BOOKS

Books about LEO

- Anon (1952) **The Layman's Guide to LEO**, Lyons.
  The guide was circulated to Lyons executives and senior management to help them understand how computers, and in particular LEO, worked. The typewritten document is in part based on Ernest Lenaerts Development of the LEO Computer – see below. The manuscript was donated to the LEO Computers Society by Philip Bird in November 2017

- **Anon** (1962), **Computers for Shell-Mex and BP**. An 8 page brochure published by management for distribution to employees explaining the forthcoming installation of a LEO III computer in a new office complex to be opened in the New Town of Hemel Hempstead. The brochure suggests the role the computer will play and lauds the benefits of moving to the New Town.

- **Anon** (1963), **Wythenshawem The Second Computer Centre for Shell-Mex and BP.** A 7 page brochure like the one for Hemel Hempstead announcing the establishment of the norther computer centre to house a LEO III at Wythenshawe and singing the praises of Manchester and Wythenshawe

- **vid Caminer, John Aris, Peter Hermon and Frank Land (1996)** ***The World's First Business Computer: User-Driven Innovation.*** London: McGraw-Hill Book Company, 401 pages, ISBN 0-07-709236-8

- Reviewed by:
- Professor Robin Mansell, Science Policy Research Unit, University of Sussex
- Professor of Media and the Internet, London School of Economics

- A successful confectionery business in Britain, J. Lyons & Company, envisaged LEO, the Lyons Electronic Office, in 1949. By 1951 the company's first computer had been designed and built. Lyons established a subsidiary in 1954, LEO Computers Ltd., to build and market its computers. John Simmons, former Chief Comptroller of J. Lyons & Company, is cited at the beginning of this book: 'innovation is the lifeblood of successful business management. The past success of a business can be its own worst enemy…'. LEO Computers succeeded at first but its business subsequently declined. LEO's story is told by its former employees and the book is organised into four main sections. The first documents the 'motivation, passion and hazards' as Lyons sought to capture a leadership position in a market that would become dominated by IBM. Other sections offer personal reflections by LEO's designers, programmers, consultants and users. This is an engaging tale of entrepreneurship, leadership, market success and failure. More than this, it is a history with lessons for information technology designers and users today.

- In his history of IBM, Emerson Pugh observes that 'remarkably the J. Lyons bakery was the first British company to build an electronic computer for business data processing'.[1] This book brings to light important characteristics of a 'user-driven innovation' process that yielded initial success. In 1951, LEO was in regular, time critical use within the company and it was the first computer system to run live office applications. In the 1950s IBM's domestic and foreign revenues were growing at an average of 22% per year and the UK was the only significant market where IBM had less than half the business. Lyon's innovative approach to information management gave it an initial 'first mover' advantage.

- Product and process innovations played a significant role in LEO's early success. A single family-owned businesses' need for improved management of information resulted in a computer design that integrated separate office tasks and reduced the need for repetitive clerical tasks. This need was very different to that which motivated defence-related computing in the US during the 1940s and 50s. By 1955, eleven companies in Britain claimed the capability to supply electronic computers and most supported scientific applications. In addition, developments in US business computing applications were regarded as being both too expensive and adhering too rigidly to punched card methods with 'no real idea of organising a job for a computer'.

- In Britain systems analysis was central to the success of early applications. Business process analysis was time consuming and costly, but LEO Computers gained experience that enabled the company to provide increasingly complex business information applications. Early user organisations were expected to operate the new systems and even perform hardware maintenance. They were also expected to introduce major organisational changes and to redefine job functions.

- Successive generations of LEOs embodied substantial technical innovation including time-sharing, micro-programming, reliable test programmes, and a distinctive programming language. The use of magnetic tape as the medium for main data fields and for intermediate results between programmes was an innovation beyond the methods in use in the US at the time. New techniques were developed for time and motion studies of clerical work covering all facets of activities and LEO employees made extensive use of flow charts before writing code. They achieved high levels of accuracy and reliability and low maintenance requirements.

- The new LEO computer applications involved product, service and organisational (business process) innovations. The main criterion for acceptance of an application was whether it offered 'clear cost savings as against conventional methods, or had to make the

business process more effective as well as showing savings in costs'. LEO designers aimed to automate close to 100 per cent of a given activity while competitors focused on speeding up the most active transactions. Companies like IBM also had substantial investments in earlier generation technology, i.e. punched card machines, and they were slower to switch to magnetic tape to automate systems.

- Factors contributing to LEO's eventual withdrawal included costs that were higher than those of competitors, but there were other factors. Lyons computer subsidiary was established without a clear view of the processes needed to build market share and no customer base upon which to build. Sales and marketing employees retained responsibilities for programming and aggressive marketing was not a significant part of LEO's culture. David Caminer, former Director of LEO Computing Ltd., also suggests that 'the degree of acceptance of change and the relative costliness of equipment in relation to salary rates placed UK manufacturers at a great disadvantage compared with their US counterparts in the respective home markets'. The UK government made few moves to procure new computer applications from the company or to support its R&D costs. In 1961 when LEO III entered the market, the company's success had been achieved without government support and at a time when almost US$ 400 million had been awarded to IBM in R&D contracts by the US government. [2]

- None of these features can be singled out to account for the eventual reversal of LEO's fortunes. Together, however, they account for the failure to succeed in an increasingly competitive market. The announcement of IBM's 360 series in 1964 was preceded by the IBM 1401 computer. This product was capable of executing jobs, but not of integrating across a wide range of clerical tasks. LEO personnel appear to have missed the signals in the marketplace or perhaps to have been hindered by the secrecy surrounding developments in US computing. When IBM's systems offered applications which did not demand a high degree of work re-organisation and the capability to integrate information processing systems, LEO was left behind. LEO management chose to continue developing applications that pre-supposed a willingness to engage in substantial business process 'reengineering' and LEO employees remained devoted to a close and detailed interaction with customers.

- Today, the poverty of the relationship between information technology systems engineers and customers for office information processing systems is increasingly cause for concern. Enormous cost overruns often accompany the introduction of information technology systems in companies seeking elusive productivity gains through their investment. Organisational change and work function interdependencies now are recognised as primary factors in information systems design and implementation. User-centred

innovation is a much sought after capability by computer manufacturers and software houses.

- In the early period, the Lyons story is a classic case of a 'lead user'. In some models of the innovation process, the user plays little active role in the generation or diffusion of an innovative technology. [3] von Hippel has shown that in some cases, however, a user will perceive the need for a product, conceive a solution, build a prototype and prove the value of the prototype through its use.[4] Foxall has studied users who, having invented a novel device and applied it internally, will act in an entrepreneurial manner to derive maximum benefit from its diffusion.[5] The user plays an active part in the development of the innovation for commercial exploitation either indirectly or by becoming a manufacturer as in the case of Lyons.[6] Successful lead users have requirements that eventually will be felt more widely in the market. In LEO's case, the need for the specific combination of product, services and organisational innovations was not widely perceived by other users.

- The LEO pioneers assumed that their approach to meeting Lyons needs would be widely accepted by other organisations. Realisation of the crucial importance of coordinating information technology systems with business processes is occurring today and, as Frank Land suggests, 'it is interesting to note that many of the ideas we put into practice at the time are now trumpeted as the latest solutions to the problems of intense business competition'. LEO championed unique information system solutions while the US led the market for business systems with packaged software solutions.

- In the 1990s, there is demand for customised software applications for decision support systems. At the same time, innovations in software development are enabling users to tailor systems to their own requirements. Systems designers and users will benefit from the lessons of LEO. The most crucial perhaps is the importance of the capacity to 're-personalise' the information generated by computerised decision support systems.[7] Hardware and software suppliers will need to learn this lesson from LEO's history. The capability to be responsive to users' needs and to shape organisational change in ways that support positive work experience is likely to differentiate winners from losers in the information technology electronic commerce markets of the 21st century.

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[1] Pugh, E. W. (1995) *Building IBM: Shaping an Industry and Its Technology*. Cambridge MA: The MIT Press.

[2] Ibid.

[3] Mowery, D. and Rosenberg, N. (1979) 'The influence of market demand upon innovation: a critical review of some recent empirical studies', *Research Policy*, Vol. 8, pp. 102-153.

[4] von Hippel, E. (1978) 'Users as Innovators', *Technology Review*, Vol. 80, No. 3, January, pp. 31-39.
[5] Foxall, G.R. (1989) 'User Initiated Product Innovations', *Industrial Marketing Management*, Vol. 18, pp. 95-104.
[6] Rothwell, R. (1994) 'Issues in user-producer relations in the innovation process: the role of government', *International Journal of Technology Management*, Vol. 9, Nos 5/6/7, pp. 629 - 649.
[7] Credé, A.(1997) 'Information Society Security: Trust, Confidence and Technology: ICTs, Information Production and Tacit Authentication, FAIR Working Paper No. 26, Science Policy Research Unit, University of Sussex, February.

- Bird, P. (1994) **'LEO, the First Business Computer'**, Hasler Publishing.
  Peter Bird joined Lyons when, as he says, 'the pioneering years of computing were no more than folk history.' Nonetheless, through his 'talking with old-timers' and delving through the Lyons archives, he has made an important contribution to the LEO story. Of particular value are the appendices which, inter alia, give details of the instruction codes, speeds, capacities and deliveries of the different models.

- Caminer, D.T., Aris, J.B.B., Hermon, P.M.R. and Land, F.F. (eds.) (1996) **'User Driven Innovation: The world's first business computer'**, McGraw Hill, Maidenhead.
  A first-hand account written by thirteen of the early users who developed the disciplines of systems engineering and put LEO to work on economic, time-dependent business applications, starting in 1951. Included is an edited version of the seminal report of the two Lyons executives who, after a tour of the early computer activity in the United States in 1947, recommended that Lyons acquire a computer of their own. Also included is a Science Museum interview with John Simmons.

- Caminer, D.T., Aris, J.B.B., Hermon, P.M.R. and Land F.F. (eds.) (1998) **'LEO, the Incredible Story of the World's First Business Computer'** McGraw Hill, New York.
  The revised United States edition of User-Driven Innovation, a Chinese edition was published in 2000.

Extracts from Reviews

Professor Dick Nolan of the Harvard University Business School writes in his introduction to the book:
"This story has the best qualities of a Harvard Business School case study: it is an important event in the history of the business.
It is a study about extraordinary people ... As confident executives they look outside their company, in other countries, at universities to discover new ways of doing things and fresh ideas. In their bold actions, trust shows through as a foundation in implementing their vision. Young people are given free reign and do not disappoint. A resulting exciting, challenging 'can-do' culture is heard in the words of the people who were there."

Dr Terry Gourvish, Director Business History Unit, LSE, in LSE Business History Newssheet,

"This is a major contribution to the history of computing and computers in the UK. A full scale case study of LEO computers, written by members of the team who experienced all its

trials and tribulations, it provides a fascinating insight into the development by J. Lyons & Co. of the first business computer in the UK."

Neil Fitzgerald, editor of CA magazine, in The Scotsman, Business section. .

"Can-do culture, empowerment, user-driven innovation, business process re-engineering, flat organisations, quality, short lines of communications and decision making. We are led to believe that these are radical, modern ideas. However, a book that has come into my hands shows that they were being successfully harnessed almost half a century ago, to create the most significant event ever in business management.
The editors ... tell the story of how they and others built and put to work the world's first business computer. This did not happen in California's Silicon Valley, but at Cadby Hall, the ... west London premises of Lyons.

An important facet was that they felt they should always take a strategic view of the whole function to be computerised and make recommendations for improvements before going to work."

Dr John Pinkerton, review in **ICL Technical Journal**

"Telling the story of how the foundations of data processing were laid from 1949 onwards has evidently been a labour of love.
This is a work of scholarship but eminently readable nevertheless. It will be seen as a major contribution to the history of business computing; it is strongly recommended for anyone already working in or studying to enter the field of IT."

Michael Braithwaite, Deloitte, Touche, European Journal of Information Systems.

"I commend this book to a wide audience. To the general reader it stands as a very well written and exciting account of technological innovation. To the business school student it presents a remarkable story of technological success that, as a commercial venture was flawed, perhaps by factors beyond the control of the players."

Professor George Mitchell, review published Journal of Operational Research Society..

"This fascinating book tells the life story of LEO. Rather over a third of the book is the historical record, carefully researched and engagingly written up by Caminer. The rest is largely personal memoirs of those involved in the early days, including accounts of several innovative applications. The whole is rounded off by an evaluation by Aris. The book's value is enhanced by the style of writing. Those who worked in LEO, especially in its earlier days, including many of the book's authors, exercised an influence on the development of business computing in the UK quite disproportionate to their numbers.
I found this book a good read and one which exited several strands of thought. Although its main market will be among scholars and students of IT and business studies, it deserves a wide readership in the OR community."

John Perkins, National Computer Centre Newsletter,

"The book is a fascinating adventure story in which the dynamics of an extraordinary group of people made the seemingly impossible happen."

Professor John Ward in the Journal of Strategic Information Systems.

"The story of that first business computer: Leo - Lyons Electronic Office - is told in this book. Whilst it is history, reflection on what was achieved and not achieved and why still has many lessons of relevance to the successful use of IT today - we seem to be learning painfully and slowly!.

.... a review by John Aris of what of what he calls the 'LEO approach' - an integrated combination of technology innovation, application and consultancy designed to enable significant business improvements from computer use in a range of situation. Many of these applications would be called 'business process redesign' in the 1990s!

The wide range of contributors provide many different perspectives on what happened and views on why things evolved the way they did. It is a set of memoirs - often very personal ones - of a time when Britain could be said to have led the world in the application of this new technology.

... it is a book that we should all be grateful the authors took the time and trouble to get together and write. It is a story of extraordinary achievements, by a talented team..."

I. A. Lovelock in Management Accounting.

"This book is a first-hand account of how this astounding innovation came about. It is a flesh and blood, warts and all story related by the participants, brimming over with the same enthusiasm that enabled the unlikeliest of organisations to lead the way into the future that we are all familiar with today.

It concludes with different strands coming together to provide the essence of the LEO credo of comprehensive, integrated, secure, action stimulated implementations."

Professor T. Brady, Brighton University

"As well as being a fascinating piece of historical writing the book provides food for thought in the supposedly computer literate world of the 21st Century. Spectacular computer disasters such as the London Stock Exchange's Taurus system have left us with rather jaundiced perceptions about computer projects. Why were Lyons better at implementing computer systems?

One major factor was that before automating business processes the Lyons team ensured that they were well understood and ready for computerisation. Long before the prospect of computers came along, Lyons had established a systems research office with the brief to constantly search out how improvements might be made to the business by changing processes."

Professor Paul Ceruzzi, Smithsonian Institute Washington

"Most surveys of the history of computing mark the beginning of the commercial computer age with the delivery of the first UNIVAC in 1951. The better ones note the first delivery of a UNIVAC to a commercial, not government, customer (General Electric) in 1954. Only the best histories mention LEO, a computer built by the British catering company J. Lyons & Co. and first operational in September 1951, as the real beginning of commercial application of the stored-program computer."

Ferry, Georgina (2003) **'A Computer Called LEO'**, Fourth Estate, London.
'LEO and its creators deserve their place in history not because of what it was, but because of what it did. For LEO was the first computer in the world to be harnessed to the task of running a business.
A paperback edition was published in 2005, by Harper Perennial

Coombs, M. (2003) **Review: 'A Computer called LEO'** (Ferry, G.), European Journal of Information Systems, Vol. 12, Issue 4, 241-24. http://www.computinghistory.org.uk/det/53095/Book-Review-A-Computer-Called-LEO

- Caminer H., editor (2016) **'LEO remembered: by the people who worked on the world's first business computers'**, LEO Computers Society. Collection of reminiscences, testifying to a sense of collective endeavour among the LEO community.

- Lenaerts, E. (1948) **'Development of the LEO Computer: Brief Description of EDSAC'**.
  Peter Bird collected and had bound (September 1992) the photocopies of the handwritten description of EDSAC compiled by Ernest Lenaerts in October 1948, with contributions from David Caminer, Derek Hemy, Thomas Thompson and others. It formed the basis of a larger publication titled **The Layman's Guide to LEO** – see below. The volume was donated to the LEO Computers Society by Philip Bird, November 2017.

- Simmons, J.R.M. (1962) **'LEO and the Managers'**, Macdonald, London.
  The paperless office concept of the Lyons Comptroller, whose support was vital to the LEO project

Books that refer to LEO

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- Anon (2011) **'ICL Mainframe Computers'**, Books LLC.
  This 19 page pamphlet gives a brief description of a number of UK designed and manufactured computers including the LEO range, pages 18 and 19. All the texts are lifted from Wikipedia entries and include some errors made in these entries.

- Arms, William Y, (2019), **Early Years of Academic Co1962mputing,** Cornell University, Internet University Press. The memoirs include a brief account of the LEO story including a photo of LEO III. See
  http://www.cs.cornell.edu/wya/AcademicComputing/text/titlepage.html

- Baker, Rob (2015) **'Beautiful Idiots and Brilliant Lunatics: A sideways look at twentieth century London'**, Amberley Publishing Limited. Chapter 22 includes the story of Lyons and its place in London, and notes its role in the development of LEO and business computing. See
  https://books.google.co.uk/books?id=yOwgCwAAQBAJ&pg=PT300&lpg=PT300&dq=How+Lyons+Produced+the+Worlds+First+Large+Business+Computer&source=bl&ots=8MWwgk_uLN&sig=ucgm-M47SKOlozeLgYGfI6TU_MA&hl=en&sa=X&ved=0ahUKEwjcmumWyK_MAhW

FOyYKHSu9DHcQ6AEIYDAJ#v=onepage&q=How%20Lyons%20Produced%20the%20Worlds%20First%20Large%20Business%20Computer&f=false

- Bird, P. (2000) **'The First Food Empire: A History of J. Lyons and Company'**, Phillmore.
  Peter Birds account of the history of J. Lyons including a reference to the LEO initiative.

- Bruderer, H. (2015) **'Meilensteine der Rechentechnic (Milestones in Computer History)**', De Gruyter Oldenbourg, Berlin/Boston. This 820-page book written in German has a number of references to LEO throughout the book. The author is a Swiss academic.

- Bruderer, Herbert: Milestones in Analog and Digital Computing, Springer Nature Switzerland AG, Cham, 3rd edition 2020, 2 volumes, 2113 pages, 715 illustrations, 151 tables, English version. https://www.springer.com/de/book/9783030409739

- Campbell-Kelly, M. (1989) **'ICL A Business and Technical History'**, Clarendon Press, Oxford.
  The history of ICL is synonymous with the history of the British computer industry. ICL was formed by a series of mergers in response to the increasing market dominance of the large American corporations, particularly IBM. The struggles between these two giants and the inherent problems and implications of competing with US multi-nationals are examined in detail in Campbell Kelly's wide-ranging study. At the time of writing in the late 1980s, the author was given unrestricted access to ICL archives and his lucid account of the company, its set-backs and successes makes for a compelling and informative read. This book, which was Winner of the Wadsworth Prize for Business History (1989), will be of great interest to anyone involved in business or the computing industry.

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- Greenia, Mark (2003) **'The History of Computing: An Encyclopaedia of People and Machines that made Computer History',** Lexikon Services. A useful and comprehensive chronology of computer history including recognition of Lyons and LEO plus pictures and descriptions of the LEO initiatives. *Note*: a photo of LEO II/1 is wrongly labelled LEO 1, and the link to the LEO Computers Society website does not work. https://www.amazon.com/History-Computing-Encyclopedia-Machines-Computer/dp/0944601782

- Greenia, Mark, (2021), Mark writes: "I found a 1966 film about the LEO III in Manchester, which I posted to my site. I include a link to your LEO 1 History video in the description section for people to follow if they want the early history" See https://www.youtube.com/watch?v=H_0Astp1dEU

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- Haigh, T., Ceruzzi, P., (2021), **A New History of Modern Computing**, an updating of the earlier book by Paul Ceruzzi, includes reference to the Lyons and LEO story as the first business computer. Published by MIT Press. See https://mitpress.mit.edu/books/new-history-modern-computing

- Hally, Mike (2003) **'Electronic Brains: stories from the dawn of the Computer age'**, Granta Publications, London.
  The book is based on 4 BBC radio programmes produced by Mike Hally. Despite its populist title, it is a very readable and informative account of some early computer ventures in the USA, UK, Soviet Union and Australia. Chapter 5 is an account of the LEO story.

- Harding, Thomas, (2019), **Legacy: One Family, a Cup of Tea, and the Company that Took on the World**, *Penguin Books*. **Legacy** charts the rise and fall of one of the most influential dynasties in British history through the lives of five astonishing generations; both sweeping and intimate, it is a story of sacrifice and selflessness, betrayal and personal tragedy, and Empire and its cost. Included in the story is a brief account of the origins and development of LEO, the decision to found LEO computers Limited as a subsidiary company, and the later decision to dispose of the subsidiary. The book allows the reader to peek behind the scenes at the way the members of the family which ran Lyons operated https://www.penguin.co.uk/authors/1071513/thomas-harding.html

- Hendry, John (1990) **'Innovating for Failure. Government Policy and the Early British Computer Industry'**, MIT Press, Cambridge, MA. xx, 240 pp. Hendry analyses the failure of the British Computer Industry in spite of the efforts of the

NRDC to rationalise the industry. https://www.amazon.co.uk/Innovating-Failure-Government-Computer-Computing/dp/0262081873

- Hénin, S., (2014) **Come le violette a primavera**, AICA, pp. 163, 174-5, 19
- Henin, S., (2017) **Il racconto del computer** , Edizioni Manna
- Hicks, Marie (2017) **'Programmed Inequality:** How **Britain Discarded Women Technologists and Lost its Edge in Computing'**, MIT Press. Marie Hicks, an American Academic, has produced a well-researched and in many ways fascinating account of the British Computer Industry from its birth at the beginning of World War 2 code-breaking at Bletchley Park to the demise of ICL in the mid-1970s. As such it includes many references to LEO including reports of interviews with LEO employees. However, the focus is on British Government computing, and in particular on the making of staffing policy in the Civil Service. Whilst the account is often interesting and provides an insight into the social history of the Civil Service as it enters the Information Age its basic hypothesis embodied in the title of the book is at best dubious. http://programmedinequality.com/
- Hollingdale, S.H. & Toothill , G.C., (1965), **Electronic Computers**. Penguin (Pelican) Books, London. This early book on the history of computers includes a number of references to LEO. See pages 230 and 281-282, and a photograph. It is a brief but accurate account noting payroll and teashop ordering. What is also interesting, in a book published in 1965, is the absence of any mention of war—time computing in Bletchley or any computer innovations outside the USA and UK. A surprising number of pages are devoted to analogue computers. A second edition was published in 1975.
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- Jones, Capers (2014) **'The Technical and Social History of Software Engineering'**, Addison-Wesley. Capers Jones's book is a monumental history of computers and computing with a prime focus on 'software engineering'. Jones has an introductory chapter which deals with the pre-history from the beginning of civilisation to 1930, then chapters dealing with each decade up to 2013. His chapter on the 1950s includes the LEO story, brief (pages 85, 86, in a 452 page book), but giving some weight to the place of LEO in computing history.
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- Lavington, Simon H. (1980) **'Early British Computers: The Story of Vintage Computers and The People Who Built Them'**, Manchester University Press, http://ed-thelen.org/comp-hist/EarlyBritish.html#TOC
  Chapter 13, pages 68-77, gives a brief history of LEO and English Electric, including a timeline.
- Lavington, Simon, (2011), **Moving Targets: Elliott-Automation and the Dawn of the Computer Age 1947 – 67,** Computer History, Springer. Although the book is primarily a history of Elliott-Automation it has a number of references to Lyons and LEO.

- Lavington, Simon (ed.) (2012) **'Alan Turing and his Contemporaries'**, British Computer Society. 111 pages, summarises the background to all the early British stored-program projects
from 1945 – 1951.

- Lavington, S., (2019) **Early Computing in Britain, Ferranti Ltd. and Government Funding, 1948 — 1958**, Springer Computer History Series. A valuable addition to the exposure UK computing developments in the early years of computers with a focus on the initiatives taken by the Ferranti Company, in particular with their Mark I. LEO is only referred to in Appendix D, see
https://www.springer.com/gp/book/9783030151027

- Lean, T, (2016), **Electronic Dreams: How 1980s Britain learned to love the computer,** Bloomsberry/Sigma. The book includes references to LEO and its early success. See also Review by Jonathan Margolis in Financial Times, below.

- Marshall, Stephen (2015) **'The Story of the Computer: A Technical and Business History'**, Kindle edition available. 592 pages the story of computing up to, but not including, the advent of smart phones. The LEO project is noted in Chapter 6, pages 198-189 and further mentions are made elsewhere such as the donation to EDSAC (Chapter 5, page 185). Reviewed by Dik Leatherdale in Resurrection Issue Number 79 Autumn 2017.

- Mathews, S., (2007), **From Agit-Prop to Free Space: The Architecture of Cedric Price**, Black Dog Publishing, London, U.K., 2007. 285 pp. Cedric Price a "visionary" architect: one whose schemes were grand was hired by Lyons to propose a radical redesign of one of its Corner Houses. In practice Lyons decided that they could not afford the re-design. The book makes a number of references to LEO including photos of a LEO installation.tcoteEast

- MOD Secrets of Eastcote Government Office Site: **The Customs Excise Years.**
(In 1947, under the inspiration of TR Thompson, Lyons, the firm of tea-shops, started - with remarkable foresight - to take a serious interest in applying digital computing to their accounting and office work generally. By 1954, LEO (Lyons Electrical Office) computers carried out 3 commercial
jobs for Lyons - the bakeries' payroll, calculation of production and schedule dispatch to 150 tea shops, and the provision of management information.)

- The the earlier Elliot 405 was replaced in 1963 by the tenth LEO 3 ever built.
It was housed in H Bay (thought by many to have been originally intended as the location for the Operating Theatre had D-Day proved more widely injurious), and, being a very advanced and powerful machine for its time, it aroused so much interest that a glass wall was built around it to allow for a viewing gallery. Data input was via Hollerith punched cards (rectangular holes, and 80 columns), and paper tape. At this stage the purpose of the site's computing power was purely for Census Office work, but later the Department's Payroll system was computerised and run on the LEO, a huge undertaking. The LEO worked until 1971/

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