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Object name: Investigating the Work and Life of Percy Ludgate

Vintage: 2021

Synopsis: Technical paper by Coghlan, Randell, Hockie, Gonzalez, McQuillan, O'Regan, in the IEEE Annals of the History of Computing, plus a printed copy of the issue that contains the paper, both courtesy of IEEE.

Description:

This technical paper¹ [1], and its companion historical paper² [2], reported the first substantive discoveries in fifty years about the work and life of Percy Ludgate. The paper's Abstract is shown on the first page of this paper in Fig.1. The front page of the enclosing issue is shown in Fig.2. For further detailed background on Ludgate, see [3]. This ongoing pro bono investigation was begun in 2016 by Brian Coghlan under the aegis of this Collection, and then Brian Randell, Paul Hockie, Trish Gonzalez, David McQuillan and Reddy O'Regan agreed to join with their specialist knowledge and skills. It has been further aided by joint outreach activities with the Ludgate Hub.³

Percy Ludgate was the second person to publish a design for a computer (his *Analytical Machine*) [4], the first after Babbage's *Analytical Engine*. His design was very novel, utilising discrete logarithmic indexes (*Irish logarithms*) that he invented to do multiplication. Its arithmetic unit was designed to perform the now common multiply-accumulate (MAC) operation, the first computer arithmetic unit to do so. It also was designed to perform division by convergent series seeded with an estimate from a mechanical table of initial values (again a first), and could be stepped through a sequence of operations either manually or under automatic control, the latter using perforated paper. His sequencer had two-operand instructions, subroutines and pre-emption, so was closer to that of modern computers than Babbage's. His storage system was based around two concentric cylinders that held numbers as the displacements of rods in shuttles, another novel invention. But, while Ludgate's 1909 paper explained key principles of his machine, it was not very forthcoming otherwise, and none of his drawings of the machine had been found. This technical paper concentrated on the new details and understandings of the machine that had been discovered and also deduced.

Our grateful thanks to the IEEE for generously granting permission to preserve and republish the electronic copy of this paper, and for donating a printed copy of the issue that contains the paper to The John Gabriel Byrne Computer Science Collection.

¹ An electronic copy of this technical paper from the *IEEE Annals of the History of Computing* is available at:

<https://www.scss.tcd.ie/SCSSTreasuresCatalog/literature/TCD-SCSS-V.20210507.001/IEEE-Annals-FINAL-asPublished-Ludgate-20210307-0849.pdf>

² An electronic copy of the companion historical paper from the *Proceedings of the Royal Irish Academy: Archaeology, Culture, History, Literature* is available at:

<https://www.scss.tcd.ie/SCSSTreasuresCatalog/literature/TCD-SCSS-V.20210921.001/BrianCoghlanEtAl-PercyLudgate-PRIAC-2021-121-09.pdf>

³ An e-commerce hub opened in 2016 in Ludgate's birthplace Skibbereen.

The homepage for this catalog is at: <https://www.scss.tcd.ie/SCSSTreasuresCatalog/>
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Accession Index	Object with Identification
TCD-SCSS-V.20210507.001	Technical paper by Coghlan, Randell, Hockie, Gonzalez, McQuillan, O'Regan, 'Investigating the Work and Life of Percy Ludgate', in the <i>IEEE Annals of the History of Computing</i> , plus a printed copy of the issue that contains the paper, both courtesy of IEEE, 2021.
TCD-SCSS-V.20210507.001.01	Technical paper by Coghlan, Randell, Hockie, Gonzalez, McQuillan, O'Regan, 'Investigating the Work and Life of Percy Ludgate', in the <i>IEEE Annals of the History of Computing</i> , Vol. 43, No. 1, pp. 19-37, January-March, 2021, DOI: 10.1109/MAHC.2020.3038431, preserved as electronic file: https://www.scss.tcd.ie/SCSSTreasuresCatalog/literature/TCD-SCSS-V.20210507.001/IEEE-Annals-FINAL-asPublished-Ludgate-20210307-0849.pdf , Electronic ISSN: 1934-1547, courtesy of IEEE.
TCD-SCSS-V.20210507.001.02	Printed copy of the issue of the <i>IEEE Annals of the History of Computing</i> titled 'Early Computers: Imagined and Built', Vol. 43, No. 1, January-March, 2021, Print ISSN: 1058-6180, courtesy of IEEE.
TCD-SCSS-V.20210921.001	Historical paper by Coghlan, Randell, Hockie, Gonzalez, McQuillan, O'Regan, 'Percy Ludgate (1883-1922), Ireland's first computer designer', in the <i>Proceedings of the Royal Irish Academy: Archaeology, Culture, History, Literature</i> , plus a printed copy of the issue that contains the paper, both courtesy of RIA, 2021.
TCD-SCSS-X.20121208.002	Percy E. Ludgate Prize in Computer Science. Prize in memory of Percy Ludgate's novel 1909 design for an Analytical Engine, the next after Babbage's, c.1909.

References:

1. Coghlan, Randell, Hockie, Gonzalez, McQuillan, O'Regan, 'Investigating the Work and Life of Percy Ludgate', *IEEE Annals of the History of Computing*, Vol. 43, No.1, pp. 19-37, DOI: 10.1109/MAHC.2020.3038431, January-March, 2021.
2. Coghlan, Randell, Hockie, Gonzalez, McQuillan, O'Regan, 'Percy Ludgate (1883-1922), Ireland's First Computer Designer', *Proceedings of the Royal Irish Academy: Archaeology, Culture, History, Literature*, Vol. 121C, pp. 1-30, DOI: 10.3318/PRIAC.2021.121.09, 2021.
3. Trinity College Dublin, *Percy E. Ludgate folder*, see:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/miscellany/TCD-SCSS-X.20121208.002/>
For a more mobile-friendly interface to selected Ludgate folder contents, see:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/ludgate/>
Also *Percy E. Ludgate Prize in Computer Science*. Available at:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/miscellany/TCD-SCSS-X.20121208.002/TCD-SCSS-X.20121208.002.pdf>
Last viewed 7-May-2021.
4. Percy E. Ludgate, 'On a proposed analytical machine', *Scientific Proceedings of the Royal Dublin Society*, Vol. 12, No. 9, pp. 77-91, April, 1909. Available at:
<https://www.scss.tcd.ie/SCSSTreasuresCatalog/literature/TCD-SCSS-V.20121208.873/TCD-SCSS-V.20121208.873.pdf>
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ARTICLE

Investigating the Work and Life of Percy Ludgate

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Percy Edwin Ludgate (1883–1922) is notable as the second person to publish a design for an Analytical Machine, the first after Babbage's "Analytical Engine." We outline the initial results of the first new investigation into the work and life of Percy Ludgate since Randell's papers of nearly 50 years ago and nearly 100 years after Ludgate's death. First, we examine the principles of his machine and how it was constructed and worked. Second, we outline his life. We present a range of new material, including two significant discoveries, one concerning Ludgate's machine and the other his family.

Percy Edwin Ludgate (1883–1922) is notable as the second person to publish a design for an Analytical Machine,^{1,2} the first after Babbage's "Analytical Engine."³ Strangely enough, he was not a scientist, but a clerk to a corn merchant (and subsequently an accountant), born in Skibbereen and employed in Dublin, Ireland. He was working in his spare time, presumably on his own, from 1903 to 1909, and was not aware of Babbage's work until later. Indeed his engine differed greatly from Babbage's in that it was largely based on multiplication using rods in shuttles plus logarithmic "slides" like a digital evocation of slide rules, whereas Babbage's was based on addition using cogs and wheels (interestingly, Babbage's initial difference engine efforts were based on sliding rods, although they were not logarithmic⁴). Both Ludgate and Babbage based input on perforated paper (separately for instructions and data), but Ludgate notably unified instruction and operand sequencing, whereas Babbage separated them. Either machine would be capable of doing everything a modern computer of their scale could do, although very slowly.

Randell's 1971 and 1982 papers^{5,6} revealed Ludgate and resurrected him from obscurity, but nothing new has been published on him since then. Prof. J. G. Byrne collected an original offprint of Ludgate's 1909 paper for what became The John Gabriel Byrne Computer Science Collection⁷ in the Department of Computer Science, Trinity College Dublin, and then in 1991 instigated a prize in memory of Ludgate.⁸ The Collection now holds copies of all the known literature and records relating to Ludgate and, spurred by the cataloging of this collection, since 2016 the collective authors have undertaken a detailed investigation of his work and life. This and Coghlan's work⁹ outline the initial results of this first new investigation into the work and life of Ludgate since Randell's papers of nearly 50 years ago and nearly 100 years after Ludgate's death, and provide a range of new material.

Prior to the present investigation, there were two central mysteries about Percy Ludgate. One has to do with his machine and the other to do with his life.

First, his 1909 paper explains key principles of his machine, but said it was: "not possible in a short paper...to go into any detail as to the mechanism...I must therefore, confine myself to a superficial description, touching only points of particular interest or importance." So machine details are scant. However in 1909, he said he had made: "many drawings of the machine

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Figure 1: 'Investigating the Work and Life of Percy Ludgate', first page.
Courtesy of IEEE.

<< **PHOTO TBD** >>

*Figure 2: 'Early Computers: Imagined and Built', IEEE Annals of the History of Computing,
Vol. 43, No.1, January-March 2021, front page.
Courtesy of IEEE.*