8	5	7	33	25	46	54	22
7	33	8	8	3	27	21	56	36
8	3	3	9	14	28	35	63	47
9	14	6	10	24	30	31	64	6
			12	9	32	5	72	17
			14	34	35	56	81	28

(Simple indexes form a non-monotonic function of the decimal operands, but a monotonic function of the "ordinals".)

The Sequencing Mechanism

- The Analytical Machine was to be controlled from a keyboard, or by a "formula-paper" (a sheet or roll of perforated paper), on which each row of perforations defined a complete instruction – a definite improvement on Babbage. Operand values came from a "number-paper", or a second keyboard.

- Each instruction specified the type of arithmetic operation to be performed, and identified two operands, i.e. the shuttles involved.

- Ludgate agreed with Babbage as to the fundamental importance of <u>conditional branching</u> – presumably to be done by skipping a specified number of rows, either forwards or backwards – e.g. at "a change in the value of a function or its approach to zero or infinity".

- He made provision for built-in subroutines. The operation code for Division, for example, passed control temporarily to a sequence of instructions represented by perforations in a permanent 'dividing cylinder'.

- Another cylinder provided a logarithm subroutine, and he mentioned that "this system of cylinders ... may be indefinitely extended".

Results of my 1970 (Pre-Internet!) Investigation

- Just one relative of Percy Ludgate, his niece Violet, was found – in fact by the Royal Dublin Society Secretary, who called all the Ludgates in the Dublin Telephone Directories for me!

- Violet's family had lived near Percy Ludgate – she was 19 when he died – her memories were my main source of information.

- She provided the only known photograph of Ludgate.

- I tracked down just one colleague with recollections of Ludgate as an accountant, and learned he won praise for his work during WW1 for a committee controlling supplies to the cavalry.

- I found a review of his 1909 paper in *Nature* by Prof. C.V. Boys.

- In 1914 Ludgate had stated: "Complete descriptive drawings of the machine exist, as well as a description in manuscript, but I have not been able to take any steps to have the machine constructed."

- But NONE of these drawings or manuscripts could be found!

Just Two Publications Resulted

Ludgate's analytical machine of 1909

B. Randell

Computing Laboratory, Claremont Tower, University of Newcastle upon Tyne

This paper discusses the little known analytical machine, or program-controlled mechanical calculator, designed by Percy E. Ludgate in Ireland during the years 1903 to 1909, and documents the results of a search for information about his life and work.

(Received January 1971)

1971

B. Randell - Ludgate, Torres, Bush

From Analytical Engine to
Electronic Digital Computer:
The Contributions of
Ludgate, Torres, and Bush
BRIAN RANDELL

This paper, based on an invited lecture given at MIT in March 1980, discusses the little-known work of Percy E. Ludgate (1883-1922), Leonardo Torres y Quevedo (1852-1936), and Vannevar Bush (1890-1974). These three inventors, who apparently were unaware of one another's existence, were all directly influenced by knowledge of Charles Babbage's Analytical Engine, and each played a significant role in the history of the development of program-controlled computers.

1982

My 1971 *Computer Journal* paper, and my 1982 paper in the *Annals of the History of Computing* revealed Ludgate and resurrected him from obscurity, **but no new information was found and revealed about Ludgate or his machine until . . .**

. . . 2017, When The Hunt Resumed

- I was contacted out of the blue by <u>Dr. Brian Coghlan</u>, curator of The John Gabriel Byrne Computer Science Collection of machines and documents in Trinity College Dublin.

- The Byrne Collection now holds copies (many original) of all the known literature and records relating to Ludgate. Its cataloguing had prompted Coghlan's attempt to investigate:

  - **Is there any chance that Ludgate's drawings and documents still exist and can be found?**

  - **Are any relatives (perhaps descended from his parents) alive or their possessions findable - and if so are there any documents, photos or memories of Percy Ludgate?**

- I soon found myself enmeshed in the team Brian Coghlan had assembled for his Ludgate investigation.

- This investigation's results to date are described in the January-March 2021 issue of the *IEEE Annals of the History of Computing* – and (shortly) in the *Proceedings of the Royal Irish Academy*.

Our Annals Paper

ARTICLE

Investigating the Work and Life of Percy Ludgate

Brian Coghlan, *Trinity College Dublin, The University of Dublin, Ireland*

Brian Randell, *Newcastle University, U.K.*

Paul Hockie, *Genealogist, U.K.*

Trish Gonzalez, *Genealogist, USA*

David McQuillan, *Retired Systems Designer, U.K.*

Reddy O'Regan, *Retired Solicitor, Ireland*

The Royal Irish Academy Paper

Percy Ludgate (1883–1922), Ireland's first computer designer

BRIAN COGHLAN*
School of Computer Science and Statistics, Trinity College Dublin, Ireland.

BRIAN RANDELL
School of Computing, Newcastle University, U.K.

PAUL HOCKIE
London, U.K.

TRISH GONZALEZ
Florida, U.S.A.

DAVID MCQUILLAN
Wokingham, U.K.

REDDY O'REGAN
Skibbereen, Co.Cork, Ireland.

Proceedings of the Royal Irish Academy (To be published "real soon" now :-)

This second paper concentrates mainly on Ludgate's background and life.

Babbage's Analytical Engine – 1834
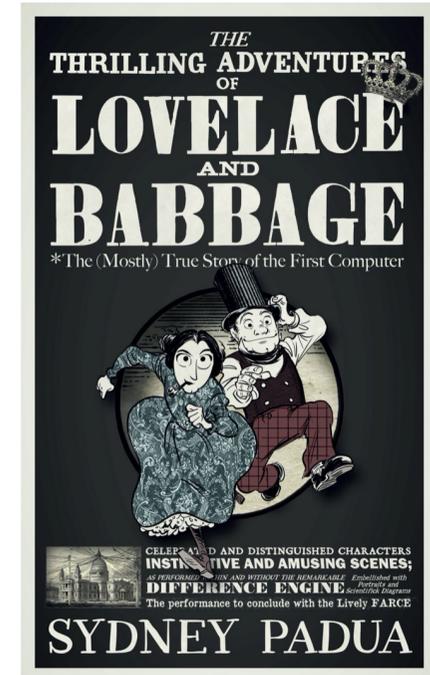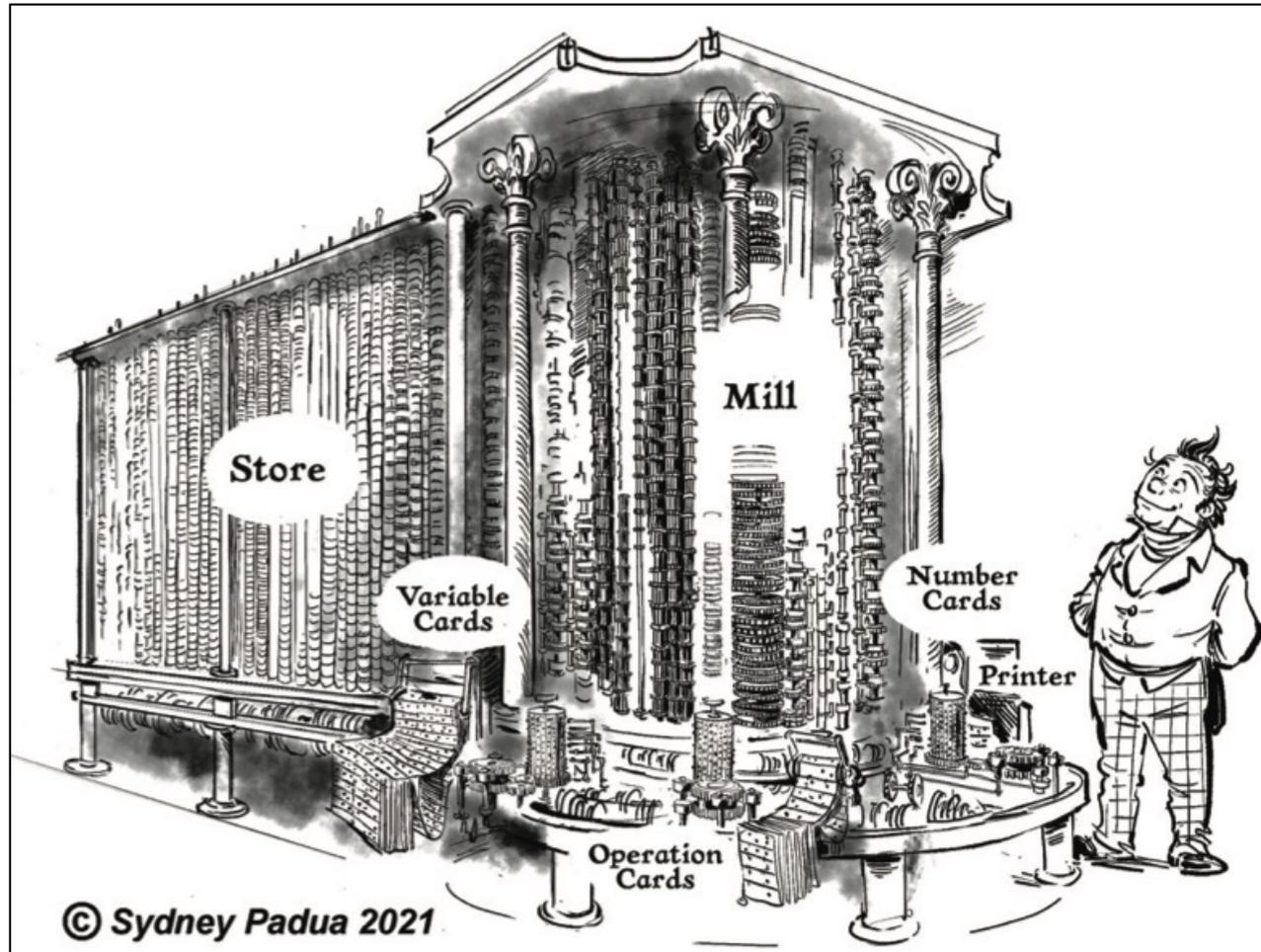
A monstrous machine, of which only a small fragment was ever built.

Ludgate's Machine 1909 – conjectural diagram
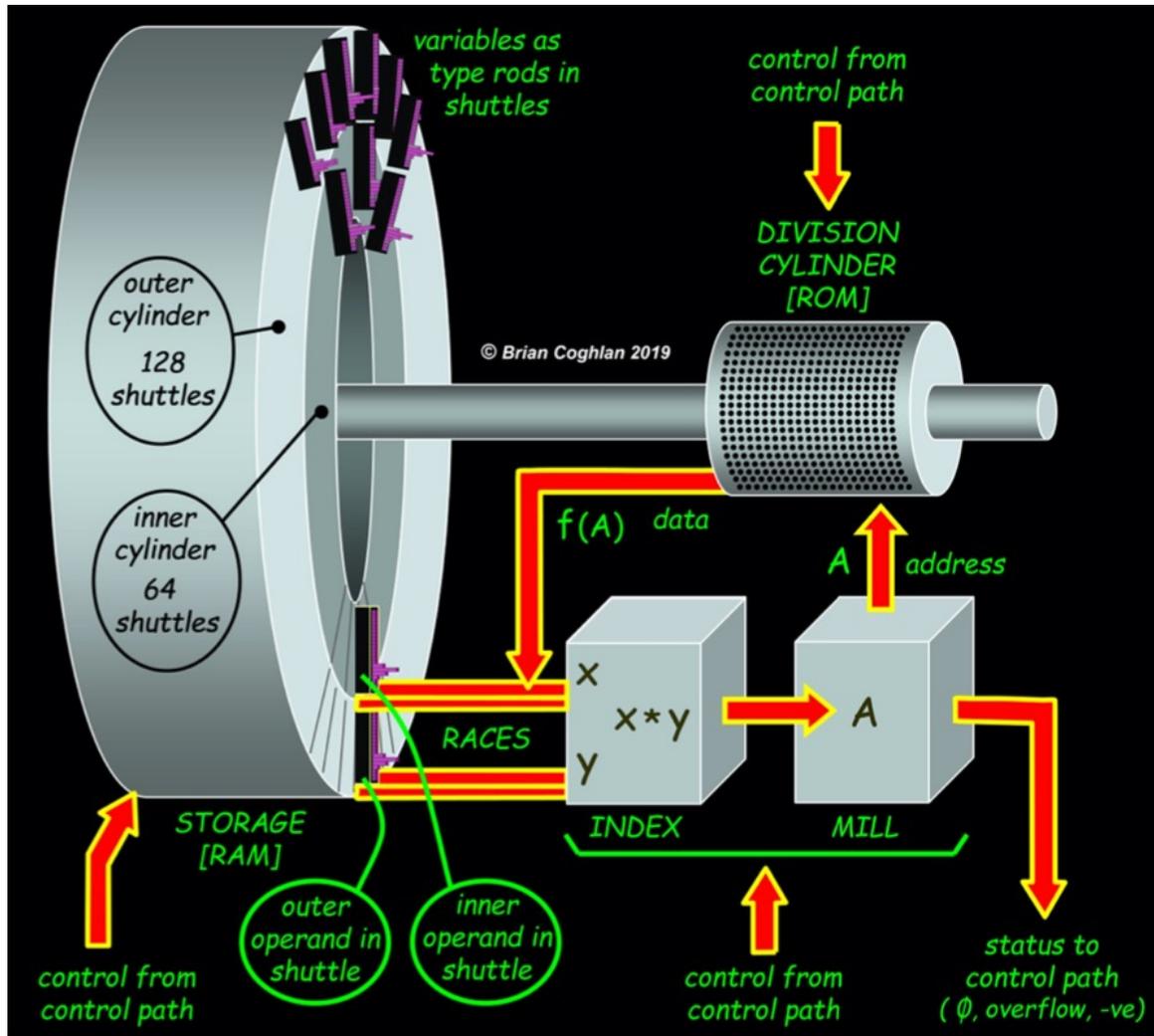
Here 'control path', 'data path', 'status', 'RAM', 'ROM', ' address', data', are modern terms, all other terms are from Ludgate's 1909 paper.

(A "Race" is "a groove or guide in which a ball bearing or roller bearing runs".)

The Two Designs Compared

© Brian Coghlan 2020

© Sydney Padua 2021
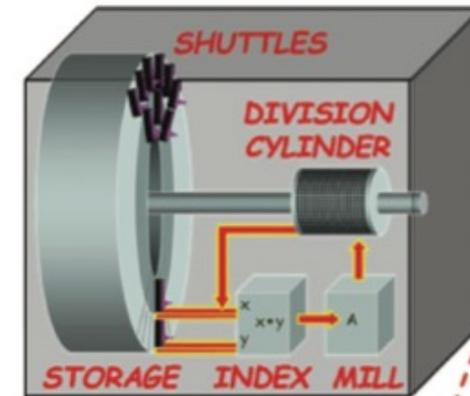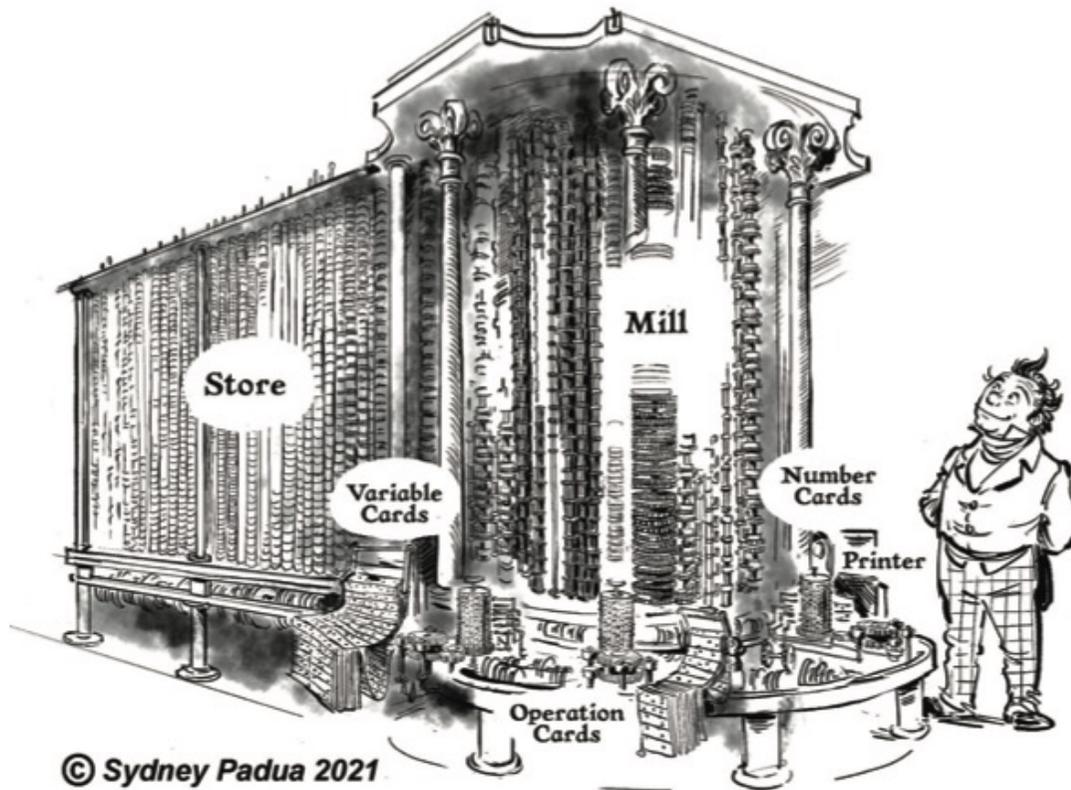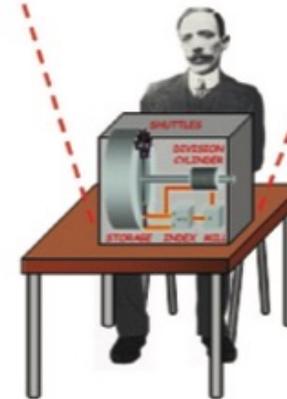
Ludgate's Tables (Again)

Decimal operand	Simple index	Ordinal number
0	50	9
1	0	0
2	1	1
3	7	4
4	2	2
5	23	7
6	8	5
7	33	8
8	3	3
9	14	6

Partial product	Compound index	Partial product	Compound index	Partial product	Compound index
1	0	15	30	36	16
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4	2	20	25	45	37
5	23	21	40	48	11
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7	33	25	46	54	22
8	3	27	21	56	36
9	14	28	35	63	47
10	24	30	31	64	6
12	9	32	5	72	17
14	34	35	56	81	28

The right-hand table lists compound indexes representing the partial products. Thus, using the initial digits from the example in Ludgate 1909 (**8132 * 9247**):

$$Z_8 + Z_9 = 3 + 14 = 17 = Z_{72}$$

Logarithmic Slides and Rods
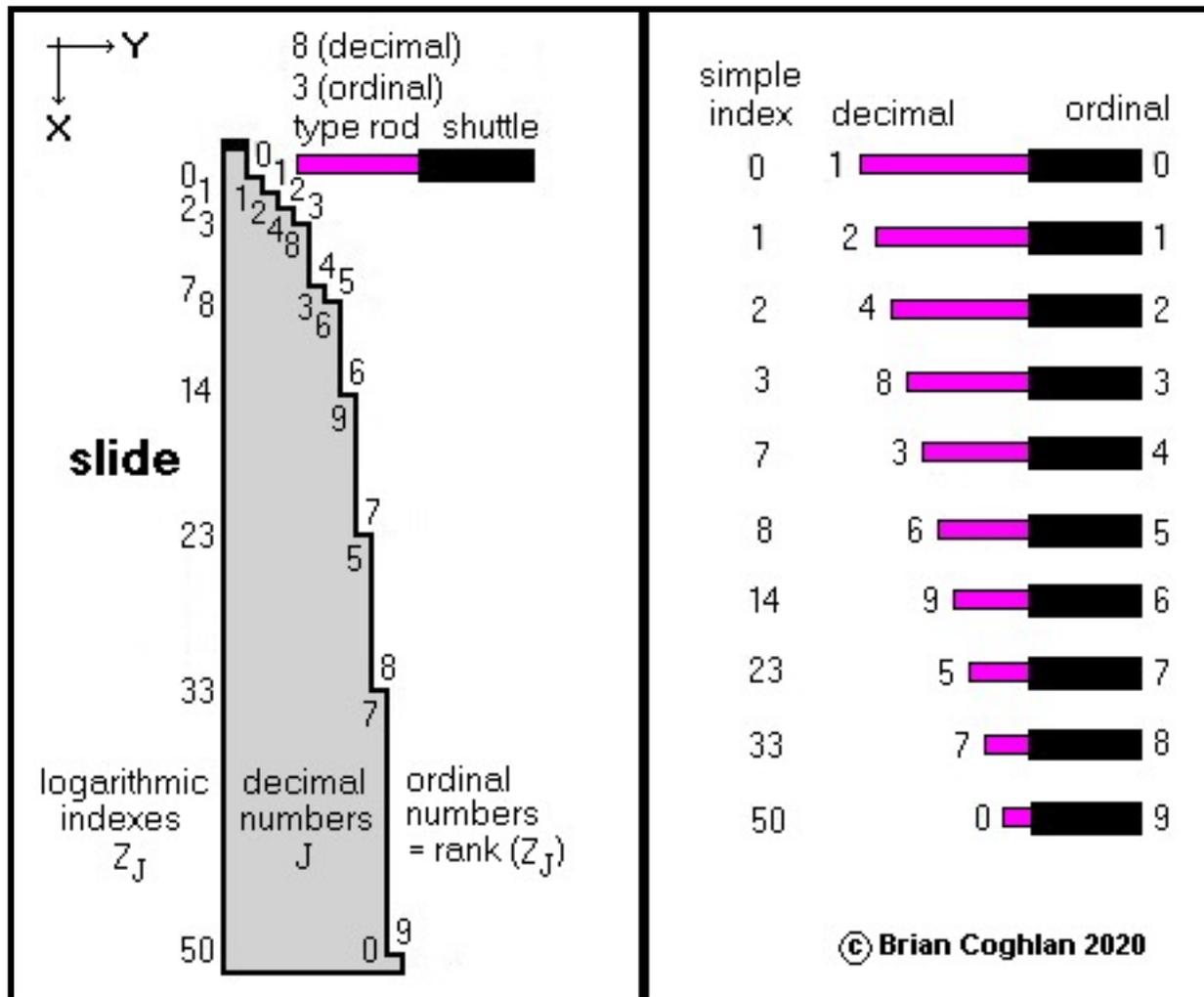
An Index Slide

Rod Protrusions

LHS: A "Slide" (presumed design) for converting ordinals representing decimal digits to "logarithms".

RHS: A set of rods, whose protrusions represent the set of decimal digits. The extent of each protrusion matches a decimal digit's <u>ordinal</u> value – thus they are <u>monotonic</u> and engage conveniently with a set of "steps" in the slide's profile.

Logarithmic Multiplication
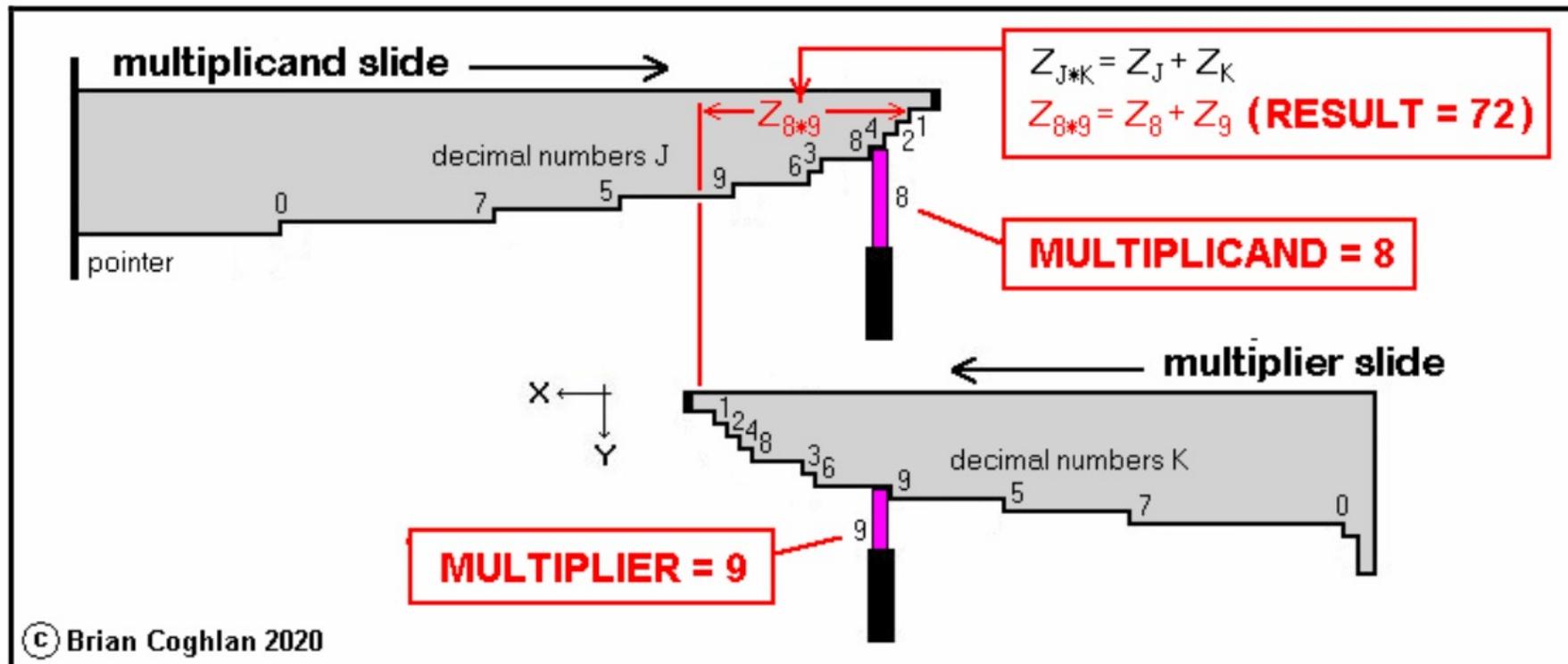
(It is not evident how the resulting <u>product</u> of two digits (the <u>increased overlap</u> of the two slides) is converted to a pair of decimal digits and transmitted to the "Mill".)

A Drawing is Discovered!

- The chance of our finding Ludgate's drawings was remote, but the search was nevertheless intense and protracted. Family wills and papers were sought, libraries and archives (and the Internet) were scoured, and attempts made to find paperwork related to his career, to his submission of his 1909 Royal Dublin Society paper, and to his paper for the 1914 Napier Tercentenary Celebration.

- Just before Christmas 2019, prompted by our publicity campaign, an account of his work was discovered by Ralf Buelow (Heinz Nixdorf MuseumsForum) in the little-known magazine *The English Mechanic and World of Science* (Sept. 1909), which turned out to be derived from one in the equally obscure journal *Engineering* (August 1909).

- **Both included a drawing representing Ludgate's Index! This drawing surely must have been provided by Ludgate himself!**

- This additional information has facilitated detailed conjecturing concerning the design of the Index in particular.
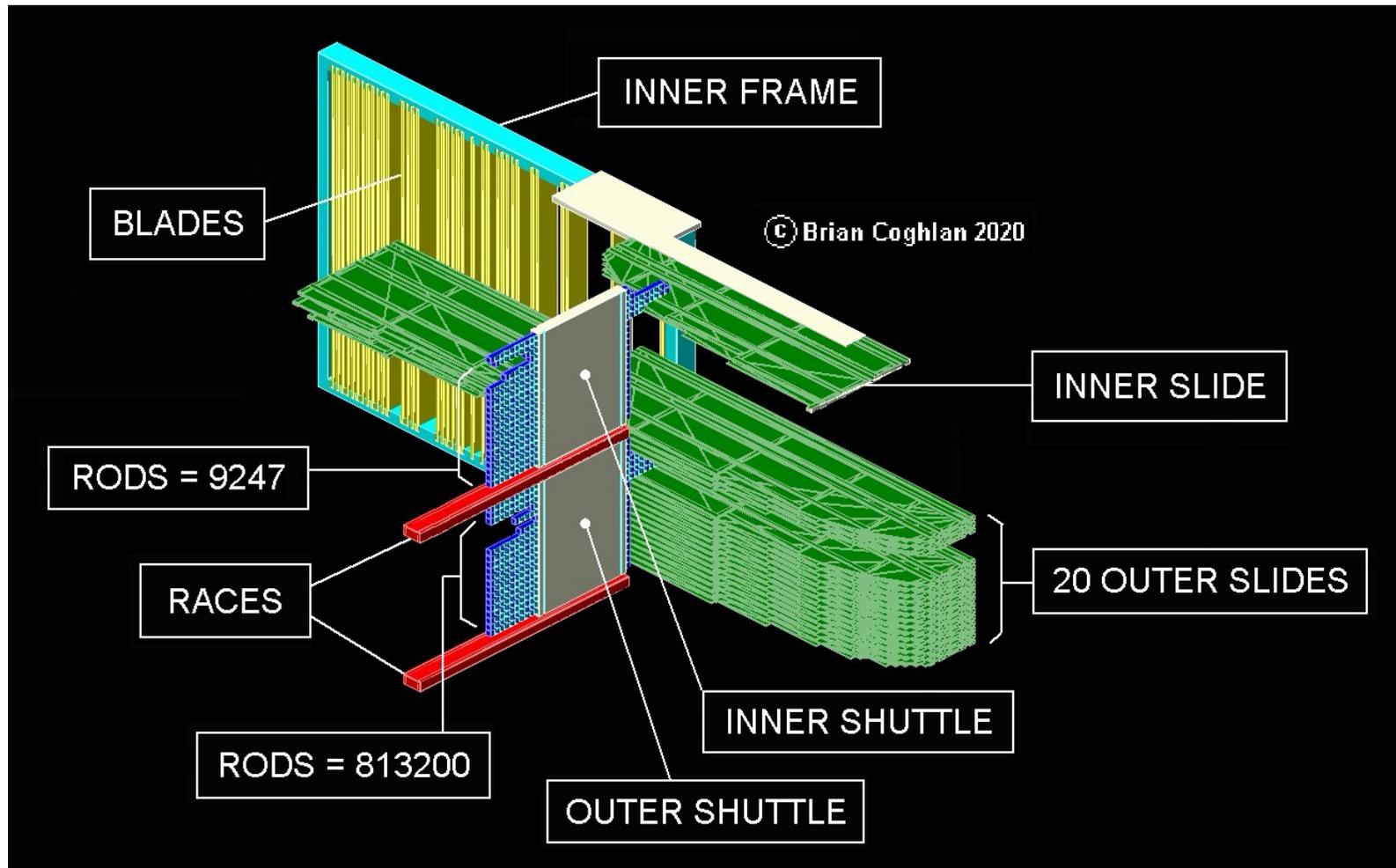
The Drawing of the "Index"
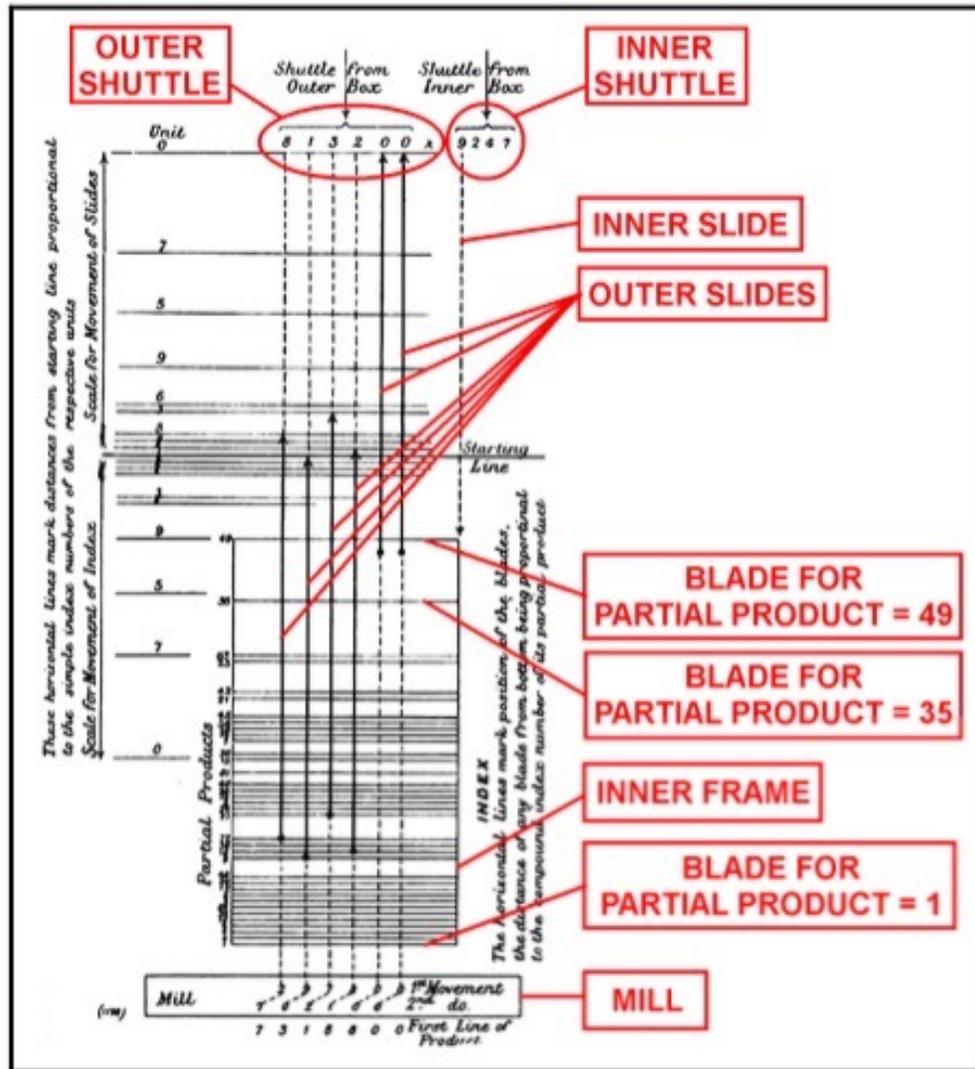
Annotated version of the Diagram
from:
Anon. A Proposed Analytical Machine, *Engineering*, 20 Aug. 1909.
– which shows an Inner (Multiplier) slide and the Outer (Multiplicand) Index slides (edge-on).

"In Babbage's engine, it was proposed to effect multiplication by successive additions, and divisions by successive subtractions . . . Mr. Ludgate, in his engine, proposes to effect these operations on entirely different principles. Multiplication is effected by a series of index numbers analogous to logarithms. The arrangement is shown diagrammatically in Figure 1. Here, the number 813,200 is to be multiplied by 9247."
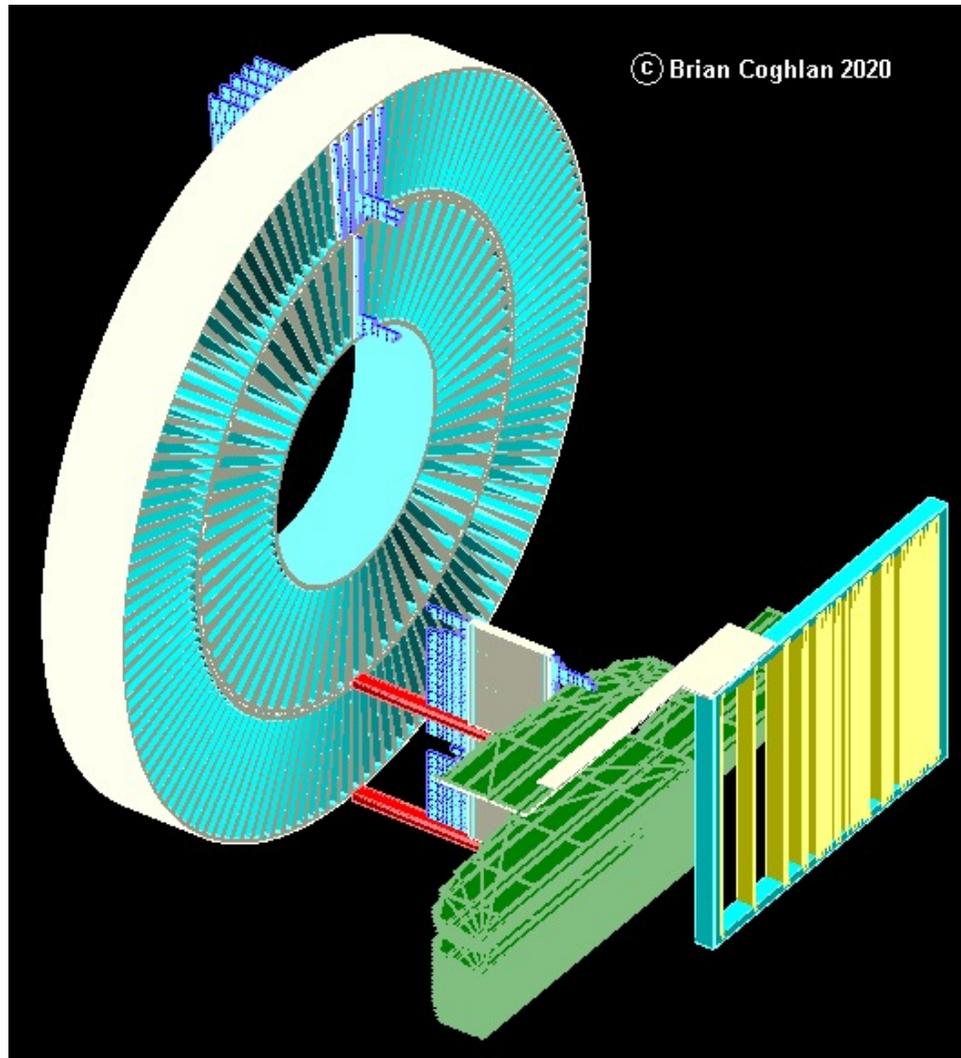
Ludgate's "Index"

INNER FRAME

BLADES

© Brian Coghlan 2020

INNER SLIDE

RODS = 9247

20 OUTER SLIDES

RACES

RODS = 813200

INNER SHUTTLE

OUTER SHUTTLE

See Annals article, and our on-line analysis, for an explanation of this early 3D CAD rendition.

The Store and Index

© Brian Coghlan 2020

An early 3D CAD rendition of a possible re-imagined Ludgate's Store and Index.

Three-quarter view, showing inner and outer shuttles withdrawn along the "Races" .
(These drawings actually show '813200' multiplied by '9', the first digit of '9247', the example portrayed in the 1909 drawing in *Engineering.)*

What we've added to our understanding

Base operation is **multiply-accumulate (MAC),** not addition

Multiply is done with **Irish Logarithms** by **INDEX**

Long multiply **starts at left digit** of multiplier

☆ Numbers must be **fixed point**

Multiply-accumulate result **units first, then tens** by **MILL**

☆ Timing implies **pipelining** tens carryadds

☆ Instruction set: **ADD, SUBTRACT, MULTIPLY, DIVIDE, STORE, CONDITIONAL BRANCH**

Two-operand addressing for LOAD and STORE

Fast for 1909: ADD/SUB 3 sec, MUL 10 sec, DIV 90 sec, LOG 120 sec

☆ Storage of 192 variables implies **(64 inner and 128 outer) shuttles** equi-spaced

☆ Hence storage size implies **binary storage addressing**

Numbers stored via **rod for sign & every digit** protruding 1-10 units

Data input/output via **perforated number-paper** (or upper keyboard)

Program input/output via **perforated formula-paper** (or lower keyboard), one instruction per row

☆ **Manual preemption**

Small size: estimated by Ludgate as 0.5m H x 0.7m L x 0.7m W

☆ denotes inferences that we have documented in a detailed on-line analysis

CCS – 16 September 2021

# Ludgate's Analytical Machine – Some Still Unsolved Questions

- How storage cylinders were rotated.
- How a shuttle was moved.
- How the Mill mechanism worked.
- Most of the internal timing.
- Almost everything about program control.
- Almost everything about input and output.

And of course, despite extensive searching,
all the other drawings remain to be found!

Percy Ludgate's Ancestry and Early Life

- His ancestry has now been traced back to the mid-18th century, and some fifty relatives identified. No obvious motivations or influences have been discovered – his father was a Sergeant Musketry Instructor in the Militia. However, there remains hope of finding some descendants of the later generations, and hence the possibility of more information about Percy.

- We have established a number of further facts about his early life, e.g.
  - He attended St George's National School. At age 15 he was appointed a 'Boy Copyist' in the Irish Civil Service, a temporary post for boys aged 15-20 years old
  - In March 1903 Percy was the top Irish candidate in the Civil Service examinations for Assistant Clerkship. Six other Dublin candidates below him were appointed, but for some unknown reason he was not.
  - In October 1904 Percy Ludgate passed the Civil Service exams for Second-Division Clerkships in the Civil Service but failed the medical examination. His case was raised in the House of Commons, by Timothy Harrington MP, to no avail.
  - By 1911 he was a "commercial clerk" to a corn merchant.
  - He passed his Intermediate Accountancy Examinations in 1916, and his Finals (with Honours) in 1917.

Skibbereen – Ludgate's Birthplace
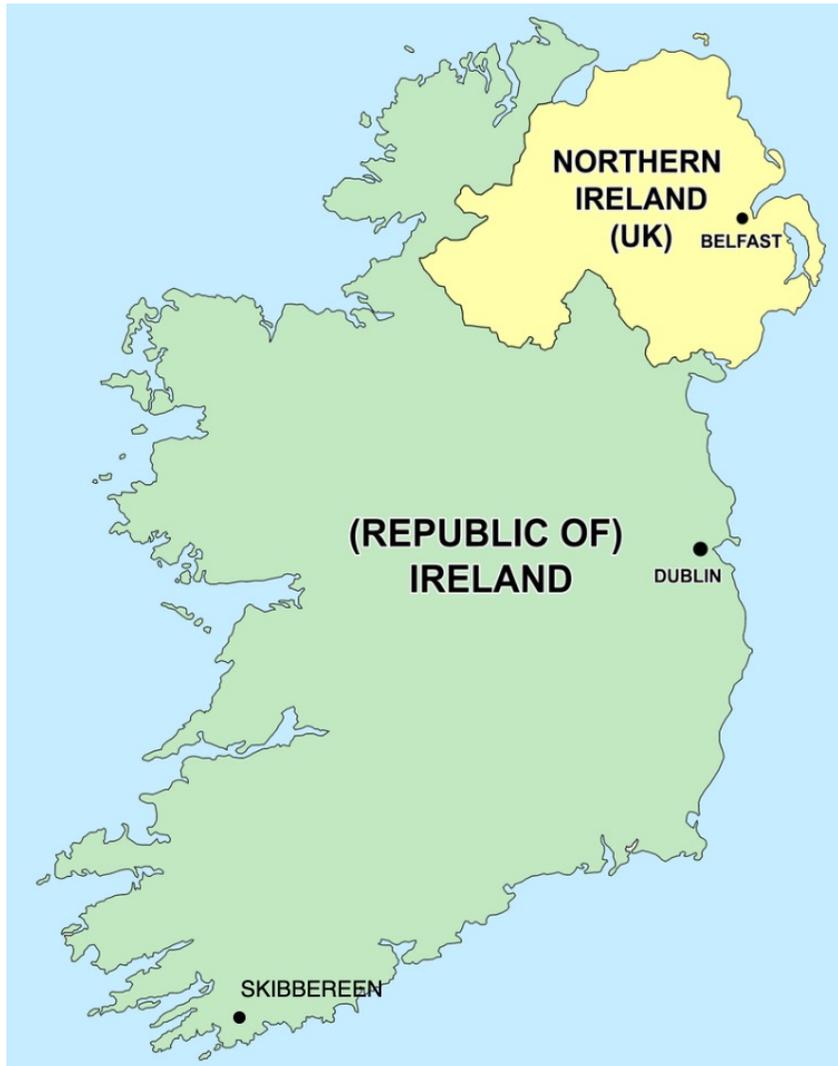
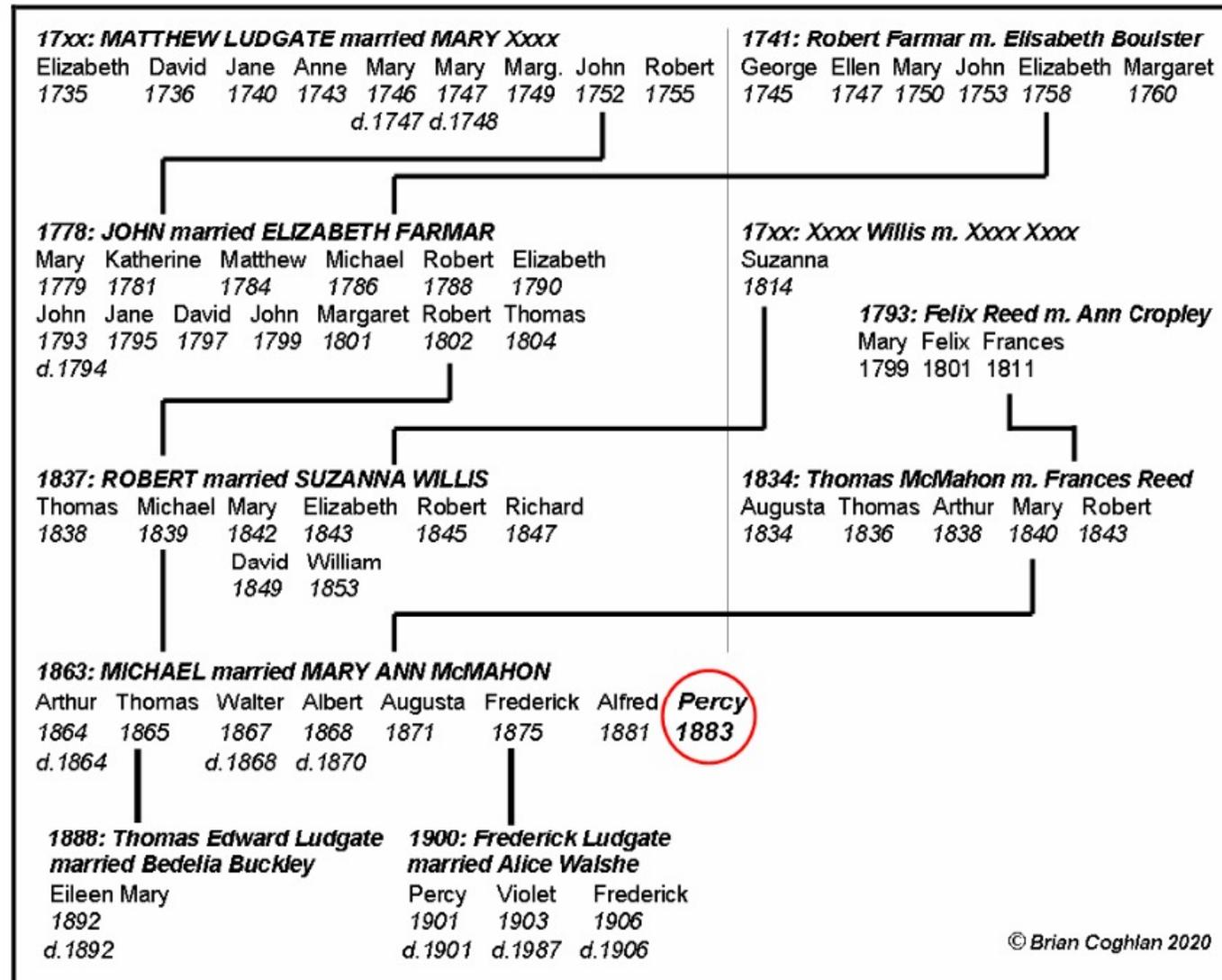

Skibbereen High Street

Inside Skibbereen's Ludgate Digital Hub

Ludgate's Relatives

- Via his parent's siblings, and his own siblings, Percy had a large number of close relatives and in-laws,
- In total on his paternal side he had 5 uncles, 2 aunts, and at least 7 cousins, while on his maternal side he had 3 uncles, 1 maternal aunt, and presumably cousins.
- In addition his sister-in-law Bedelia (Bridget) née Buckley from Douglas, Cork, had eleven siblings, and his other sister-in-law Alice (Alicia) née Walshe from Dublin City had two siblings.
- In total his close relatives and in-laws included 15 of his parent's generation, plus at least 20 of his own generation.
- However, to date, our efforts to find and contact any living descendants, in the hope of obtaining further information, have had little success.

Ludgate's Ancestry

17xx: MATTHEW LUDGATE married MARY Xxxx

Elizabeth	David	Jane	Anne	Mary	Mary	Marg.	John	Robert
1735	1736	1740	1743	1746	1747	1749	1752	1755
				d.1747	d.1748			

1741: Robert Farmar m. Elisabeth Boulster

George	Ellen	Mary	John	Elizabeth	Margaret
1745	1747	1750	1753	1758	1760

1778: JOHN married ELIZABETH FARMAR

Mary	Katherine	Matthew	Michael	Robert	Elizabeth
1779	1781	1784	1786	1788	1790
John	Jane	David	John	Margaret	Robert	Thomas
1793	1795	1797	1799	1801	1802	1804
d.1794						

17xx: Xxxx Willis m. Xxxx Xxxx

Suzanna
1814

1793: Felix Reed m. Ann Cropley

Mary	Felix	Frances
1799	1801	1811

1837: ROBERT married SUZANNA WILLIS

Thomas	Michael	Mary	Elizabeth	Robert	Richard
1838	1839	1842	1843	1845	1847
		David	William		
		1849	1853		

1834: Thomas McMahon m. Frances Reed

Augusta	Thomas	Arthur	Mary	Robert
1834	1836	1838	1840	1843

1863: MICHAEL married MARY ANN McMAHON

Arthur	Thomas	Walter	Albert	Augusta	Frederick	Alfred	*Percy*
1864	1865	1867	1868	1871	1875	1881	*1883*
d.1864		d.1868	d.1870				

1888: Thomas Edward Ludgate married Bedelia Buckley

Eileen Mary
1892
d.1892

1900: Frederick Ludgate married Alice Walshe

Percy	Violet	Frederick
1901	1903	1906
d.1901	d.1987	d.1906

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Ludgate's Dublin Home from 1899 to 1922

30 Dargle Road, Drumcondra, Percy Ludgate's second home in Dublin.
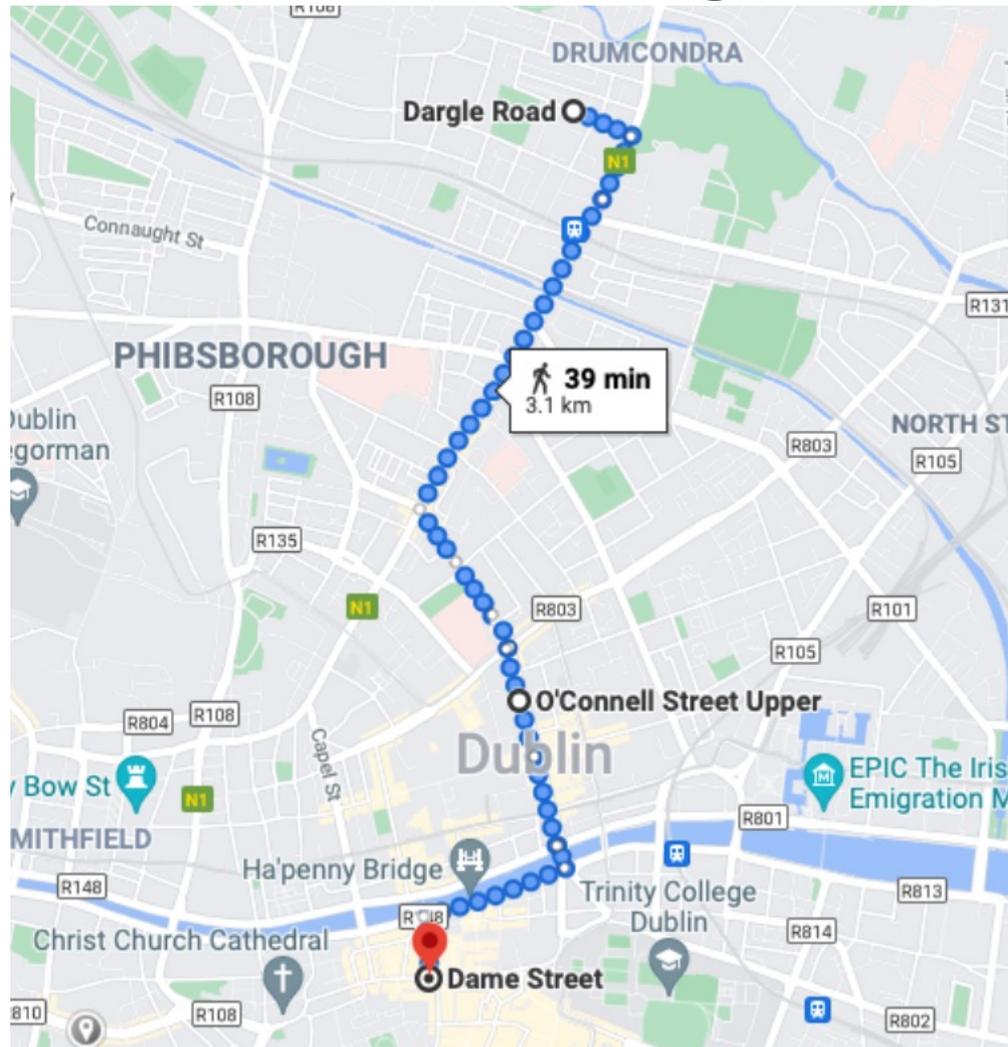
Courtesy Michael Mongan

31 Dame St, Dublin

After some years as a commercial clerk to a corn merchants, Percy Ludgate worked (until his death in 1922, aged 39) as an accountant for Kevans & Son in the building with the yellow flag.

Courtesy Brian Coghlan

Ludgate's Dublin

On any of Ludgate's likely regular routes from home to work he must have seen the impact of the Easter uprising of 1916, the destruction of Eden Quay, the General Post Office and the Metropole Hotel beside it, and extensive ruin along Sackville Street looking north and south, and the general mess created, much of which remained for years.

Aftermath of the 1916 Easter Uprising

Lower Sackville Street (now O'Connell Street)

National Library of Ireland, via Wikimedia Commons

Dublin 1918-1919

Freeman's Journal, 21 July 1919

Ludgate also could not have avoided seeing first-hand the impact of the Spanish Flu epidemic. Returning soldiers bought The Spanish Flu to Dublin and Cork in 1918. As many Irish died in the pandemic as died in World War 1, which ended in Nov. 1918, when Ludgate was 35 years old. A massive Peace Day Parade took place on the 19th July 1919, passing right in front of his place of work. There is a high probability he saw these things, that they were part of his short life.

Finally, Our Other Surprising Discovery

- Violet Ludgate – my only source of family information in 1970 about Percy Ludgate – had died, never having married, in 1987.

- By 1954 Percy Ludgate's parents and siblings had died, and until late 2018 it was thought that by 1987 there were no other descendants of his parents.

- The Ludgate grave lay unmarked in 2018; it could only be marked with permission from the owner, who was dead, or by close descendants, but there were none known.

- But then we discovered that someone else had been looking for information about Violet, in fact one of her <u>descendants</u>!

- Violet we learned had given birth to a daughter Barbara in 1935, who was adopted and renamed Anita, and brought up overseas. Anita had married and moved to America, and had numerous descendants there.

- One of Anita's daughters joined our project and contributed greatly!

- And Violet's grandchildren managed to obtain the necessary permissions and to arrange that the Ludgate grave have a suitable headstone at last!!

Thanks to Violet's Descendants
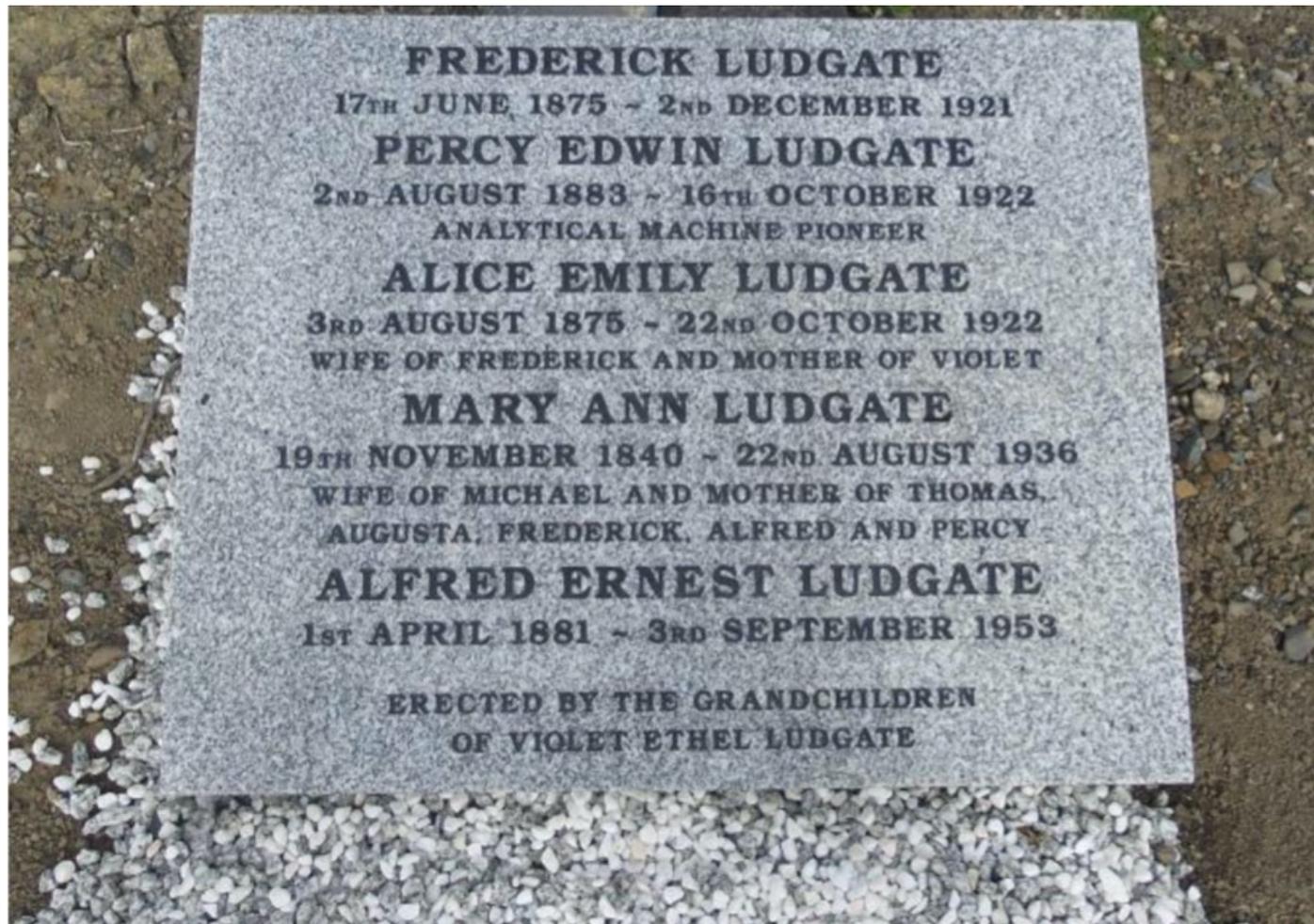
A Very Pleasing and Surprising "Result" of Our Investigation!

Courtesy Brian Coghlan

Acknowledgements

Possibly the Main "Take-Away" From Our Project

"The more you practice the luckier you get."

After: Arnold Palmer, the champion golfer

To dig deeper: https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/