

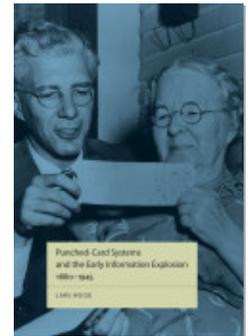


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Punched-Card Systems and the Early Information Explosion,
1880–1945

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Essay on Sources

The shaping of punched-card technology is the focal point of this book. Individuals shaped the technology and, in most cases, they worked in groups of engineers and craftsmen. Their options and choices were based on their training and professional experience as well as their interaction with people in their work, including end users and customers, real or imagined.

The preserved material limits the analysis of the shaping of technology by the various punched-card producers in two ways: little material is preserved from the shaping processes of the early producers and only larger producers have well-preserved archives. First, the few written records that have been preserved from the development process include, for example, drawings, letters, and reports. Further, the shaping process was based on nonrecorded knowledge. To cope with these limitations on the preserved material, it was necessary, to a large extent, to refer to reflections of this process on different company-based material, which include papers and minutes from different boards of directors and management boards, memoirs, company histories based on reminiscences, and records that have vanished since the company history was written. Much of this material was created on a company level, which limits the amount of details on how the technology evolved, and yet contributes to a reasonably detailed representation of the industry's shaping of the technology.

Second, the preserved material in the archives of the various punched-card producers is limited by its unevenness. While IBM and its predecessors and the French *Compagnie des machines Bull* have extensive archives from the period up to the Second World War, much less material exists from the smaller producers and very little material exists from foreign agencies and subsidiaries with little or no innovation. Therefore, the materials handed down from the bigger companies tend to dominate the representation.

To counteract this imbalance, three additional groups of material have been used: public antitrust records, public patent records, and records on punched-card users. This material facilitated locating information about contributions to the shaping process by individuals or companies without well-preserved and accessible archives. Also, this material complements the preserved and accessible company material. For example, it facilitates the study of details in the complex processes of the shaping of punched cards for book-keeping at the Tabulating Machine Company and IBM between 1911 and 1933 and at the Bull company in the 1930s.

The public records from the antitrust suit against IBM and Remington Rand between 1932 and 1936 provide an overview of the punched-card industry in the United States. Also, this material identifies the essential technical features in the development of this technology and the importance of the patents on automatic group control.

A patent contains a description of the patented device, and in many cases it outlines the envisaged applications. First, patents have contributed considerably to identifying significant new technical features that were discarded subsequently, and they facilitate understanding the potential and implications of essential features. Second, patents provide the same information about all members of the industry. Particularly, this has contributed to understanding the development of members of an industry in which few company records on technological development have survived.

Patents also provide access to fruitful related information on the processing of the original patent application, the litigation on patents, and the variations between the patent laws in different countries, which had considerable implications for the industry. However, the archival material on the processing of patent applications and patent litigation is huge and the archives on patent litigation are dispersed throughout the various countries, as patent cases were heard in the lower courts first (with the exception of Herman Hollerith's patent infringement suit against his government in 1910–1912). Therefore, this material is only used in this book in situations concerning the processing of patents and for court cases indicated elsewhere in the material that are considered to be important for the analysis.

Actual and envisioned users were important for how the technology was shaped in that inventors selected features with them in mind. Furthermore, customers were essential for the success or failure of the produced technology and for the shaping of a company's organization, particularly its sales depart-

ments. Sales meant the collection of information about experience from the actual use of the technology and user wishes and ideas concerning additional features. As most interactions with users were simple, secondary sources were sufficient documentation. However, in several cases the interaction with a user was essential for the shaping process because a new application or new technical feature was suggested. In this book, a detailed analysis is made of producer relations with several of the users seen as essential in the shaping process, including census offices, the Bureau of the Census, and the Social Security administration in the United States; the Corps du contrôle de l'administration de l'Armée de terre and the Service de la démographie in France; and the Maschinelles Brichtswesen in Germany. A detailed analysis of additional users in the four countries is not included, but would have produced different details, though their addition apparently would not have resulted in a significantly different story.

Using diverse groups of material established a robust and detailed net of information. This net provides a robust representation of the main features of the development of the technology and facilitates distinguishing between the technology's varying characteristics in the four countries.

Archives on Producers

IBM was the prime mover of punched cards in the United States, dating back to Herman Hollerith's work. The IBM Archives, which are in New York, contain mainly company level material and the minutes of board meetings and of various executive committees for the period up to the Second World War. In addition, the archives hold extensive material from the company's own technical history project, which ran from the 1960s up to 1993. The researchers on these projects conducted oral interviews with key people in the technical development process and collected archives established by engineers during their work at the company that would not otherwise have been preserved. (Copies of these interviews are in the archives of Charles Babbage Institute at the University of Minnesota, Minneapolis, Minnesota.) Also, the IBM Archives hold material on several competing inventors and producers, notably inventors John Royden Pierce and Gustav Tauschek, who IBM hired and whose patents they acquired.

The IBM Archives have a collection of material related to Herman Hollerith and his activities, but Hollerith's private archive is kept in the Manuscript Division of the Library of Congress, Washington, D.C. The correspondence

between Hollerith and George F. Swain is in the Baker Library at Harvard Business School in Boston, Massachusetts, and the Pusey Library at Harvard University in Cambridge, Massachusetts.

Two sets of material from public archives were used to complement the handed-down material in the IBM Archives. First, there were the records of Hollerith's patent infringement suit against the Bureau of the Census, 1910–1912, Equity Case No. 29,065 of the Supreme Court of the District of Columbia. The records are in the Washington National Records Center in Suitland, Maryland. Second, there are the court files of the government's antitrust suit against IBM and Remington Rand, 1932–1935, first read as Equity Case No. 66-215 in the Southern District of New York. Its records are in the National Archives, Northeast Region, in New York. The appeal to the Supreme Court of the United States, File No. 758 of 1935 is in the Washington National Records Center. The file on IBM in the Antitrust Division of the Department of Justice is in the records of the Department of Justice (RG-60) in the National Archives in College Park, Maryland.

The machine workshop in the Bureau of the Census was the first challenger to Hollerith's punched-card monopoly. The archives of the Bureau of the Census (RG-29), which are located in the National Archives in College Park, Maryland, hold some material on the activities in the machine shop.

Powers Accounting Machine Company was the first commercial challenger to Hollerith's company. The preserved records from this company are in the archives of Remington Rand Corporation (Accessions 1825 and 1910) at the Hagley Museum and Library in Wilmington, Delaware. However, very little is preserved from the Powers company. Further, a personnel file on James Powers from his time at the Census Bureau machine shop is in the National Personnel Records Center in St. Louis, Missouri. In addition, a small collection from Powers' private archives is in the National Museum of American History in Washington, D.C. (No. 1991.3180.09).

In Great Britain, the British Tabulating Machine Company and the British Powers Machine Company merged in 1959 and, subsequently, the new company was named International Computers Limited (ICL). The preserved parts of the archives from the British Tabulating Machine Company and the British Powers Machine Company, however, are in three locations. First, board minutes and papers are kept by ICL, their exact location, though perhaps in London, is unknown to the author, who tried in vain to get access to them. Martin Campbell-Kelly, however, had access to this material when he wrote

the book, *ICL: A Business and Technical History* (Oxford: Oxford University Press, 1989) and was so kind as to lend his notes and copies to the author. Second, their trade journals sit in the Library of Science Museum in South Kensington. Third, diverse material on technical development and sales activities are in the National Archive for the History of Computing in Manchester, England.

In Germany, the archives of Deutsche Hollerith Maschinen Gesellschaft mit beschränkter Haftung (Dehomag) (B-95) are in Wirtschaftsarchiv Baden-Württemberg, Stuttgart-Hohenheim. The archives of the company custodian during the First World War, the Zwangsverwaltung der feindlichen Beteiligung, are in the Geheimes Staatsarchiv, Preussischer Kulturbesitz, in Berlin. The archives of the company custodian during the Second World War, the Reichskommissariat für die Behandlung feindlichen Vermögens (R-87), are in the Bundesarchiv in Berlin-Lichterfelde.

No archives from the German Powers companies were located. The archives of the company custodian during the First World War, the Zwangsverwaltung der feindlichen Beteiligung, are in the Geheimes Staatsarchiv, Preussischer Kulturbesitz, in Berlin. The archives of the company custodian during the Second World War, the Reichskommissariat für die Behandlung feindlichen Vermögens (R-87), are in the Bundesarchiv in Berlin-Lichterfelde. Siemens' design and production of punched-card equipment was related to the second German Powers company. Papers related to this activity are in the Siemens' Archive in Siemens Forum, Munich.

In France, the archives of the Compagnie des machines Bull are in St. Denis, and the author obtained access through the Fédération des Équipes Bull in France. Supplementary material was obtained from the archives of Bull A/S in Oslo, Norway. In addition, the author was granted access to the diaries of Henrik Hartzner (in Danish) by his family. Files on the patent infringement suit by IBM against the Bull company are in the archives of the Cour d'Appel de Paris, Greffe Civil, Nos. H-1440 (1947) and H-1441 (1947) in the Archives de Paris.

Patents

Most of the patents since the 1880s are in national publications with yearly indexes. The patent publications are available at the national patent authorities, which have publications of foreign patents as well. For example, the Danish national patent authority has the printed patents from France, Ger-

many, Great Britain, and the United States. In Austria and France, printing granted patents only started just before 1900. Lists of earlier patents exist at the national patent authority, and these patents are available in archives. In Austria they are located in the Kaiserliche und königliche Privilege Archiv in the Österreichisches Patentamt in Vienna, while in France, they are located at the Archive de brevet of the Institut national de la propriété industrielle in Paris.

All patents granted in the United States are available on the Internet (www.uspto.gov/patft/), and although they are accessible via their patent number, search tools for locating patents by, for example, inventor and subject are not yet available for the period before the interwar years. As a result, it is still necessary to use printed annual indexes to locate patents. The various European patent authorities are also engaged in publishing their patents on the Internet (www.espacenet.com). However, most European countries have fewer complete Internet publications for the start of the twentieth century than the United States does, which refers researchers to the printed national publications of patents.

A special service in the United States is the national patent authority's recording of the transfer of patent rights, which is a valuable entry for studying the business context of patents. The digest of the assignment of patents are in the records of the Patent and Trademark Office (RG-241) in the National Archives at College Park, Maryland.

Archives on Users

In the United States, the main organizational users in this book were those processing census returns in the United States between 1880 and 1940 and the Social Security administration. The records of the census offices in 1880, 1890, and 1900 and the permanent Bureau of the Census are in the Records of the Bureau of the Census (RG-29), which is in the National Archives in College Park, Maryland. The Records of the Social Security Administration (RG-47) are in the same location. Additional material lies in the Social Security Administration History Archives in Baltimore, Maryland. Its website holds extensive public material on Social Security (www.ssa.gov/history/history.html).

For Great Britain, Martin Campbell-Kelly published studies of data processing in five organizations in the nineteenth and early twentieth centuries: "Data Processing and Technological Change: The Post Office Savings Bank, 1861-1930," *Technology and Culture*, 39(1998): 1-32, "Information Tech-

nology and Organizational Change in the British Census, 1801–1911,” *Information Systems Research*, 7(1996), 22–36, “Large Scale Data Processing in Prudential, 1850–1930” [in England], *Accounting, Business and Financial History*, 2(1992): 117–139, “Punched-Card Machinery,” in *Computing before Computers*, ed. William Asprey (Ames: Iowa State University Press, 1990), 122–155, and “The Railway Clearing House and Victorian Data Processing,” in *Information Acumen: The Understanding and Use of Knowledge in Modern Business*, ed. Lisa Bud-Frierman (London: Routledge, 1994), 51–74. Additional information is in the archives of the Records of the General Register Office (RG) and the Stationery Office (STAT) at the Public Record Office in Kew, London.

For Germany, an overview of data processing in private and public administration is in Pankraz Görl, *Technisierung der Administration: Maschinelle Datenverarbeitung und die Rationalisierung der Verwaltung in Deutschland 1924–1945* (unpublished M.A. thesis, Ludwig-Maximilians-Universität, Munich, 1993). Most of the archives of the Maschinelles Brichswesen were destroyed during and just after the Second World War. The remaining parts are in the archives of the Reichsministerium für Rüstung und Kriegsproduktion (R-3) in the Bundesarchiv in Berlin-Lichterfelde.

In France, the archive of the Corps du contrôle de l’administration de l’Armée de terre is in the Archives du Service historique de l’Armée de terre in Château de Vincennes, Paris. The archives of the Service de la démographie are in the Centre des archives économiques et financières at Savigny-le-Temple near Paris.

Studies of Office Technologies

First, there is an extensive bibliographic guide by James W. Cortada, *A Bibliographic Guide to the History of Computing, Computers, and the Information Processing Industry* (New York: Greenwood Press, 1990). It is particularly useful for locating diverse publications on the various uses of information technologies. Second, the studies of office mechanization can be divided up into three groups: Technical studies, business histories, and recent studies focusing on the interaction between the technology and the related social structures.

Technical history studies on office technologies focus on the artifacts, rather than on how the artifacts relate to the cultural, economic, political or social context. The main emphasis is on telling the story of the emergence of

the electronic computer and its subsequent history, with only a few studies appearing on precomputer technologies; see Hartmut Petzold, *Rechnende Maschinen; Eine historische Untersuchung ihrer Herstellung und Anwendung vom Kaiserreich bis zur Bundesrepublik* (Düsseldorf: VDI Verlag, 1985) and Hartmut Petzold, *Moderne Rechenkünstler; Die Industrialisierung der Rechentechnik in Deutschland* (Munich: C. H. Beck, 1992); Robert Ligonnière, *Préhistoire et histoire des ordinateurs* (Paris: Robert Laffont, 1987); Werner Lange, *Buchungsmaschinen. Meisterwerke feinmechanischer Datenverarbeitung 1910 bis 1960* (Munich: R. Oldenbourg, 1986); Friedrich W. Kistermann, "The Invention and Development of the Hollerith Punched Card: In Commemoration of the 130th Anniversary of the Birth of Herman Hollerith and for the 100th Anniversary of Large Scale Data Processing," *IEEE Annals of the History of Computing*, 13(1991): 245–259, Lars Heide, "From Invention to Production: The Development of Punched-Card Machines by F. R. Bull and K. A. Knutsen, 1918–1930," *IEEE Annals of the History of Computing*, 13(1991): 261–272; Friedrich W. Kistermann, "The Way to the First Automatic Sequence-Controlled Printing Calculator: The 1935 DEHOMAG D11 Tabulator," *IEEE Annals of the History of Computing*, 17:2(1995): 33–49; Peggy Aldrich Kidwell, "The Adding Machine Fraternity at St. Louis: Creating a Center of Invention, 1880–1920," *IEEE Annals of the History of Computing*, 22:2(2000): 4–21; Peggy Aldrich Kidwell, "'Yours for Improvement': The Adding Machines of Chicago, 1884–1930," *IEEE Annals of the History of Computing*, 23:3(2001): 3–21.

These historians documented the technical development, but their narrow approach curtailed their contribution to understanding how this technology was shaped and its impact on society. Notable exceptions are Paul N. Edward's study of the role of computers in Cold War discourse in the United States in *The Closed World: Computers and the Politics of Discourse in Cold War America* (Cambridge, MA: MIT Press, 1997) and Jon Agar's history of the British civil service in *The Government Machine: A Revolutionary History of the Computer* (Cambridge, MA: MIT Press, 2003).

Another factor to consider is that the business history studies of the office machine industry have a narrow approach. They focus on the business context of the technology, providing important insights into the history of office machine producers. Their information about the importance of establishing sales organizations is useful, as it draws attention to the role of the customer. However, the relations between demand and the shaping of the products is

not analyzed; see Saul Engelbourg, *International Business Machines: A Business History* (New York: Arno Press 1976); Gunnar Nerheim and Helge W. Nordvik, 'Ikke bare maskiner'. *Historien om IBM i Norge 1935–1985* (Oslo: Universitetsforlaget, 1986); Geoffrey Austrian, *Herman Hollerith: Forgotten Giant of Information Processing* (New York: Columbia University Press, 1982); Martin Campbell-Kelly, *ICL: A Business and Technical History* (Oxford: Oxford University Press, 1989); Martin Campbell-Kelly, "Punched-Card Machinery," in *Computing before Computers*, ed. William Asprey (Ames: University of Iowa Press, 1990); Pierre-Eric Mounier-Kuhn, "Bull: A World-Wide Company Born in Europe," *Annals of the History of Computing*, vol. 11 (1989), 279–29; James W. Cortada, *Before the Computer: IBM, NCR, Burroughs, and Remington Rand and the Industry They Created, 1865–1956* (Princeton, NJ: Princeton University Press, 1993).

In *Structuring the Information Age: Life Insurance and Technology in the Twentieth Century* (Baltimore: Johns Hopkins University Press, 2005), JoAnne Yates analyzed the social shaping of office technology from the perspective of the American life insurance industry and office technology card producers. Her study convincingly demonstrates the potentials of analyzing the interaction between producers and users.

In contrast to the top-down perspectives of producers and managers, studies in the history of office workers provide a bottom-up perspective. As society entrusted more and bigger assignments to offices, these offices changed in several ways. In addition to the new machines, offices gained a new social and educational composition, a different organizational structure, and a new look. The crucial story of how female secretaries and typists outdid the better-educated male clerks was the subject of several studies. Analysis threw light on the critical cultural, social, and economic changes within the office, which facilitated the introduction of office machines; see *The White Blouse Revolution: Female Office Workers since 1870*, ed., Gregory Anderson (Manchester: Manchester University Press, 1987); Margery W. Davies, *Woman's Place Is at the Typewriter: Office Work and Office Workers 1870–1930* (Philadelphia: Temple University Press, 1982); Samuel Cohn, *The Process of Occupational Sex-Typing: The Feminization of Clerical Labor in Great Britain* (Philadelphia: Temple University Press, 1985); Delphine Gardey, *Un mode en mutation: Les employés de bureau en France: Féminisation, mécanisation, rationalisation* (doctoral dissertation, Université Paris 7, 1995).

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