

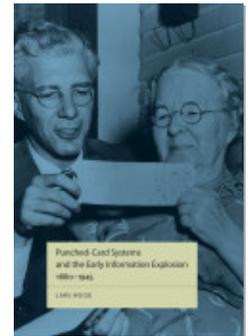


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1880–1945

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Keeping Tabs on Society with Punched Cards

The Social Security Act of 1935 was a core part of President Franklin D. Roosevelt's New Deal policy to raise the United States out of the economic crisis that had started in 1929.¹ The act authorized a national system of contributory old age benefits for people who turned 65 in 1942 and later a state administered, federally supervised unemployment insurance system and a program to induce nationwide financial aid and to provide aid for the needy, the aged, the blind, and those children deprived of parental support.² It also promoted national financial assistance for improved public health services by expanding research, by helping states improve their health staffs, by giving special aid to disadvantaged children and children with disabilities, and by renewing promotional health work for mothers and infants. Finally, the act established a three-member Social Security Board to manage the program.³

Compared with other Western societies, however, the United States was tardy in introducing compulsory national programs for old age pensions and unemployment compensation. The United States had extensive examples from abroad in the form of old age pension programs in Germany, Great Britain, and France to draw on in creating their system.

For the first time, the Social Security Act conferred a general federal commitment in social matters in the United States but only help to blind people and orphans was to come from the transfer of public revenues. The programs for unemployment insurance and old age pensions were intended to pay their own way. To take care of each of the millions of participants in the old age pension program, however, the federal government organized and funded an extensive central bureaucracy more ambitious than

any other undertaken in the United States or abroad. The national government wanted to care directly for the individual.

The objective of a just relationship between contributions and pensions was shaped by the politicians and civil servants who formed the Social Security Act of 1935. They knew of the old age pension programs in Germany, Great Britain, and France and of policy administration in insurance companies. A bureaucratic program designed to execute the intentions of the law was only developed subsequent to its enactment. It was only at this point that the punched-card method was introduced, and the bureaucracy became based on a vast register of IBM punched cards of all wage holders who had contributed to an old age pension.

Previously, punched cards by and large had remained a processing tool and were discarded when the processing was completed. Exceptions were punched-card systems for insurance policy administration. For every premium collection, one card per policy of the same set with the basic information was used in issuing invoices. Administering the Social Security program introduced for the first time a similar register on a national scale, giving it unprecedented size and scope. In turn, the size of the program provided the essential impetus for further development of the established closure of punched cards for bookkeeping. This further development opened up the industry to considering changes to their model, reversing their usual inclination to be conservative about changes to an established closure.

Furthermore, this large, register-based national system for administering old age pension savings in the United States became the first of many large registers used to mobilize all people. Large registers became an essential tool in modern societies. France established a comparably large register between 1940 and 1944, while in Germany, the government tried in vain from 1943 to 1944 to establish a large register of people. In the Second World War, additional large registers in the United States became a means of enhancing warfare capabilities, and subsequent large registers were used to manage a more advanced society.

Franklin D. Roosevelt's Social Security Program

Franklin D. Roosevelt promised “social justice through social action” in his presidential campaign in 1932. After his election, the most pressing

problem for his new administration was providing relief for destitute families, and this was done through relief and support measures for industry and agriculture. In the summer of 1934, Roosevelt revived his ideas concerning general social legislation, establishing a committee to study economic insecurity in the United States and European experiences with social security. Their report became the basis for the bill on social security, which was adopted by Congress in August 1935.

The contributory old age pension of the Social Security Act from 1935 was compulsory and encompassed all wage holders in the United States with several notable exceptions, including, agricultural labor, domestic service, sailors, and public employees.⁴ In 1937, the scheme was comprised of 32.9 million people and grew to 46.4 million people in 1945.⁵ Employers were obliged to report frequently to the Office of the Commissioner of Internal Revenue, the federal tax collecting authority, any wages they paid and to pay 1 percent of the wages as new tax, alluded to as pension contributions, plus the same amount as an excise tax on employers.⁶

The information about wages paid to individuals was forwarded to the Social Security Board, which was created as a federal organization to run the Social Security program. The Board was responsible for monitoring each individual's accumulated earnings, the basis for his or her pension. A small percentage of the accumulated earnings were then paid monthly from the age of 65 until death, and Social Security also paid widow benefits.⁷ The taxes paid under this program were accumulated as a special fund in the Treasury, which was also responsible for paying pensions that were determined by the administration of the Social Security program.

The Social Security Act did not specify how monitoring wages reported for individual employees should take place, but the operation was to start in 1937. The president's committee in 1934 and its staff, who prepared the bill, had studied contributory old age pension programs in Germany, Great Britain, and France and seemed certain that a system could be devised to monitor the wages paid to tens of millions of individuals over many years.⁸ This became one of the first great challenges of the Social Security Board.⁹

During its first year, the Social Security Board shaped the general design of the system for monitoring the wages earned, which included a way to identify the records of each of the millions of workers covered by the Social Security Act. The act mentioned several traditional means of

reporting wages earned, indicating that manually processing the reports was envisioned.¹⁰ While this system was being designed, punched cards emerged as a means of processing wage reports, becoming preferred over more traditional means.

The establishment of a system for monitoring wages needed a way to identify people. Simple considerations showed the importance of issuing identifiers and not simply of recording wages by name and identifying like-named individuals by their dates of birth, mothers' maiden names, or other similar information. A telephone book from Washington, D.C. (with about 500,000 inhabitants), revealed thirty-three individuals named John Smith and eighteen named Mary Jones, demonstrating how difficult, time-consuming, and inexact differentiating among so many individuals would be without some type of numeric or alphanumeric identifier.

In November 1935, the newly appointed Social Security Board tentatively decided that the identifier should have eight characters, three letters and five digits. This decision sparked two controversies. First, the Social Security Board found that several federal agencies used their own exclusive numeric identification schemes, and a wish emerged to define the Social Security identification in a way that would facilitate an extension to universal registration. Second, they learned that these agencies had rejected the use of alphanumeric systems largely because only IBM and Remington Rand produced machines that could work with such a system. Moreover, the government had filed an antitrust suit against these companies in 1932 that was only resolved by the United States Supreme Court in April 1936.¹¹ Thus the Social Security Board's tentative decision for an alphanumeric indicator was not only inconsistent with the exclusive use of identifiers government-wide, it also clashed with Justice Department strategy.

These considerations made the Social Security Board realize that only an all-numeric identifier would be feasible, reducing the focus to how many digits a Social Security number should have and what they would represent. The Social Security Board decided in June 1936 to identify each individual wage holder with a number composed of nine digits divided into three sections. The first three digits specified the geographical area where the individual lived when applying for a Social Security number, the next two digits indicated the group, and the remaining four digits constituted an individual serial number. The two-digit group number was originally planned to facilitate the location of the individual location

within the wider area specified by the first three digits. However, the two-digit group number lost its meaning in the initial number assigning process in 1937, and it would, anyway, have lost meaning as people moved.¹²

A similar numerical identifier for employers was also originally designed to facilitate localization. This nine-digit number also had three groupings. The first grouping of two digits indicated the Internal Revenue District to which employers were to report the wages they had paid and through which they would pay the excise tax levied upon them as an employer as well as the income tax deducted from employee salaries.¹³ The second group of two figures embodied the industrial code of the employer's business, and the final group of five digits was a serial number. Also the design of this number was subsequently simplified, as the industrial code was eliminated and added to the serial number, which now consists of seven digits.¹⁴

The initial task of enumeration was performed by post offices throughout the country, as the Post Office Department was an already established government organization that maintained offices in a majority of communities, while the Social Security Board had not yet established a network of offices. In the first step of this process in November 1936, each local post office identified every employer in its area, providing each of them with an application for an employer identification number. The applications, which included a question concerning the number of employees each employer had, were to be returned within a week. Although there was no legal compulsion for the employers to cooperate, nearly all complied with the request, indicating a high degree of public acceptance of the social security program. Next, the post offices provided employers with sufficient application forms for Social Security numbers for their employees. The completed applications were then sent to the Social Security Board's office in Baltimore, which assigned account numbers.

The Board originally anticipated an initial registration of some 26 million employees, and expected an increase of about 5 million during the first year of operation and 2 million each year thereafter, until an average load of 35 to 40 million active numbers was established. However, this projection turned out to be too low. In less than a month after the application forms had been distributed by the post offices, more than 22 million completed applications had been received. Some 30 million numbers had already been assigned in July 1937 when the Board assumed responsibility

from the Post Office Department for the entire operation of issuing Social Security numbers.¹⁵

Monitoring every employee's wages, an enormous undertaking, was the basic task of the Social Security Act's old age pension program. Since wage reports were to start arriving near the middle of 1937, most of the decisions surrounding this issue were being made simultaneously with those concerning employee registration.

Comparable old age pension programs had already been established in Great Britain, France, and Germany, and the United States Social Security Board included these experiences in their considerations. All these programs, which accounted for people's varying wages, used written files and key office machines. In addition, they were all based on decentralized administration in a large number of organizations, but the total number of people encompassed by the schemes in Great Britain and France were comparable to the projected number of people in the United States. In Great Britain a total of 19.1 million people were insured in 1932, which was along similar lines to that planned in the United States.¹⁶ In 1939 in France, a total of 21,000 organizations administered the pension insurance of 9.2 million people.¹⁷

The old age program for social security in the United States distinguished itself from all of the others by being administered by a centralized bureaucracy, which complicated the task. The key problem was to frequently monitor the income of tens of millions of people. In the summer of 1936, the Social Security Board considered two basic methods for obtaining information on peoples' earnings: payroll reports and stamp passbooks. The payroll report method would rely on quarterly or semiannual statements of each individual's earnings. Another method would entail stamp passbooks that indicated the earnings of individual employees and were to be sent to the Social Security Board once or twice a year. The stamp passbook method was simpler, particularly for small employers, who relied on handwritten records in ledgers. However, Social Security Board discussions from the summer of 1936 eliminated the stamp passbook option.¹⁸

Based on the choice of the payroll report method and the decisions concerning identifiers for wage holders and employers, the Social Security Board asked ninety equipment companies to submit bids or proposals for establishing and maintaining the record-keeping system. Eight of these

companies submitted proposals that were comprehensive enough to be considered by the Social Security Board. Five of these were soon eliminated, leaving the Burroughs Adding Machine Company, IBM, and the Monroe Calculating Machine Company. Their proposals were comprehensive and explicit enough regarding operation plans and the breakdown of operating costs to make detailed comparisons possible. Because the differences between the operating costs in the three proposals were small, cost was quickly eliminated as a determining factor.

As a result, the choice came down to the method proposed rather than which equipment company. The Burroughs and Monroe proposals were based on key-bookkeeping machines and involved extensive manual handling of records. In contrast, IBM proposed a punched-card method. The committee that the Social Security Board had convened to study the proposals chose the most technically sophisticated option, concluding that the application of the highly mechanized IBM system was the best approach at the outset. This system was superior in terms of adaptability to future change, both concerning procedures and workload volume. Moreover, it reduced the human element, which the committee believed should be eliminated as much as possible. The committee recommended acceptance of the IBM proposal, to which the Board concurred.¹⁹

Next, the Social Security Board acquired space for a centralized office in Baltimore and began establishing wage records for all the coming beneficiaries of Social Security old age pensions. This operation began just after the Social Security numbers had been assigned after applications were received from wage holders. Based on the information on the application forms, punched cards were produced, and registers and ledgers were established.

A master punched card, produced for every employee, was used to maintain the wage record. Each master card contained the employee's Social Security number, first ten letters of the first name, first three letters or initial of middle name, first twelve letters of the last name, a three-digit phonetic code, date of birth (but not year), sex, race (eight categories), and date of issuance of the Social Security number. The Social Security number and name were mechanically printed on the top of the card by a punched-card typewriter (interpreter). Compared with the subsequent French national register, it is worth noting that employee addresses, while not punched, were kept in the written case record.

The phonetic code was applied to eliminate confusion and errors rising from variations in the spelling of a registrant's name on different records associated with his account, for example, on wage reports filed by different employers. The phonetic code represented the last name by a letter and a three-digit number. Though costly to implement, the Equitable Life Assurance Society in New York had claimed that the code had eliminated the misspelling of names in their handling of policies.²⁰

Next, punched cards were used to prepare the visible index of registrants, an index made up of legible strips that came in large perforated sheets. Each strip provided for one line of print and was used for a single Social Security number. Since the strips appeared primarily in the same order as the phonetic code, all the names that were phonetically similar, but that had dissimilar spellings were brought together in the visible index. Examination of this index therefore revealed a surprising number of variations in the spelling of many common names. In spite of the complications caused by having literally hundreds of thousands of individuals with the same surname and a total of about 32 million names in the file in 1937, it was possible for the clerks familiar with the visible index to quickly find any name and its corresponding Social Security number.

The master punched cards were also used to produce a numerical register of accounts by listing the name and date of birth of each registrant in numerical order. This register, a printed list of the information from the sorted cards, was kept in loose-leaf books and was applied to locate available numbers for assigning additional Social Security numbers. And, finally, the master cards were used to head up the ledger sheets on which wage records were posted. This was accomplished on fanfold paper by a tabulator, which was subsequently separated into sheets. The master cards and ledger sheets were then filed separately in numerical order by regions. The same procedure was followed for subsequent applications for Social Security numbers.

Established registers were used to record wages paid from the beginning of 1937. Employers reported the wages paid quarterly to the Bureau of Internal Revenue, now known as the Internal Revenue Service;²¹ the Bureau then verified the reported information for consistency and forwarded it to the Social Security administration. They processed employer wage reports by preparing a punched card for each wage earned, allowing wage reports to be mechanically processed. They also balanced the cards



Clerks filing Social Security punched-card records in Baltimore, late 1930s.
(Social Security Administration, Baltimore, Maryland)

punched with the wage report information, verified the identity of each registrant for whom wages were reported, and posted the amounts reported to the correct ledger sheets so that records of individual earnings were available to determine the amount of benefits due.

As the ledger sheets of the registrants were filed in the same order as the Social Security numbers, employee earnings cards also were sorted in the same order before the mechanical posting of wages was carried out expeditiously. This system brought all the earnings cards for an individual's account together in instances where more than one employer had reported wages during the period. The earnings cards were then mechanically compared by use of a collator punched-card machine with the corresponding employee master cards. This step was taken to verify the identity of the individual for whom wages were reported and to segregate the cards of individuals who did not yet have an employee master card. If the name on an earnings card did not agree with the name on the master

card bearing the same account number, the account was removed from the ledger section, the various files were searched to establish identity, and the account was posted at a later time.

The earnings cards in the ledger section were listed mechanically, the total number of cards and the amount of earnings recorded. This list of accounts indicated which individual ledger sheets were to be taken from the file for posting. The earnings were then mechanically posted on the individual ledger sheets by accounting machines which “read” the amounts punched on the cards. All records were then returned to the files.

The Social Security Board’s choice in 1936 of a punched-card system to monitor the wages of tens of millions of people had a variety of implications. It provided extensive punched-card business, which shaped technology and the industry. It also provided the national government with a tool for direct access to individual citizens.

The monitoring of wages could have been accomplished by the standard IBM equipment available. However, two new items were introduced to ease the operation: a collator—a nonstandard punched-card machine—and a new posting attachment to the tabulator. People at IBM had worked to design a collator punched-card machine since the early 1930s to facilitate frequent file mergers, for example, permanent employee master cards, and weekly wage cards in a wage administration. However, the development of the machine was only completed in 1937, when it went into production as a response to the demand from the Social Security administration.

The collator merged two piles of punched cards that had been sorted in the same succession, for example, when the quarterly earnings cards were compared with the employee master cards to verify the identity of the wage earner. A standard sorter could accomplish this operation, but extensive and time-consuming sorting would be required. The core problem was how to handle unmatched cards and cards that had been misplaced. IBM built a collator that could reject unmatched cards. Misplaced cards could still derail the process, and merging punched cards remained a major problem. This problem was finally solved by the transition to magnetic storage combined with extensive sorting, which had not been feasible for punched cards.²²

The new posting attachment to the tabulator was a technically sophisticated solution to the problem of adding information onto the wage

earner's ledger sheet regarding a record of aggregate wages after the beginning of 1937. The solution was chosen from IBM's overall proposal in 1936, which suggested either strip posting or direct posting. Strip posting entailed the tabulator printing information to an adhesive strip that clerks subsequently affixed to the proper ledger sheets. The strips were heat laminated onto the ledger sheets using an iron.

To provide direct posting onto the ledger sheets, it was necessary for IBM to equip its regular tabulator with a new posting device. At first, the strip method appeared to be better, as it was less costly. However, there was no way to judge the life of such strips, or exactly how long they would remain firmly adhered to the ledger sheets. And when a strip fell off, an individual's record would be ruined. IBM, in contrast, was able to satisfactorily demonstrate that it could supply an appropriate device to print the posting directly onto the ledger sheets. The Board chose this solution.²³

Notably, IBM's huge punched-card contract for monitoring wages was not contested by Remington Rand, who did not submit a comprehensive proposal for monitoring wages to the Social Security Board in 1936. The Social Security contract, which enhanced IBM's position as the leading punched-card producer in the United States, was probably a major reason why Remington Rand, in 1938, finally launched their Model 3 line of alphanumeric punched-card machines, which went into production and reached the market over the following five years.

The register for monitoring wages in administering Social Security was a noted success for Franklin D. Roosevelt's contested New Deal policy, and it opened up the possibility of using large, machine-readable registers. They also became an important tool for warfare during the Second World War. Many other administrations on the federal, state, and local levels developed an interest in establishing a Social Security number as an identifier for a large number of people in the United States and its application in the machine-readable register. However, to safeguard the confidentiality of the information in the register, the Social Security Board decided in 1937 to require that all records must be confidential and used only for administering the program.²⁴ In this way, they established a high standard early, distinguishing them and their successors from the people who built comparable registers in France and Germany between 1940 and 1944.

The Vichy Mobilization Register

In June 1940, France capitulated after five weeks of fighting against the German invasion. The country was divided into two parts, one was occupied by Germany and the other was under rule by a French government in Vichy. Armistice conditions were harsh, allowing the French government an army of a mere 100,000 men, which could not threaten Germany.

During the 1930s, René Carmille, who held a key administrative position in the French army, had tried in vain to improve the administration of conscription and mobilization via the use of punched cards or a combination of punched cards and address plates. Shortly after the fall of France, Carmille suggested establishing a mobilization register using punched cards to prepare an army with an amount of strength not permitted by the armistice. Over the following two years, he implemented a register that allowed for the conscription of 300,000 men. The scope of the register, however, went beyond this to become a national register enabling the state to monitor its subjects, for better and for worse.

The mobilization register was completed in the spring of 1942, but the Germans took over the unoccupied part of France in November 1942, removing the possibility of mobilization and raising the risk of the register's being detected by the Germans. Consequently, Carmille destroyed the mobilization register and related archives but continued to build up the national register. However, the autocratic French government in Vichy provided a far from ideal setting for exploring the concept of keeping a national register, its history illustrating the somber implications of big, machine-readable registers. The register was used to keep tabs on the population by improving both the control of identification cards issued and the distribution of ration cards. Since Jews were registered separately because of the anti-Semitic inclination of the Vichy regime, punched cards may have been used to locate Jews for deportation.

The civil administration of the French national register was established from scratch in 1940, which resembled the development of the punched-card register that the administration for the United States Social Security went through from 1935 to 1937.²⁵ However, René Carmille had promoted office mechanization based on punched cards for use in the French army since the early 1930s, starting with operational statistics and later

including bookkeeping of the weekly payment of wages for workers at an armament factory.

Compared with these tasks, managing a vast modern army of conscripts was a huge administrative undertaking that was crucial for France's military performance and was accomplished by simple manual methods. The first step involved in conscription administration was to call the conscripts up and provide their basic training. Then, they were transferred to the reserves, and the military had to keep track of the conscripts to prepare them for exercises and for any future mobilization. The administrative task was complicated, as the conscripts remained in the reserves for sixteen years after their basic training. The size of this task is apparent from the fact that at the outbreak of the Second World War in September 1939, France called up 4.7 million men.²⁶

Back in 1933, when France had adopted a new mobilization plan, the conscription and mobilization service began studying ways to mechanize this gigantic bookkeeping operation, taking into account where people currently lived, rather than their last contact address. The military wanted to improve the distribution of personnel to the various units, and they wanted to be able to print the diverse mobilization documents quickly. This assignment required writing or printing various kinds of information on each soldier, including name, address, profession, and unit.²⁷

It was ascertained that the mobilization system could be improved, either through a system that used punched cards or a combination of punched cards and address plates. An exclusive punched-card system would have required an alphanumeric capability and a punched card with more than the standard forty-five columns to allow bigger records units.

Various companies in France had the ability to provide different solutions to the government's needs. After 1928, IBM was able to use their new 80-column card, and by 1933 they could supply alphanumeric machines. The French Bull company built their first alphanumeric tabulator the following year and were prepared to adopt the IBM 80-column card even though this constituted an infringement of IBM's French patent.²⁸ SAMAS marketed 65- or 130-column numeric punched cards and a combined system of punched cards and address plates.

For what were most likely patriotic reasons, only Bull was asked to provide machines for testing at the Versailles draft administration office. In the summer of 1935, the tests failed because of deficient machines. The tests,

using one 80-column card per soldier, showed that addressing mail, for example, for mobilization orders for individual reservists was not possible.²⁹ However, this planned system introduced punched cards as a full register tool in the French army. Unlike the army wage administration system, the punched-card register comprised the core of the register. Bull was so eager to gain the draft administration order that they introduced IBM's 80-column card for this application.

After Bull's failure in 1935 concerning the army conscription administration test, the administration began to develop a conscription and mobilization system at their regional office in Rouen in Northern France, using a combination of SAMAS punched-card equipment and address plates. The zinc address plate was a well-established technology, widely used by big insurance companies. The drawbacks were that handling the zinc plates was heavy work and that the sorting was done by hand—for these reasons, an additional punched card was used for each conscript. These cards were used to produce statistics on the conscripts and to provide lists of the zinc plates to be selected. During the initial tests at an army recruiting office, a soldier was caught and convicted of industrial espionage for the Bull company against SAMAS. This incident probably contributed to the choice of the combination of the SAMAS punched-card equipment and address plates in 1936 as the basis for the conscription and personnel administration system.³⁰

For the next two years, the army built up a system for the conscription administration in Rouen using SAMAS and addressograph equipment. The 130-column SAMAS punched card allowed a system that used only one punched-card per person in addition to an address plate. The punched card was used to assign the reservists to various groups for administrative and statistical purposes. The address plate printing machine enabled the operators to print selected information on the ten or so different forms issued during basic military training as well as for subsequent exercises and for an ultimate mobilization. A seven-digit number identified each person, his punched card, and his address plate.³¹ The large storage capacity of an address plate changed the originally planned, but rejected, Bull system where it was necessary to store all information on one punched card holding eighty characters. At that time, the register of conscripts and army personnel held much more information, including the full name and postal address.

In spite of its potential, by the outbreak of the Second World War in September 1939, this system had not advanced beyond the regional conscription administration office in Rouen. One reason for this was a dispute over the choice of a French address plate supplier instead of the American Addressograph company, which had supplied the equipment for developing the system.³² Clearly the project was considered low priority if the government allowed this controversy to impede it. The planned improvement of the conscript administration was not considered essential, as the French governments were blind to the growing power of the German armed forces after the revengeful Nazi government came to power in 1933. This blindness was closely linked to the French governments' conviction that their army was the best in the world, a victor from the Great War. In addition, the planned improvement of the conscription administration was impeded by the general inability of French society to implement reforms in the 1930s.³³ These factors explain both the lack of improvement in the French conscription and mobilization service during the 1930s and what followed during the early 1940s.

The foundation to French conscription vanished on 22 June 1940, when France capitulated to the German invasion. The country was divided into two parts: the northern and western three-fifths of the country were occupied by Germany, while the southern, nonoccupied two-fifths of the country came under a French government in Vichy. The latter was headed by the aging Marshal Philippe Pétain, known for his outstanding service during the First World War. The armistice conditions were harsh. Pétain's government was only to govern two-fifths of the country, while he formally remained in charge of much more land occupied by Germany, including Paris. The new French government was allowed an army of a mere 100,000 men, which could not threaten Germany, and the 1.8 million French prisoners of war would remain in German captivity to be exploited by them in later bargaining situations.³⁴

The last parliament elected under the constitution of the unstable Third French Republic elected Pétain head of state and conferred on him great power, which he exercised to transform what remained of the democratic republic into the autocratic *l'État français* (the French state). This state was based on the virtues of work, family, and obedience to authority and had transparent fascist connotations. A flagrant example was the exclusion of Jews starting in late 1940 from all but low-ranking public

jobs in both the occupied and the nonoccupied parts of France. This anti-Jewish policy represented a distinct break from the secular and egalitarian policies of the Third Republic.

Public employees had grown disenchanted during the 1930s. They had experienced considerable instability, right-wing governments, the People's Front government from 1936 to 1937, last-minute avoidance of a civil war, and extensive government by decree. Now, public employees agreed to serve the Vichy state, but, subsequently, their loyalty became strained as the German occupation was extended to include the whole of France.³⁵

During the 1930s, René Carmille had experienced the success of his operational statistics assignments, but attempts by Carmille and his colleagues to improve the conscription and mobilization administration through the use of punched cards or a combination of punched cards and address plates had come to nothing. In August 1940, he took the major initiative of proposing to the Vichy government the establishment of a punched-card register of all inhabitants in France to be used as a permanent census tool. His avowed intention was to improve census processing at the ailing French Statistics Department (*Statistique général de la France*, established 1833), which for many years had needed basic improvement, an example being that they still processed the population censuses without punched cards.³⁶

A register of all inhabitants in France would remove the work of having to collect and punch fresh material for each census, although it would be a major and costly task to keep the huge punched-card file up to date. However, a general punched-card register could make the individual vulnerable because of the confidential information provided. It would, for example, be much easier to locate people with special, recorded characteristics, than would otherwise have been the case by reading every returned census forms. This new option could give rise to requests from various authorities leading to the misuse of the information supplied through census returns. The register would supply the authoritarian regime with a tool to monitor its citizens.

However, the true purpose of the register, which at this point was to create a mobilization register, is evident in that the Vichy Minister of War was the recipient of Carmille's proposal. Two months after the armistice, the French army started to prepare a secret mobilization of 200,000 men,

in addition to the army of 100,000 men permitted by the terms of the armistice. The implicit goal was, therefore, an uprising against the German oppressor. Such an uprising might not have been realistically possible, but the ability to mobilize a decent army was critical if the credibility of the regime among the commissioned officers was to be maintained. According to this interpretation, Carmille contributed significantly to the stabilization of Vichy France.

French economist Alfred Sauvy claimed in his memoirs from 1972 that the mobilization register was a smokescreen, allowing Carmille to achieve a national register of people in France.³⁷ In his interpretation, Carmille personified the ultimate technocrat, exploiting a national catastrophe not only to implement the punched-card-based conscription and mobilization register, which had failed in 1935, but also to establish a central register to monitor and control every inhabitant of France. The material recovered does not provide adequate proof of the correct interpretation, but the German occupation of Vichy in November 1942 made the national register the sole objective.

Whatever Carmille's original purpose, the Vichy government decided to establish the national punched-card register, which required vast administration. A new entity, the Demographic Service (*Service de la démographie*), was established in 1940 in Lyon (in Vichy France). Carmille donned civilian clothes to head the new institution, which the following year was merged with *Statistique générale de la France* in Paris (in the occupied parts of France) to form the *Service national des statistiques* (SNS, National Statistics Service), though they remained two separate geographical entities, in Paris and in Lyon, until after the end of the Second World War.³⁸

The size of the register project is made apparent from the employment in the summer of 1941 of 1,968 people who operated 233 punches, 22 sorters, 14 tabulators, and 7 reproducers.³⁹ The project used the 80-column punched card and the Bull alphanumeric standard, which was incompatible with the IBM standard.⁴⁰ The SNS used both Bull and IBM equipment, but they only applied IBM equipment to process numeric information.⁴¹ Bull shared the IBM numeric punched-card code that had been introduced as early as in the 1890s.

Carmille developed the national register of Vichy France and Algiers on the basis of a written file on each individual and two punched cards.

The information kept in the national register went far beyond that of population statistics or the requirements for a conscription and mobilization register. The register was used to strengthen government control over the inhabitants of France. The introduction in 1940 of the “national identification card” had the same purpose and remained in use after the Second World War. The identification card became an SNS responsibility, and the card was distributed displaying the thirteen-digit national identification number, starting in 1943.⁴⁴ The national register had become a central tool in monitoring the individual.

From the outset, the national register was based on information collected from soldiers following their demobilization in the summer of 1940. In June 1941, this information was complemented by a census of professions in Vichy France and Algiers of everyone between the ages of thirteen and sixty-five. This excluded processing information on men too young or too old to serve in the military, but it included women. This limited census allowed SNS to systematically update the addresses of male citizens who were vital for a mobilization. Furthermore, the register, for the first time, received information on women other than their change of addresses. From 1941 to 1942, most of the work at SNS concentrated on processing census information on men, while processing information on women had a lower priority.⁴⁵

By early 1942, Carmille managed—without German detection—to establish a secret file of 300,000 males for mobilization in Vichy France (the 100,000 men allowed by the armistice agreement, plus an additional 200,000 men) that was stored in a separate location from the general files. This register was subsequently updated and, if used, would have allowed a mobilization by letter within thirty-six hours. During the spring of 1942, the mobilization was tested through a successful paper exercise that produced tabulator lists. Furthermore, in 1942, Carmille started to extend his service to the German-occupied regions of France, a demonstration of Vichy’s authority in that part of the country.⁴⁶

But the carefully prepared mobilization never materialized. On 8 November 1942 the Allied Forces landed in Algiers. Three days later, the Germans occupied Vichy France, which both removed the possibility of mobilization and raised the risk of detection of the mobilization register by the Germans. In consequence, Carmille destroyed the mobilization register and related archives.⁴⁷ If this register had been the only objective

of Carmille's register project, he should have destroyed the unfinished national register as well; but this did not happen.

Failure to do this was probably the basis for Alfred Sauvy's claim that the national register from the outset formed the core of Carmille's register project with the mobilization register serving only as a pretext. But the register was a different entity in 1942 than when it had been proposed two years earlier. An organization had been established that provided register options and employment, thus carrying with it a significant momentum. Therefore, Carmille continued to build up a national register comprised of all the inhabitants in France, which became the key register for all national identity numbers and was used to monitor the issuing of ration cards. Carmille worked to consolidate his punched-card enterprise and to establish a corps to administer his register as a complement to the existing civil service corps. In 1942, he began to compile a punched-card register of French companies and institutions. In 1943, he established a spot-test service and a school of punched-card statistics applications. After the war, his organization became the core of the current French national statistics department.⁴⁸

Keeping the Germans out had been a fundamental reason to establish Vichy France, and its occupation made many public employees reconsider their position. Before the occupation of Vichy, Carmille, as a loyal Vichy public servant, had insisted that there should not be any relation between his punched-card service and the resistance movement. But the Vichy regime strained the loyalty of its public servants and officers. Following the German occupation of Vichy, Carmille rebelled and joined the resistance movement while also working to improve a key Vichy monitoring tool. Arrested by the Gestapo in 1944, Carmille died in the Dachau concentration camp in early 1945.⁴⁹

The French Third Republic had been secular, and, accordingly, its census statistics did not contain any information about religion.⁵⁰ After the formation of the Vichy state, the rights of Jews in France vanished. The German occupiers took the initiative, but the Vichy interventions went beyond the German requests. On 27 September 1940 the Germans ordered the segregation of Jews in the occupied areas, which caused the Vichy regime to adopt a law to the same end six days later, a law valid not only for the occupied zone but also in Vichy, the nonoccupied zone. As a direct result of this law, all Jews were swept from spheres of public influence. It

was part of the Vichy struggle to exercise sovereignty over the whole of France, but the regime was infected by anti-Semitic prejudice, as had already been made evident from its encroachments on Jewish rights during the summer of 1940.⁵¹

In March 1941, Vichy honed its anti-Semitic policies by establishing a General Commissariat for Jewish Issues (Commissariat général aux questions juives), run by Commissioner Xavier Vallat. Back in September 1940, the German occupation force had ordered a census of Jews in the occupied parts of the country to map their number and distribution. In April 1941, Vallat ordered a census of Jews to be carried out by the French police and the municipalities in the nonoccupied zone to be processed by Carmille's SNS.⁵² In both the German census and this separate Vichy census only Jews were requested to report, and no mechanism existed to identify those who evaded.⁵³ The two separate censuses enabled a detailed mapping of Jews in France, though the definitions of "Jews" used by the two censuses diverged.

The general census on professions in Vichy France in June 1941 differed from its predecessors by asking whether each inhabitant was of the "Jewish race."⁵⁴ This offered an additional mechanism to identify Jews in Vichy France. They were identified on the punched card for this census by specific perforations in the "nationality" field, thus segregating Jews as aliens. The cards on Jews were kept separately, which indicates that this information could have and might have been exploited.⁵⁵

The census on professions and the special census on Jews in Vichy France were conducted concurrently in June 1941, but they were distinct. All inhabitants between thirteen and sixty-five years of age were requested to report in the general census on professions, the completed forms processed by SNS on a national basis. In contrast, only Jews were asked to respond in the separate census. No form existed, and each individual reported by writing a letter that was kept at the police station. In several areas, because the number of Jews who reported was significantly below the expected number, it was assumed that many Jews refused to cooperate. As France had been a secular state, Jews were, indeed, able to avoid declaring themselves Jewish without the fear that they would be traced through official sources.⁵⁶ The police were requested to compile lists of the Jews in their area from the returns of the census. Even so, it was difficult to monitor Jews who moved to a different police district.

Vichy authorities could have improved monitoring of Jews by consolidating the information gathered in the two censuses in June 1941, but this was never accomplished. The reason seems to have been René Carmille's deliberately low prioritization of this contribution to a more efficient segregation of Jews, which was probably due to his resistance to the anti-Semitic policies of the Vichy regime. In late 1939, he had dissociated himself vehemently from German anti-Semitism in a publication.⁵⁷ It is true that in June 1941 he offered to commence consolidating the information gathered in the two censuses, but nothing appears to have happened before this was requested by the Commissioner for Jewish Issues in late 1941.⁵⁸ The records show that, in 1942, the SNS was working to produce a central register of Jews in Vichy France, and that the work was proceeding very slowly.⁵⁹

One reason for this concerned the problems of identifying the same individual in both censuses. Another problem was that the national and mobilization registers were the main task of the SNS, and these diverted manpower from the creation of a punched-card-based register of Jews in France. Establishing the national register was an enormous and protracted undertaking that had not yet been completed by early 1944.⁶⁰ Moreover, as the national register had not been completed, the compilation of the register of Jews had to be based mainly on returned but as yet unprocessed forms, further impeding the process. However, these tasks should have been within the reach of the SNS, as the material had been collected and as the total number of Jews in France was only around 300,000.⁶¹

When the deportations started in 1942, the victims were located on the basis of lists compiled by the Gestapo and the French police. The member lists kept by Jewish communities comprised one possible source for locating the victims, but, the question is whether the Vichy national register organization also provided confidential information. So far, no case has been found of any national register disclosure for this purpose, but the problem remains as to whether any such disclosure would be recorded in the incomplete archives that have been handed down.⁶² Further, if information from a punched-card register had been used, this probably would have had the form of tabulator prints; and it remains doubtful as to whether the historians who studied the various deportation records actually checked if tabulator prints were applied.

In addition, René Carmille himself was ambivalent about the confi-

dentiality of the register information. In 1941, as already mentioned, he accepted that the information gathered in the 1941 general census could be used to supplement the information collected in the separate census on Jews in Vichy France the same year. In 1943, on at least two occasions, records were extracted from the punched-card register—50,000 men in one case—to supply people for forced labor in Germany. Further, in 1944, Carmille offered to make confidential information available for any “police purpose” without, for example, requiring a court order or warrant.⁶³

The French national register after 1940 shows how a register of punched cards could be established in an autocratic state. The register was built to enhance the weakly founded Vichy state, its primary mission to improve credibility with the army. However, while the national register originally had been a shield against German detection, it gradually became a tool to monitor the individual, strengthening the Vichy state. It was the key register of all national identity numbers and was used to monitor issuing of ration cards and national identification cards.

There is no indication, however, that the endeavor to improve the conscription and mobilization administration aimed at anything other than rationalization within the French army before the summer of 1940. Only the French defeat and the German occupation of the country opened the possibility that a register of punched cards could improve the state of the nation’s military position. The project to extend René Carmille’s vision of a mobilization register to encompass all of France was certainly impressive, but it hardly reached beyond the technical potential of the register.

The war and the German occupation may well have provided the reasons for this project, but the Germans do not appear to have shown much interest in the national register project or to have considered its potential, limiting the danger of the register. The reason for the absence of interference from the Germans might stem from the lack of a German national register project until 1943.

Managing Resources during the War in Germany

German punched-card applications in the Second World War were distinguished by their continued reliance on nearly exclusive numeric operations and their late introduction of registers of punched cards. Only after

1939 did German authorities become interested in punched-card alphanumeric registers to control the war efforts, bringing them into conflict with the IBM subsidiary in Germany, Deutsche Hollerith Maschinen Gesellschaft mit beschränkter Haftung, or Dehomag, which was not able to supply the machines needed for this purpose. Dehomag won this dispute due to the quality of their machines and the capacity of their production facilities, but this does not answer why the authorities accepted their failure.

This can be answered by the absence of an alternative punched-card producer and the chaotic power structure of the Third Reich. Dehomag succeeded in clipping the wings of its competitors in Germany through cunning use of the German patent law and its own talents in technology and sales. The chaotic power structure explains why the Nazi regime only started to develop a national register of punched cards in 1943, in spite of the technology's capacity to facilitate control. While this late date limited the options of the authorities, it did not imply a lack of control over the population in Germany. A system of local registers using simpler methods had been established in the 1930s, and their cruel efficiency was proven when Jews had to be located for deportation.

The German army staff had started their preparations for a new large-scale war in 1924. A significant component was to establish and maintain control of the German industrial capabilities crucial for modern mass warfare. For this purpose, the army staff established a Statistics Office in 1926. Around 1930, they set up index card registers of industries important to the military, one organized alphabetically according to company name, another organized according to location, and, finally, a register of machines requisite for armament production, like capstan lathes, drills and planing machines.⁶⁴ In 1937, the people in charge of this work proposed the transfer of these registers to punched cards. An obvious advantage was that the two industry registers could be reduced to one set of punched cards, to be sorted as requested. Other considerations included improved possibilities to control raw materials and semimanufactured articles for which the raw materials had previously been monitored manually. The register processing by means of punched cards was assigned to a new army punched-card service (later called *Maschinelle Berichtswesen*). From the outset, the punched-card registers were conceptualized as exclusively numerical, requiring all information to be coded.

The industry register demanded a new company number suitable for punched cards, the introduction of codes for geographical districts, and a number for each raw material and semimanufactured article.⁶⁵ Before the outbreak of the Second World War, the army punched-card service transferred the registers for monitoring industry, raw materials, and semimanufactured articles to punched cards. They also took charge of compiling army health statistics, statistics on the psychotechnical tests of new conscripts, and of doing inventory control on military equipment at the various units, as well as of the use of raw materials for the arms buildup. From 1939, statistics relating to armament workers were also punched-card processed.⁶⁶

Most of this work involved processing statistics, but punched-card registers were introduced for controlling industry and raw materials. These registers differed from the Social Security register in the United States and the planned French Army service register in that they were only numerical. This enabled standard Dehomag machines to be used, but it limited the tabulator printout to numbers.

In the United States during the 1930s, public utilities were a prime field for the introduction of alphanumerical systems. From 1935, Dehomag mounted an offensive in Germany to expand its energy supply installations to cover the calculation of consumption, the amounts to be paid, and printing of invoices. This plan was predicated on the improved calculating capacity of its machines and their upgraded ability to control the movement of the forms on the tabulator during printing, although consumer bills continued to be addressed using address plates.⁶⁷

Dehomag continued to improve the numerical capability of their machines in the late 1930s.⁶⁸ The company, which considered expanding into alphanumerical machines, had three options in this regard: (1) Dehomag could import alphanumerical tabulators produced in the United States; (2) it could start producing IBM-designed alphanumerical tabulators, as the French IBM subsidiary did or; (3) it could develop its own alphabetic tabulator (allowing numerical and alphabetic printing in separate printing positions).

The company chose to develop an alphabetic version of the numeric DII tabulator, but the decision does not seem to have had much impetus. Development ran into problems, and a prototype was not finished until 1944.⁶⁹ It is not clear whether these difficulties were caused by a lack of com-

pany commitment or by an insufficient amount of engineering expertise to address the technical complexities; low demand, however, was certainly a major reason. The limited demand from government bodies has been discussed above. Only high government demand might have enabled imports, and the absence of a Dehomag production of an IBM-designed alphanumerical tabulator can only be explained by a lack of company interest. New directions during the war reversed this situation.

By the late 1930s, Dehomag's technical *Sonderweg* enhanced Heiding-er's position in relation to IBM and was simultaneously strengthened by the German autarchy. Dehomag was highly profitable and had its own production, which made the German company less sensitive to the parent company's views. Ironically, however, IBM's position might have been strengthened decisively if a demand emerged in Germany for punched-card technology that went beyond Dehomag's capability—for example, for alphanumeric tabulators. It appears that IBM had only brought an alphanumeric tabulator to Germany by 1939, where the German punched-card users were starting to appreciate its improved capability.⁷⁰ Interest in this American technology grew with war needs.

The outbreak of the Second World War in September 1939 caused increased demand for punched cards to control production and to manage the warfare. Dehomag's turnover increased by 26 percent from 1939 to 1940.

In 1939, the army's economic office, headed by General Georg Thomas, stepped up its planned economic mobilization for a general war.⁷¹ This created new tasks for the army punched-card service. Monthly statistics were established of the stock and turnover of 350 types of weapons, ammunition, and military equipment, as well as their production figures and estimates of completion within the next six months. Further, the already existing monitoring of raw materials was developed into full-scale bookkeeping of raw materials encompassing all providers and users, as well as the three armed services.⁷²

During the war, the application of punched cards for control was intensified to enhance war planning. In the summer of 1941, the transition from traditional means to punched-card processing began of monthly employment statistics in important areas of the armament industry, encompassing 90,000 companies and their 10 million employees. This represented an early attempt to improve the information available to key

authorities about actual industry production. The company was still the unit for keeping these statistics.⁷³ This application involved the numerical punched-card statistics processing of data, similar to the previous army punched-card service applications, but it also introduced the first step toward punched-card registers. Punched cards holding information on employment, raw materials, coal, and semimanufactured articles for a month were kept to compile tables projecting development over the coming months.

In the autumn of 1941, the failed Russian campaign made the low armaments production evident.⁷⁴ In December 1941, the national Armaments and Munitions Minister, Fritz Todt, established a system of entrusting eminent technicians from leading industrial firms with management of separate areas of armament production.⁷⁵ Shortly after succeeding Fritz Todt in February 1942, Albert Speer managed to improve on Todt's earlier position in relation to the other German planning authorities.⁷⁶ He extended Todt's system into a network of "industrial self responsibility." He formed thirteen "vertical" committees for managing the various kinds of weapons production, like the armor committee headed by Professor Ferdinand Porsche, and the army weapons committee headed by Krupp manager, Erich Müller.

The allocation of raw materials and intermediate goods was organized through a similar number of "horizontal" committees, supported through the formation of a special section in the Speer ministry. In addition to these vertical and horizontal committees, Speer established development commissions where army officers met the best designers in industry. These commissions were to supervise new products, suggest improvements in manufacturing, and call a halt to any unnecessary projects. A key element of the industrial self-responsibility network was to ensure that a given plant only concentrated on producing one item at a time, and on setting maximum quantities.⁷⁷

Punched-card technology became essential to Germany's planning efforts. The transparency of available production capacity, as well as the allocation of resources and production, was crucial both for Speer to manage this network and for the various committees to function. To this end, in April 1942, the army punched-card service was transferred to the Speer ministry as a staff function.⁷⁸ By 1944 the office comprised nine branches and twenty-one offices throughout the Reich, what was then

Czechoslovakia, and Poland, employing 833 trained people and using 1,055 punched-card machines.⁷⁹

Finding qualified available manpower was, in particular, a growing concern. By the end of May 1942, of the German workforce 9.4 million members had been conscripted, and of these 800,000 had fallen. There was strong pressure for more troops, but also for workers in industries of importance to the military. By that time, 4.2 million foreigners worked in Germany, either forced or of their own accord.⁸⁰ To improve Speer's control, an advanced system of monthly employment reports was started in the autumn of 1942. Companies of military importance were required to report how many employees they had and to divide them according to various categories, for example, German workers, workers from the "Eastern Countries," Jews, and Russian and other prisoners of war. The reports were punched-card processed, partly on alphanumerical tabulators, probably using improved table printing control. No indication was found of letter printing. Like the 1941 armaments industry report system, the punched cards from each month were kept in a numeric register, enabling control of subsequent reports and table production.⁸¹ During 1942, the outcome of Speer's improved armaments production organization was an aggregate monthly production growth of 76 percent. Between February and December, the production of armaments grew each month.⁸²

In early 1943 efforts were introduced to simplify collection and distribution of information brought on by the need to reduce administrative staff and the desire to improve control of the workforce.⁸³ In this process, two large alphanumeric punched-card registers were devised: an army payroll system and a national register, which for the time being was restricted to the domestic population.⁸⁴

The start of the large alphanumeric punched-card systems in Germany can be traced via the development of the army payroll system. This was the first time that alphanumeric registers and punched cards were linked, except for in a few private companies. In the summer of 1943, a payroll system was established for the 12,000 civilian workers in the army. Each worker had a typed index card and two punched cards, enabling printing of various sorted lists including their full names, date of birth, place of work, and monthly and yearly salaries.⁸⁵

By the end of 1943, the government started extending the system to

cover all military personnel—a project that was planned for completion by 1945. For this project, thirty alphabetic tabulators were ordered from Dehomag, but they were never delivered. Perhaps this was the reason that the leader of the Speer punched-card service, Kurt Passow, made enquiries in the summer of 1943 into the possibility of building a full address printing Dehomag tabulator, resembling the alphanumeric IBM tabulator, type 405.⁸⁶ This showed that the Speer ministry punched-card people were starting to consider directly addressing individual correspondence using punched cards. They considered the full potential of alphanumeric punched-card registers.

The national register was the second major German punched-card register project. The idea was conceived in early 1943, the payroll system for the army's civilian workers acting as a test case to bring it into being. From late 1943 until late 1944, two large-scale trials were carried out.

The first trial took place in late 1943 and included the workers in selected industries in Breslau in Schlesien (today Wrocław in Poland). The aim was to replace the frequent and detailed statistical reports on workers to both the Speer ministry punched-card service and the conscription registers. The Breslau register seems to have been organized according to national company identification number. Each employee had his or her individual card, which contained this number, name, date of birth, and address. The register produced sorted lists, which were compared successfully to the many local index card registers. This kind of identification was cumbersome, as easy identification would require a unique individual identification number, along the lines of the existing national company identification number. In addition, the Breslau register only included people who were employed. The Speer ministry punched-card people realized that industry reports were not an appropriate tool on which to base a register of the entire workforce in Germany.⁸⁷

The second large-scale experiment included all the inhabitants of the city of Ansbach in Bavaria. During this test in the autumn of 1944, the central personal register was defined, consisting of a report form for each individual and one punched card to hold a condensed version of this information—green cards for women and yellow for men. People were ordered to report, and procedures for changes were established. Each individual was identified via a national registration number containing twelve digits that was devised during this experiment.

The register held key information from the twenty or so civil registers in the city, as well as the various military registers, enabling easy comparison of information. Several errors in the existing registers became obvious, especially the information used for food rationing and people's ages. The Ansbach register covered every individual in the city and was able to provide more comprehensive information for the reports more quickly than ever before. Due to its success, it was decided to establish a national register near Berlin, but this was never implemented.⁸⁸

The Speer punched-card people were the driving force behind the development of punched-card applications to monitor the production of military importance and this vital sector's employment of manpower. This development could have originated in several places, for example, it could be based on experiences in German industry, or it might have been inspired by information on the punched-card based French national register, established in 1940. Regardless, it originated outside Dehomag, creating a new level of demand that Dehomag had great difficulties meeting.

During the 1930s, IBM's business in Germany had involved three sets of actors: IBM, Dehomag, and the German authorities. IBM controlled Dehomag, while Dehomag maintained all relations in Germany. Only in a few instances did IBM have direct contact with the German authorities or customers. Among the rare examples were Thomas J. Watson's meetings in 1937 with Hitler and the German Minister of Economics, Hjalmar Schacht, during a visit to Germany as Chairman of the International Chamber of Commerce.⁸⁹

Between 1939 and 1941 these basic relations remained intact, as the United States was neutral. However, the expansion of punched-card applications in industry and within the armed forces during the first two years of the war, brought about by extensive warfare, the occupation of several countries, and growing industrial production in Germany, was partly facilitated by Dehomag's growing production and was reflected in its rising turnover. In addition, the German invaders compelled the various national IBM agencies or subsidiaries in the occupied countries to surrender leasing contracts on punched machines, which were and remained the property of IBM in New York.⁹⁰ The extension of punched-card applications in 1942 caused additional requisitions of IBM leases in Belgium, France, and the Netherlands.⁹¹ These leases contributed to the Dehomag turnover as a result of punched-card purchases, as rents contin-

ued to be paid to the national IBM subsidiaries from which the machines had been confiscated.

However, the German campaign of May–June 1940 to conquer Benelux and France had provoked pressure on IBM's relations with its German subsidiary. The conquest of these countries caused Thomas J. Watson of IBM to return a German decoration that he had received in Berlin in 1937 while Chairman of the International Chamber of Commerce working for appeasement with Nazi Germany.⁹² This act triggered a putsch by Dehomag's managing director and founder, Willy Heidinger, who tried to regain majority control of Dehomag and was apparently supported by German authorities. However, the IBM majority ownership was rescued by the introduction of enemy company custodianship when the United States entered the war.⁹³ The custodianship took over IBM's role as majority shareholder and gave Heidinger's management free reins, implying that he had regained control of his company, but not the ownership.

While Dehomag's relations with IBM disappeared for the duration of the war, new conflicts emerged with Kurt Passow about his project concerning a German-controlled punched-card industry and Dehomag's inability to supply letter printing tabulators. Passow was the leader of the army's punched-card service that had moved to the Speer ministry in April 1942.

Within the German government's autarchy policy, Passow worked to establish a German-controlled punched-card industry independent of IBM and the American Powers company. As early as 1938, he had approached Wanderer-Werke Aktiengesellschaft (Wanderer Works Limited) in Chemnitz in a drive to get them to develop a complete set of punched-card machines with the potential to replace the Dehomag and Powers machines. Passow made this approach only the year after the army punched-card service had been established.

Wanderer-Werke, which had been producing typewriters since 1902 and during the First World War, started to produce mechanical adding machines.⁹⁴ They had designed their first punched-card device in 1929 that consisted of a link between a key bookkeeping machine and a punch that facilitated punching onto cards, without extra action, of information keyed-in and processed in an ordinary bookkeeping process. This feature enhanced the modest calculation capability of a standard tabulator and resembled a similar Dehomag design also from 1929.

Since 1933, Wanderer-Werke had committed resources to developing punched-card machines, but none of them had been produced as of 1938. Moreover, Passow's approach in 1938 led to nothing. He asked Wanderer-Werke to concentrate all their resources on office machine development to generate a complete set of punched-card machines for statistics processing, while the company's directors preferred to develop bookkeeping machines.⁹⁵

Then, in May 1940, early on in the campaign to conquer Benelux and France, Kurt Passow took a new initiative in his endeavor to establish independent, German punched-card production. As he did not have any able technician in his employ, he persuaded engineer Hermann Voigt, who had headed punched-card construction work in the 1930s at Siemens, to head his development work.⁹⁶ In 1940, tests were conducted on Powers and Bull machines.⁹⁷

After the fall of France, the Bull company in Paris came under German control, making it the first industrial punched-card technology under complete German control. Wanderer-Werke began negotiations with Bull to gain access to its technology. A preliminary agreement that was only reached in early 1941, stayed in effect until the two companies entered a final contract nearly two years later. This contract was notably entered into between two equal partners, in spite of the German occupation of France and opened up the exchange of information about research and development, which was a one-way clause serving Wanderer-Werke, as it did not have much to share.

Wanderer-Werke was also allowed to produce Bull punched-card machines on the condition that Bull received a royalty of 2 percent of the price Wanderer received when the machines were sold.⁹⁸ Aside from that, some twenty Bull tabulators and some forty punches and verifiers had been taken as spoils of war to Germany in 1940, causing several problems, serious even during a war. Dehomag claimed that these tabulators infringed upon the German IBM and Dehomag patents, and Dehomag refused to perform maintenance on them.

In the spring of 1941, Dehomag contended that Bull tabulators produced by Wanderer-Werke would also infringe on Dehomag's patents.⁹⁹ Wanderer-Werke was up against numerous German patents that were the result of Dehomag and IBM's development work and intended to guard their prime-mover position. This was exactly the same experience that all

contenders to IBM's prime-mover position in punched cards had. In reality, Dehomag used their strong patent position to avoid the German national punched-card system becoming a threat to IBM's business in German-controlled Europe, as they had successfully, via litigation, fended off Powers in Germany from 1914 to 1923 and from 1924 to 1929—in spite of the fact that they eventually lost the cases.

Wanderer-Werke's counteraction was to try to obtain a compulsory patent license for the patents held by Dehomag. They asked the National Ministry for Trade and Industry to order a license based on the importance of punched cards for the war effort. This failed, probably because Wanderer-Werke had not yet supplied any punched-card equipment. Nevertheless, they could have obtained a compulsory license through the law courts, though this might have taken several years, as indicated by the earlier experiences of the German Powers company. Wanderer-Werke never obtained a patent license from Dehomag.¹⁰⁰

Encouraged most likely by the Wanderer-Werke agreement with Bull, the German army signed, in April 1941, a contract with Wanderer-Werke to develop a series of punched-card machines, which Wanderer-Werke subsequently worked on. Two months later, this was supplemented by a contract with the army to repair the booty Bull machines brought to Germany.¹⁰¹ However, development work at Wanderer-Werke did not provide results that brought into sight a substantial German production of punched-card machines outside Dehomag proper. This reduced Kurt Passow's options for obtaining, in particular, letter printing tabulators, causing two different reactions.

First, Passow reduced his stakes in Wanderer-Werke's development of punched-card machines, though they managed to complete a sorter in November 1942. He only awarded the company additional minor contracts for punched-card development work that never provided substantial results. Instead, in early 1944, Passow contracted Wanderer-Werke to make Bull machines produced at Bull's factory in Paris, which never materialized because of the liberation of Paris in August 1944.¹⁰² However, the contract triggered claims from Dehomag for a license on imported Bull machines, which was never settled.¹⁰³

Second, the lack of results at Wanderer-Werke caused Kurt Passow to turn his attention back to Dehomag, which erupted into a heated conflict in the summer of 1942. Passow and the army punched-card service had

been transferred to Speer's successful management in April 1942, giving Passow a higher profile that he was most willing to exploit. The factor provoking the conflict was the improvements of war production control since February 1942, which caused an emerging demand for alphanumeric punched-card machines. For two years, Passow's punched-card people had gained experience by using the IBM alphanumeric tabulators requisitioned from the occupied countries and a few alphanumeric tabulators imported from the United States in 1939.¹⁰⁴ Passow probably applied these machines to improve the existing statistics processing and numeric register-based applications by adding letter specifications to the prints, as shown in several published examples.¹⁰⁵

The heated nature of the dispute is clear from Kurt Passow's high-profile accusation in September 1942 that Dehomag withheld the alphanumeric IBM machines from the German market. Passow accused Dehomag of accepting instructions to this end from an enemy company (IBM). He raised slanderous doubts about the Dehomag management's loyalty to Germany, an extremely serious accusation in the midst of the war which, rightly, infuriated Heidingger, who had displayed his enthusiasm for the regime in the 1930s.¹⁰⁶ The only basis for Passow's attack was the assembly of alphanumeric tabulators by the French IBM company (Compagnie electro-comptable) for the French market.

Seen from the Dehomag perspective, because the German government had encouraged an independence from imports and liabilities in foreign currency, Dehomag had followed the principle when it developed the numerical DII tabulator and when it established extensive production in Germany. This policy had prevented the kind of conflict with the national Ministry for Trade and Industry experienced by the German Powers company in the late 1930s due to its objection to moving the production of tabulators from the United States to Germany. Dehomag, whose customers demanded an increasing number of the numerical DII tabulators, did not experience sufficient demand to complete building the alphabetic version of the DII tabulator or to negotiate with IBM in New York to get the blueprints to produce the IBM alphanumeric tabulators, as the French IBM company did in the late 1930s.

As time passed, problems worsened because of air raids. Punched-card machines were destroyed and damaged, and, in August 1943, the Dehomag factory in Berlin was severely hit. Most of the production was

then moved to Hechingen in Württemberg, near Dehomag's factory in Sindelfingen.¹⁰⁷

By the spring of 1943, Kurt Passow's reduced number of options, however, had forced him to be content with Dehomag. Consequently, he then tried to enhance Dehomag's development of the letter printing tabulator by transferring the manager of Wanderer-Werke's punched-card development to Dehomag.¹⁰⁸ In 1944, Dehomag nevertheless finished the design of the letter printing version of the DIT tabulator and a prototype was built, but it never went into production. Dehomag had by far the best organizational capabilities in the German punched-card field and emerged as the major winner. They avoided the influence of the Speer ministry in their management, retained control of the vitally important large punched-card machines, and took control of the French IBM company.¹⁰⁹

It seems surprising that a national register of punched cards in Germany had not been established by the end of the Second World War, particularly as France had started to build such a register just after Germany had occupied three-thirds of the country in 1940. After the war, one of Speer's punched-card managers explained the absence of a national register in Germany as being due to the lack of alphanumeric tabulators and trained staff.¹¹⁰ However, by the time the national register concept was finalized in Germany in October 1944, implementation was not feasible. By then, the toll of the war had made its mark on Germany through the destruction of property and the dislocation of people. But why, only in 1943, did the Nazi authorities commence working on a national register of punched cards that could have been an effective tool applied to control the population in this totalitarian state? This can be explained by the chaotic organizational structure of the Third Reich and the many local registers that had been established using simpler methods.

After Albert Speer became minister of munitions in 1942, he accomplished the improvement of war production over the next couple of years. However, this was accomplished through the establishment of a nationwide organization and extensive punched-card processed statistics to facilitate an overview of the country. This happened at the expense of the regional party bosses (*Gauleitern*) who resisted such a centralization of control and revolted against Speer in late 1943. In spite of his success at improving war production, Speer subsequently lost this battle.¹¹¹ A similar reaction to a national register of punched cards that would entrust Speer's

punched-card people with the capability of additional nationwide control was to be expected.

In a study of the role of IBM in the Third Reich, two historians analyzed the role of IBM punched cards in the location of Jews for deportation. They searched for a substantial Dehomag complicity in the Holocaust, but their studies reduced the issue to the detailed processing of census data, which already in the 1880s had been the basis for the invention and building of Herman Hollerith's first punched-card system.¹¹² Information about religion was already perforated into the punched-card used to process the German census in 1933 in Prussia. The card used to process the census returns in Prussia did not have a number that could identify the individual with his or her card once punching had been completed. This made the punched card an irreversible tool to compile tables from the census data in the forms. However, the returned census forms could be used for this purpose, for example to locate Jews, but that would require manually handling every returned schedule.¹¹³ The following census in 1939 had more detailed statistics on Jews, but like just as in 1933, the punched cards did not hold individual identification numbers that could have been used for segregating the cards of Jews by using a sorter.¹¹⁴

More important, the two historians drew attention to the importance of locating Jews in the various non-punched-card registers of people in Germany, which a second couple of historians subsequently studied.¹¹⁵ The second couple noted that until 1938, the Nazi authorities used various registers of fractions of the population to control people and segregate socially undesirable individuals, like Jews and Romas (Gypsies). The Register of Jews (*Judenkartei*) was established in 1935 by the Gestapo (*Geheime Staatspolizei*, or security police) derived from Jewish communal membership lists. The Jewish communal lists were manifestations of the members' faith and cultural affiliation, not of "race," which made the Register of Jews incomplete for the Nazi segregation of Jews; as it did not, for example, encompass Jews who had converted to Christianity.¹¹⁶

Also important are the three countrywide, systematic sets of registers that were established in 1938 and 1939 to improve control of the population and segregate socially undesirables: the National Reporting System (1938), the National Register (1939), and the Ethnic Register (1939). The National Reporting System (*Reichsmeldeordnung*) was introduced in 1938, and its explicit purpose was social control. It replaced the vary-



SS officials monitoring people with written index card files in Germany, 1938. (Statistisches Jahrbuch der Schutzstaffel der NSDAP 1938. Berlin, 1939, 95)

ing registration systems in the different states, many of which had been established before 1933. The National Reporting System required all inhabitants to report any changes in residence to the local police, who established registration offices across the country. Each of these offices established an alphabetically organized resident register of all inhabitants in the district on index cards, subsequently updated by the use of the reports on changes.

Data on domicile was exchanged among local police forces, and all changes in residence were reported to the National Statistics Department (Statistische Reichsamt), which used the information to compile migration statistics, which contained summary data for each community.¹¹⁷ The local resident registers were the basis for the regime's introduction in 1938 of obligatory identification cards. Jews were required to carry a special identification card, marked with a large, black letter *J* for *Jude* (Jew).¹¹⁸

The second couple of historians found that resident registration enabled the government to keep tabs on the physical location of all Germans, including those they desired to persecute.¹¹⁹ As issuing identification cards was a local assignment, resident registration could be used at this level to locate all Jews, while the national government in Berlin had the aggregate number of Jews in every community from national statistics.

The military saw another limitation to the alphabetical organized resident register. They needed precise information about the men from each particular year, including the total number on the national level, as well as the local registers facilitating the location of each individual. The census figures provided the national level requirements, but the resident register was not well-suited to locate, for example, every male born in 1909.¹²⁰ Therefore, in early 1939, the National Register (Volkskartei) was established as locally managed registers of written cards copied from the existing resident registration register, but was—in contrast—organized by gender and year of birth to facilitate military conscription. This example displays the problems of using a register of written cards for tasks requiring it to be organized on varying criteria. A register of punched cards could either be sorted differently, or could be machine copied. However, the National Register was also linked to the project of racial enrollment from the outset, as the cards of Jewish residents were marked with a black flag.¹²¹

In contrast to these local-level registers, a national register of racially non-Aryan residents, the Ethnic Register (Volksturmkartei), was established between 1939 and 1942 based on data from the census in 1939. It was commissioned by the chief of the Gestapo, Reinhard Heydrich, and the Minister of the Interior, Wilhelm Frick. Each individual was registered on a card that contained surname, personal name, residence, sex, date of birth, and information on religion, mother tongue, race, profession, and for household heads, the number of children under the age of fourteen living in the household.¹²²

The Register of Jews, which was used for deporting Jews to the Dachau concentration camp in late 1938, along with the Ethnic Register, was used to locate Jews for subsequent deportations.¹²³ These simple means proved to be capable of facilitating this inhuman task. However, machine-readable registers might have proven even more efficient, and the operators would have been spared being confronted with each victim, as represented on the register cards.

The Punched-Card Industry's Choice of Development Strategy

The punched-card producers in the United States, Great Britain, Germany, and France developed punched cards to attract bookkeeping applications

between the First World War and 1935. This development success starting in the late 1920s opened up an ample expansion of the producers' business. Back in the 1910s, IBM had experienced a long and substantial expansion of its business based on its ability to process operational statistics, which had accomplished by 1907. Similarly, IBM might have chosen to reap for the next decade, or longer, the business generated from their development of punched cards for bookkeeping tasks, accomplished in 1935. However, the punched-card trade had changed, and development departments had been established at several companies, which provided a momentum calling for additional development. Further, the trade had grown competitive, in contrast to the situation in the 1910s. It is true that Remington Rand was only a minor challenger to IBM's punched-card business in the United States, but they produced reliable machines and they pursued business in a large number of countries together with their British sister company.

IBM's basic options for technical improvements on equipment within their bookkeeping model in the mid-1930s were either to improve the calculation capability of their machines by facilitating longer programs or to develop a punched-card with a larger storing capacity. Both paths were pursued in the 1930s and 1940s. However, an extended punched card never reached the market and the punched-card record remained confined to the eighty characters on a card, to be expanded only by the transition to computers with magnetic tape stations in the 1950s. In contrast, IBM produced a succession of punched-card calculators with growing capabilities to perform complex computations, including multiplication and division, IBM-600 (1931), IBM-601 (1938), IBM-602 (1945), IBM-603 (1947), and IBM-604 (1948).¹²⁴

A major inspiration improving the calculation capacity of their equipment was scientific punched-card applications, which emerged in the late 1920s. Scientists demanded punched-card machines to execute programs of growing length and with a greater flexibility than that provided by standard machines. In addition, the extensive calculations of these tasks made scientists demand faster machines. All scientific computations were performed on electromechanical punched-card machines, as the lack of flexibility in connection-box programming made the Powers machines less qualified for this field of application.

In 1929, IBM presented a punched-card installation to Columbia

University in New York to mechanize grading the university's large number of multiple-choice tests. The following year, IBM modified a tabulator to facilitate mechanized grading, which provided IBM with the expertise to build the IBM-600 punched-card calculator, marketed in 1931.¹²⁵

Columbia University also applied their punched-card installation for tasks from other universities in the United States. Astronomer Wallace John Eckert was one of its users. In 1933, he persuaded IBM to present several punched-card machines to an astronomy calculation center at Columbia University. During the following years, Eckert designed an electronic switch, which IBM built. It stepwise traversed about ten different adjustments of a punched-card calculator, a tabulator, and a sum punch, facilitating easier numeric computations, for example, numeric integration. Building this device provided IBM with programming expertise. Further, there were many additional scientific punched-card installations in the United States in the 1930s, and punched cards were used for scientific computations in several fields.¹²⁶

To improve capability for scientific computations, several advanced calculators were built in universities and research institutions in the United States and Great Britain, starting in 1935. These calculator building projects focused on improved programmability and higher speed of executing programs. To this end, electronics were introduced to replace the slower electromechanical technology that was used in punched-card machines. This development was boosted by the extreme demand for calculations during the Second World War for ballistics and cryptanalysis and for designing the atom bombs in the Manhattan Project, among other projects. Finally after the war, subsequent projects in Great Britain and the United States built the first electronic computers.

This line of development was the almost exclusive focus of most studies on the development of computing from the 1930s to the 1950s, as their authors approached this line of development with the knowledge of the importance of computers for science and industry in the 1960s and later.¹²⁷ The exceptions were the studies on individual punched-card and computer producers as well as studies based on the development of punched-card and computer applications.¹²⁸

However, scientific calculations were only a tiny application field for punched-card producers in the 1930s. Several hundred thousand punched cards were consumed for such tasks in a few cases, but this was in contrast

to the several tens of millions of cards consumed four times a year by the Social Security Administration for the old age pension program in 1938.¹²⁹ IBM was awarded the contract for this huge project after the law had been enacted. This application was not the outcome of IBM's development of technology for handling large alphanumeric registers, and it could have been based on standard equipment. However, the scope of this application was extended through the subsequent shaping of equipment for the closure of bookkeeping that ended up including building a ledger-posting attachment to an alphanumeric tabulator and a collator that merged piles of punched cards.

IBM developed several other specialized machines in the 1930s to land various contracts, and they felt that the Social Security contract fell within the scope of their current punched-card systems, which were designed for bookkeeping. They chose to consolidate their technological capabilities based on the general potential of bookkeeping with punched cards, and, particularly, the potential of punched-card technology for handling big machine-readable registers. Additional administrative programs using large registers of punched cards were established during and after the Second World War and provided extensive business.

The growth of bookkeeping and register applications explains why the sale of punched-card systems reached their zenith only in the 1950s. IBM's sale of punched-card equipment remained bigger than their computer sales until 1962, as was the situation until 1965 with the merger in Great Britain of the British Tabulating Machine Company and Powers-Samas.¹³⁰