



LEEDS
BECKETT
UNIVERSITY

Citation:

Martin, I (2009) Britain's first computer centre for banking: What did this building do?

Link to Leeds Beckett Repository record:

<https://eprints.leedsbeckett.ac.uk/id/eprint/786/>

Document Version:

Article (Accepted Version)

The aim of the Leeds Beckett Repository is to provide open access to our research, as required by funder policies and permitted by publishers and copyright law.

The Leeds Beckett repository holds a wide range of publications, each of which has been checked for copyright and the relevant embargo period has been applied by the Research Services team.

We operate on a standard take-down policy. If you are the author or publisher of an output and you would like it removed from the repository, please [contact us](#) and we will investigate on a case-by-case basis.

Each thesis in the repository has been cleared where necessary by the author for third party copyright. If you would like a thesis to be removed from the repository or believe there is an issue with copyright, please contact us on openaccess@leedsbeckett.ac.uk and we will investigate on a case-by-case basis.

BRITAIN'S FIRST COMPUTER CENTRE FOR BANKING: WHAT DID THIS BUILDING DO?

At the beginning of the 1960s Barclays became the first British bank to open a computer centre. In this paper I trace the life of this building starting with its official opening on 4 July 1961 and ending with its protracted closure a decade later. From initial status as the most advanced bank bookkeeping system in the world serving as a highly visible symbol of the bank's technological power, to the final repurposing of its grandiose reception as a distribution point for pre- and post-decimalisation output, the building's various meanings are revealed. Making use of written, oral, and visual sources I explore the centre's spatial characteristics, its relation to the distributed structure of the branch, and its place as a first dedicated working home for a newly emerging computing subculture. A blend of multiple perspectives, internally from the top down and bottom up, and externally from customer and competitor, provide the basis for an analysis that reveals the multifaceted purpose of the first computer centre place in the banking automation race.

INTRODUCTION

At the beginning of the 1960s Barclays was Britain's biggest high street bank and progressively earning a reputation for itself as a technological innovator.¹ In 1961 Barclays opened a computer centre in the West End of London. As the first British bank to officially open a building of this kind Barclays hailed it as a landmark in British banking automation. As a new technological place in the business of banking it offers rich analytical possibilities for business historians and historians of technology.

In this paper I consider the significance placed by the bank on the computer centre and the role it played in embodying a newfound modernity for Barclays set against a backdrop of 250 years of banking tradition. I emphasise the importance of the spectacle that was the centre's opening ceremony and highlight elements of the building's form that reveal the building's multifaceted purpose was both to symbolise and convey a set of ideas, as well as to provide practical working home for a computer-led orchestration of modern technologies and a new breed of bank clerk turned computer specialist.²

I also explore the computer centre's relationship to the traditional distributed structure of the bank branch and the building's effect on those who worked within its walls and those who worked without. This is complemented by a look at external perceptions of the centre from customers and competitors alike who saw the computer both as a threat to traditional order and as an opportunity to improve business efficiency.

By examining the effect of this building on business and social life I am building upon the work of Thomas Gieryn amongst others. Like Gieryn, what I offer here is an answer to a straightforward question: what did this building do?³

CEREMONY AND DESIGN

On Tuesday 4 July 1961 Barclays opened the No. 1 Computer Centre at 154 Drummond Street, London, NW1,⁴ an event that it later asserted was the opening of

'Britain's first computer centre for banking'.⁵ At a grand ceremony, Anthony William Tuke, near the end of his twelve-year chairmanship, made a speech intended to maximize his bank's achievements. In order to emphasise the progress Barclays had made during his stewardship he paused to reflect on the bank's former position as technological laggard in the 1930s. Then, as a wave of mechanization came in the shape of ledger posting and accounting machines, Barclays only adopted these technologies as an act of 'sheer self-defence'.⁶ Tuke impressed upon his audience that during his time in charge, however, Barclays had leapt from its trailing position of laggard to assuming the leading role in the application of 'electronic methods' to banking.⁷ By the end of the 1950s not only had Barclays under A. W. Tuke become Britain's biggest bank,⁸ it had also taken a first step in reifying its ambitions to the status of technological innovator by becoming the first British bank to place an order for a computer in August 1959. Barclays ordered an *Emidec 1100* computer from British manufacturers EMI Electronics Limited at a cost of £125,000.⁹

Tuke tempered his opening speech rhetoric somewhat by sketching out the cautious and careful work underpinning Barclays' turnaround from laggard to technological innovator.¹⁰ This work was led by two of Tuke's senior managers, John Cowen and Donald Travers. Both men had taken leading positions on the Electronics Sub-Committee set up in 1955 by the Committee for London Clearing Banks (CLCB). Cowen, a general manager and Barclays board member was its chair, while Travers, a general manager's assistant and head of Barclays' mechanisation was its secretary. In 1955 the CLCB had tasked Cowen as the chair of the Electronics Sub-Committee to:

promote discussion and research on developments in the field of mechanization with particular reference to electronics in so far as they may be applicable to banking practice, and on the impact of such developments on staffing problems.¹¹

Staffing problems in banking were nearing crisis point due to a shortage of personnel - particularly in the London area - needed to meet an ever-increasing demand for banking services, and an increasingly high turnover rate amongst clerical staff performing the routine and often boring task of customer accounting. The pressure on existing bank staff was great and they were struggling to cope with weekly and monthly peaks despite almost limitless overtime. Costs for the bank in the form of overtime payments and staff recruitment and training were spiralling out of control. The banks saw the centralized automation of branch bookkeeping using electronic computing as a way of averting an impending crisis. It was not the only solution, but it appeared to the banks to be the most promising one.¹²

The Electronics Sub-Committee formed a focused three-man working party to research the possibilities of bringing electronic computing to British banking. Membership of this working party became pivotal in establishing those banks that would become early computing pioneers. Donald Travers, Barclays head of mechanization, was one of the three. From 1955 the banks, now collectively under Barclays' leadership, as well as individually, met at home and abroad with a number of existing and would-be electronic computer manufacturers and users in order to discuss their common and specific requirements. Over the next few years British clearing banks began experimenting with centralised book-keeping using tabulators and computers alongside their existing mechanised distributed branch accounting operations. When satisfied that in principle centralised electronic computer accounting appeared the best solution to the

growing crisis of staff and space shortages in the London area,¹³ Barclays made the first firm commitment and placed an order for its own computer in 1959.

In his opening speech Tuke downplayed any strategic motive behind Barclays privileged leading role in these developments, and instead credited simple good fortune. Barclays certainly left nothing to chance on the day of the computer centre's opening. Everything about the centre's opening was carefully managed for maximum effect. After the chairman's speech the Postmaster General, the Right Hon. Reginald Bevins MP, was invited to ceremoniously open the new centre. He did so not by cutting a ribbon with scissors in the traditional manner, but instead by 'cutting an invisible ray with his hand'.¹⁴ When his hand passed through the invisible beam the lights in the centre were automatically brought to life and the centre was declared officially open. For the invited guests watching, this futuristic act was an apt conclusion to a ceremony that had radiated Barclays' newfound modernity. Behind the scenes however more traditional methods were still on hand. One of the computer centre staff was carefully watching as the MP's hand passed through the beam and was ready to throw a power switch in case the centre didn't automatically light up.¹⁵

The very presence of the Postmaster General was a significant reflection of Barclays' attitude towards technology. The Postmaster General was the ministerial position responsible for the General Post Office (GPO), the organisation in control of all communications technology that took place outside the walls of any building in Great Britain. Barclays' computer centre was as much a showpiece for telecommunications as it was for computing technology; Barclays had worked with the GPO to link the centre to local branches via a network of GPO lines that brought together a complete data processing system.



Figure 1: The Postmaster General cuts the invisible beam to officially open the centre, 1961.
Courtesy of Barclays Group Archives.

Barclays also knew that the ceremony itself was just a beginning. With a suitably large and impressive reception area Barclays anticipated that the building would welcome a stream of visitors, including many representatives from the other banks, for years to come. After the opening ceremony the first of these visitors were led on a tour around the computer centre building where elements of this new data processing system were fully operational but also clearly intended for public display. Almost embarrassed by some of the indulgences made to visitors in the building's design the bank's chairman concluded by pointing towards a simpler design for future computer centres. The name given to the centre also looked towards the future; from the outset Barclays called this its No. 1 Computer Centre.¹⁶

The new computer centre was an old furniture showroom with a large and adaptable ground floor interior space and a West End location that was conveniently close to some of Barclays' biggest and busiest branches and their business customers headquartered nearby.¹⁷ The bank district that encompassed this area, Pall Mall, was second in importance only to neighbouring Lombard Street district that was home to Barclays' head office. In addition to the increasing volume of business putting pressure on existing resources at Pall Mall branches, the district's progressive managerial attitudes was also an important contributor in determining which of the two districts would be home to the first computer centre. While Lombard Street was steeped in tradition – Barclays could trace its roots back to 1690 and a goldsmith's shop there – Pall Mall's directors were renowned for their forward thinking and were not averse to risk.¹⁸

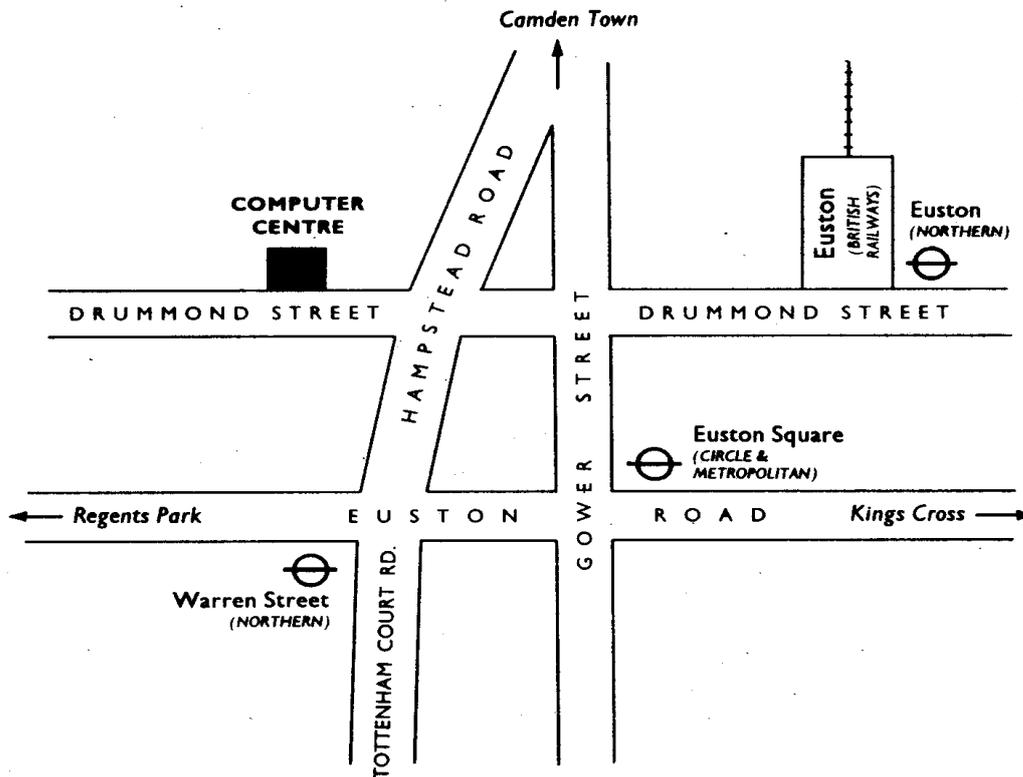


Figure 2: Card showing location of No. 1 Computer Centre, 1961. Courtesy of Jim McClymont.

With location fixed, the bank's in-house architect set about repurposing the single storey building to cater for the specific environmental needs of a large-scale computer and constructing a first home for its new workforce. There was a broader overriding requirement though; the architect also had to meet the political needs of Barclays' management. As a result, incorporated into the building's interior design were a number of features not related to the requirements of the bank's computer or staff, but that ensured that 'allowance had been made in the layout of the centre for the reception of a steady flow of visitors'.¹⁹ Barclays designed its first computer centre as a site for public display as it demonstrated its position as technological innovator amongst the British clearing banks. In purposefully courting publicity with its *Emidec* installation in London Barclays was following a tradition of computers and public display started by IBM with its *SSEC* (Selective Sequence Electronic Calculator) installation in 1948 in New York.²⁰

In the building's interior design the computer's specific requirements were certainly catered for in terms of power, and temperature, humidity and dust control. A large diesel generator was in place to cope with failures or fluctuations in power supply and thirty three air conditioning units on the roof were installed to dissipate heat output from the machinery to stabilise temperature and humidity levels.²¹ But these primary concessions to the computing equipment, like the hand on the switch that provided a backup for the opening ceremony's invisible ray, remained out of sight. Cables and ducts that brought power and air were hidden behind false floors and ceilings. On show

were indicators that the building's function was about much more than simply meeting the computer's environmental needs; it also had to function as a suitably impressive 'first of its kind' building for a bank wishing to demonstrate its technological prowess.

The opening ceremony took place in the building's cavernous reception area, a massive space framed by white walls, a black granite floor, and a white ceiling supported by simple unadorned large columns. This was the building's entry point and its most obvious statement of public display. Stretching along the length of one wall was a 100ft three-dimensional showpiece mural. The reception area (Figure 3) embodied modernist architectural concepts that were in sharp contrast to traditional classical bank architecture that symbolised stability, tradition, trustworthiness and security.²² Even by the standards of the most recently built branches the computer centre was a thoroughly modern and even futuristic building.²³



Figure 3: The spacious reception area as viewed from the entrance to the centre. The 100ft 3D Mural can be seen stretching down the left. Courtesy of Barclays Group Archives.

COMPUTING AND TELECOMMUNICATIONS

After the opening ceremony the building's first visitors were led from the reception area to a specially designed viewing room enclosed by floor to ceiling glass walls that provided 'an uninterrupted view of the computer and its auxiliary equipment.'²⁴ To the right and on show inside the first of these rooms was Barclays' own *Emidec* computer, installed and fully operational.²⁵ The *Emidec 1100* was the first British all-transistor

computer and as such regarded as an important first in a class of computers that was termed the ‘second generation’ computers.²⁶ Using less power, producing less heat, occupying a smaller footprint, and more reliable than its valve-based counterparts the fully transistorised computer presented an opportunity to make a clear break from the computing past. In timing its formal use of computers in banking with the commercial arrival of the transistor Barclays was associating itself with the new.²⁷

On their fact-finding visits to the United States Barclays’ representatives on the CLCB Electronics Sub-Committee, Cowen and Travers, had been impressed by the innovative partnership between the Bank of America and the Stanford Research Institute.²⁸ The resulting Electronic Recording Machine – Accounting (*ERMA*) specification was built by General Electric and unveiled by Bank of America at the end of September 1955.²⁹ Barclays had not been involved in the design of the *Emidec* in any way approaching the level that the Bank of America was with *ERMA* - from 1956 EMI had been working closely with the British Motor Corporation³⁰ - but Barclays let everyone know that it had ordered the *Emidec 1100* whilst it was still in the blueprint stage.³¹ Barclays was proud of its foresight and in the technological capabilities of its chosen machine. Now Barclays hailed the *Emidec* as ‘the world’s first fully transistorized and magnetic core machine linked to magnetic tapes.’³² Its own configuration of the *Emidec* together with telecommunications it called ‘the most advanced bank book-keeping system in the world.’³³

The *Emidec 1100* was a machine built with business rather than scientific applications in mind, and this was something Barclays was keen to stress in order to differentiate itself from its competitors.³⁴ EMI ambitiously marketed its medium-sized *1100* model as a central system component of a system with the potential for integrating hitherto separate tasks within an organisation.³⁵ This marketing neatly tapped into requirements of the business world that were markedly different from the scientific requirements that earlier computing efforts had predominantly been focused upon.³⁶ Later, Donald Travers reflected on the beginnings of the widespread commercialisation of computing and had this to say:

The role of the equipment manufacturer was changing. He was no longer selling a computer. He was selling the capabilities of a system, with the computer only one machine in an equipment configuration at the data processing centre that would contain also punched card readers, magnetic tape units and high-speed printers; and a system which would provide also for the preparation of input data at branches, the transfer of data to the centre and the feedback of management and accounting control information.³⁷

Barclays portrayed its computer as the leader in an orchestration of technology from a number of different manufacturers. The *Emidec* was connected to Ampex magnetic tape drives, Ferranti *FR 300* photo-electric paper tape readers, and Creed 3000 paper tape punches, which all served as input and output devices and were also housed in this first computer room.³⁸ Barclays had colour coded the different units in the computer room according to their purpose and these colours were used to help describe to the visitors in the viewing room how each operated as part of the data processing whole. On the day of the initial opening ceremony visitors were directors at Barclays’ board and local levels, afterwards they were managers and other representatives from Barclays and other banks and businesses. All were welcomed inside to gaze comfortably from the

insulated viewing room upon the flashing lights of the computer, the busy peripherals, and the smooth efficiency of the machine attendants operating within.

As part of the complete visitor experience, guests were given a glossy pamphlet entitled *Barclays Bank Limited: Our First Computer* that emphasised some of the less visible aspects of the new computer system. Through the leaflet Barclays extolled the efficiency of the new computing system in terms of its storage capacity and the speed at which it could deal with information compared to a traditional branch-based book-keeping system. The leaflet even suggested the new computer system was capable of simple decision making such as that done in a branch. The leaflet listed the input/output and processing capabilities of the computer system [emboldened in original] thus:

It can store a lot of information: the entries on 9000 full ledger sheets can be stored on 1 reel of magnetic tape, 3600 feet long. **It can read information from paper tape very quickly:** nearly 700 entries in 1 minute. **It can sort information very quickly:** 1000 entries can be sorted in 45 seconds. **It can perform arithmetic very quickly:** a credit can be added to a balance in 140 millionths of a second. **It can make simple decisions:** answering the question, ‘Does the balance exceed the limit?’ takes 410 millionths of a second. **It can punch out paper tape very quickly:** a statement sheet of 28 entries is produced in 4½ seconds.³⁹

A second computer room, a mirror image of the first, was purposely empty on opening day. The room’s emptiness allowed Barclays to make another statement about its technological future. Visitors were informed that this space was reserved for a second *Emidec* that Barclays would order from EMI later that year. Barclays needed two machines because it knew from its experimental work that the throughput of one *Emidec* system operated by a single shift would be about 40,000 accounts with approximately 16,000 update entries per day.⁴⁰ That equated to the number of accounts held by twelve large busy West End branches. Barclays envisaged automating a larger number of branches when it designed its first computer centre, and there was talk of a ‘take-on’ target set for Donald Travers’ team at the No. 1 Computer Centre of 50 London branches.⁴¹ Although its branch network in England and Wales at the time numbered over 2,240 branches,⁴² Barclays limited its first automation efforts to a comparatively small number of branches in London. The bulk of its business took place in Britain’s financial capital, and in the 1960s it was here that the pressure on staff and space was most acutely felt.⁴³

Past the two computer rooms and right at the back of the building were the communications bays that connected the centre to twelve Barclays’ branches initially. There were 24 GPO lines in total allowing for simultaneous input and output from and to each branch. Barclays had cast the operation of its own electronic computer system as an important British banking first, but with the communications bays it pressed home its real achievement. Here it portrayed the *Emidec* computer system as but one part of a sophisticated data processing system that linked branch and computer centre together by telecommunications. Twenty-four GPO lines and teleprinters allowed branch entries to be input remotely to the computer centre and statement and ledger output back to the branch simultaneously. There was nothing so old fashioned as the movement of vouchers and paper between branch and centre. *The Banker* described this system connecting two separate places as a world first.⁴⁴



Figure 4: The communications bay showing the punches re-perforating paper tape transmissions from the branches, c. 1962. Courtesy of Don Harvey.

THE ICE MACHINE

Barclays had one last trump card to play with the technology it placed inside its computer centre. Up until this moment Barclays had only been able associate itself with the prestige of technology by proxy, but now, in a perfect example of a consumer turned producer,⁴⁵ it had installed a piece of equipment in the centre that had been wholly conceived, designed, and prototyped by its own staff. This was the Input Checking Equipment, or ICE machine. Barclays drew special attention to this technology in its press release:

At intervals the punched paper-tape is transmitted over the teleprinter lines to the Centre, where a duplicate tape is automatically produced. Before these tapes are passed to the computer they are checked electronically to detect very occasional punching or transmission errors. The computer would in fact find these errors itself, but by disposing of these errors in advance the introduction of this input checking equipment (ICE) allows the computer to operate at its greatest efficiency. ICE was designed by a member of the Bank's staff, as there was no equipment on the market, or under development, which would perform this checking function, and considerable interest has been aroused in the data processing field by this machine.⁴⁶

The ICE machine performed a simple but important function. From opening at 9 a.m. until closing at 3.30 p.m. each branch connected to the centre would punch out five-channel paper tape that contained the day's debits and credits to be applied to customer accounts. These transactions would be transmitted in batches of fifty or a hundred

across the GPO line to the computer centre where they would be reproduced as paper tape input for the *Emidec*. In the early 1960s these lines were expensive but for small distances just affordable to big business and fairly reliable. A standard speed data transmission of 10 characters per second gave typical line error rates of 1 in 10,000 for the bank's book-keeping entries. No matter how low the error rate was however Barclays had to ensure that none of these errors could ever reach a customer's account.⁴⁷ So Barclays took a belt and braces approach to tackling the issue of line errors. The standard BAUDOT type code used by the GPO had its roots in the transmission of text for telegrams. Line errors causing dropped bits for these alphabetic characters were noticeable and not a major cause for concern, but errors in the numbers that were the foundations of the bank's business could have catastrophic consequences. It wasn't just line errors that Barclays had to guard against in this new data processing system; errors could also be introduced at source in the branch through mis-keying of input or by the paper tape perforator machines in the transmitting branch or at the receiving centre. It was in fact these input mistakes and punching errors that caused far more problems than the line errors.⁴⁸ Consequently Barclays replaced the GPO's standard 5-bit BAUDOT code with its own 4-bit plus parity code that allowed a parity check to be performed for each transmitted credit or debit. In addition it trailed each batch of transactions with a total for reconciliation purposes.

With parity code and reconciliation totals now in place thought had to be given to the most efficient way of checking these at the centre. The programs on the *Emidec* had been written so that they checked that the sum of the transactions matched the batch total, but detecting errors as part of the branch update programme created an unacceptable delay for both branch and centre. Updating the accounts for each branch could not take place until after the branch had closed for business at 3.30 p.m. While an error would be picked up as part of this update, it would cause the whole update programme to stop while the source of the error was determined and the branch re-transmitted some of its entries. Ideally what was needed was a way of checking the branch entries as and when they arrived during the day.

The *Emidec* was needed during the daytime for testing and training so another checking solution that did not involve the *Emidec* was required. With nothing suitable available on the market, here was a problem in need of a bespoke solution. Two of Barclays' staff at the computer centre, Davey-Thomas and Doug Pearce, met the challenge by designing and building a device for checking the transmitted paper tape. Both men, like so many of the early bankers recruited into computing, were keen hobbyists with interests in amateur radio and electronics consolidated during a period of National Service. Having the requisite technical skills and understanding that what was required was really a simple parity checker, the two men built an initial working prototype of the ICE machine using mechanical relays. The prototype machine was slow, but it proved their concept. Barclays then partnered with a small electronics firm, RDL, to bring a transistorised version into production. These transistorised ICE machines were demonstrated in place and fully functional on the centre's opening day.⁴⁹

Something that the visitors' attention was not drawn to was Barclays' often more low-tech solution to error correction.⁵⁰ As batches of entries were received during the day they would then be read in and validated by the ICE machines. If a machine detected a parity error it would stop and mark the tape highlighting the error. It was then an operator's job to perform the necessary error correction. Sometimes this involved a retransmission from the branch, but usually it was no more than a case of the

operator flicking the tape to dislodge a stubborn chad left behind from an incomplete perforator punch.⁵¹

WORK AT THE COMPUTER CENTRE

The tour of the centre was about a show of computer and telecommunications strength, but it was also about its controlled operation. In the transparent computer rooms visitors had been able to see the computer operators working within and hear their work explained in relation to the machines they were tending. The tour now involved communicating to visitors the role of Barclays' programmers whose mental labours were made visible in the form of flowcharts and machine code on display. The programmers' rooms contained exhibits of the 'extremely detailed instructions' that its specially trained staff had been responsible for preparing. This display served two purposes. It was not only to communicate to visitors what this new breed of banking staff, the programmer, did, it was also to dispel any notion of the *Emidec* being an 'electronic brain' doing the thinking all of its own accord. Barclays stressed that impressive though its chosen technology was, there was no danger of it making decisions on customer accounts of its own accord. It could only do what the programmers told it do, and visitors were reminded that Barclays programmers, like its computer operators, were all bank clerks first and foremost who knew the business of banking. It was only atop a solid set of banking foundations that specialist programmer and operator training from EMI had been built.⁵²

The centre's first programmers and operators were those bank employees that had experimented with centralised accounting using tabulators and computers in the 1950s under Travers. During the centre's first years of operation the team expanded drawing in staff from Barclays' branch network that had shown a particular aptitude for working with machines. These were the clerks who worked in the back office of a branch or machine room. The most senior of these back office clerks was the Officer in Charge of Mechanisation (OC Mech), and although the machine room was predominantly staffed by women the OC Mech in charge was sometimes a man. It was from this pool of male OC Mechs that many of the centre's first computing workers were predominantly drawn.⁵³

Prospective programmers and operators were often approached informally and in the main were more than happy to move to the centre from the branch, some even relocating to London, because they saw the move as an opportunity and a new challenge. In any case many of those approached didn't fit comfortably within the rigid confines of the branch and some were even self-described 'trouble makers'.⁵⁴ As an alternative to them becoming increasingly de-motivated or leaving the bank, they were redeployed instead to the No. 1 Computer Centre. Once there they experienced a welcome liberation of sorts and the subculture of the branch machine room was amplified in the bigger surroundings of the computer centre.

The programmers and operators were in the main young men, although initially a significant proportion were also women, between the ages of 20 and 25 years of age.⁵⁵ From the outset computing and youth were seen as going hand in hand. A thirty one year old interviewed as a programmer although accepted was seen as being significantly older than the accepted norm.⁵⁶ The first computer operators and programmers underwent a three-week training course at EMI's factory at Hayes, Middlesex and then

worked on the *Emidec* at Hayes prior to its delivery to the centre. By the live date they had built up considerable experience of the machine.⁵⁷

The centre's programmers and operators became part of the ongoing visitor experience. On a regular basis important visitors, including representatives from other banks, would be met in the impressive reception area by the head of Barclays' mechanization, Donald Travers, who would pause on the way to the computer rooms by the door of one of the white ceilinged, white walled offices. He would quietly open the door and point inside the programmers' room whispering to the visiting crowd, 'these are our programmers.' Later, as the visits became embedded in the weekly life of the centre, one of these programmers would adopt the role of computer centre tour guide.⁵⁸

As well as two rooms to house the programmers (senior and junior) other internal work spaces included the assistant manager's office, maintenance workrooms, a lecture room for on-site training, an office for the on-site EMI engineers, and a mock up of a typical branch.⁵⁹ Whilst Barclays' architect had allocated space for the practical, these rooms all lay off the main central space that was the building's reception area, and it was this reception area that dominated the building's interior design. The programmers affectionately named the reception 'The Elephant House' and 'Stonehenge', two names that reflected the relative size of the reception area compared to their own working space and its primary function as a meeting place for groups of gawking visitors that made it akin to the entrance of a tourist attraction.⁶⁰ The repurposed building was far from ideal as a working computer centre. The showroom's relatively low ceiling height meant that the introduction of false floors and ceilings to conceal cabling and ducts resulted in a building that felt rather cramped in those spaces outside of reception.⁶¹ The needs of the staff working at the centre and the building's long-term future came second to the initial impact Barclays wanted to make.⁶²

In its first year, with one *Emidec* serving a handful of local branches, there was a chief programmer, two other programmers, and four computer operators working at the centre. Although there appeared to be a clear division of labour indicated by these job roles, in practice the centre provided a fairly informal working environment compared to the rigid hierarchy of the branch. There was a great deal of camaraderie amongst the workers in this new environment and although there were designated job roles in practice 'everybody tended to do a bit of everything.'⁶³

Overseeing all of the work at the centre were a manager and controller who were both former chief clerks drawn from branches. The chief clerk was a position of authority below that of branch manager who overlooked the operations of the cashiers. The chief clerk from the first branch, Cavendish Square, had been made controller of the computer centre.⁶⁴ The manager and his deputy, the controller, oversaw the operations and programming that took place at the centre, but without the strict hierarchy that characterised working life in a branch. The absence of customers, weekly visits aside, made for a more relaxed attitude with everyone on first name terms.

In addition to the computing team there was a small team of communications staff, almost entirely made up of women, responsible for ensuring receipt of the paper tapes in the centre and then carefully winding them and placing them onto spikes. The centre also required a receptionist to front the large reception area and a number of maintenance staff. The Barclays' workers at the centre were augmented by on-site EMI engineers who were there to deal with machine failures, which although frequent by today's standards, were dealt with swiftly '99% of the time'.⁶⁵

Initially work at the centre was organised into a single daytime shift 9-5 weekdays and 9-1 on Saturday.⁶⁶ This time structure was inherited from the branches and like working time in the branches these hours were only indicative. The expectation in branches was that you left work only when all of that day's work had been balanced. Branch staff had long been used to unpredictable finish times that could play havoc with domestic arrangements.⁶⁷ The branches may have closed to the public at 3.30 p.m., but there was much work once the doors had closed and a 5.00 p.m. finish was seldom guaranteed. This branch culture of staying behind until everything had reconciled was easily translated into a culture in the computer centre where it was expected you stayed until all processing had been completed. Flexibility at the centre was very important as the workers got to grips with a new system and youth was an advantage here too. Hours were typically longer than those worked in the branches and although overtime was paid, the primary working incentive in this new environment was a newfound freedom. Staff at the computer centre were not only used to working late but some also positively thrived on it using out of hours unpaid working time in which to refine and develop new programs for the *Emidec* at the centre.⁶⁸

Even though there was an increased autonomy and a more meritocratic feel to work at the centre, there were still important elements of the inherited branch culture that persisted. They may have been specially trained by and working alongside computer specialists from EMI but this first batch of Barclays computer operators and programmers were all paid a standard bank clerk's wage. This inherited pay structure held strong until the middle of the 1960s. Up until this time their assignment to the computer centre was seen as a temporary one with it 'envisaged that they [would] remain at the centre for three years after which they [would] be returned to normal banking duties.'⁶⁹ A move to the computer centre was viewed as a temporary secondment, with the centre's programmers, operators, controllers, and managers expected to resume their 'proper' career in banking once the automation work had been completed.

WORK IN THE BRANCH

The first Barclays' branch to be served by the No. 1 Computer Centre was nearby Cavendish Square branch. Because it was the very first branch to be automated normal book-keeping operations had been run in parallel with computer accounting for a few months prior to the centre's live date. On 4 July 1961 however, the ledgers in the branch were updated no more and the sole authoritative source for customers' current accounts became the magnetic tapes held at the centre. This was the date when the first Barclays' branch *lost* its independence. Month by month more branches were cautiously 'taken on' by the centre, one at a time, with Bond Street and Marble Arch following Cavendish Square.⁷⁰ By February 1962 the centre had taken on a total of five branches.⁷¹

As part of the take on process each branch would appoint a member of staff to act as a liaison officer – with the biggest branches appointing two - and it was his or her job to act as the primary point of contact between mechanization department's take on team and the branch staff. This was a key role instrumental in managing the change in the branch as a result of the switch to automation. A liaison officer experienced in the automation process would often move from branch to branch to oversee the necessary

account personalisation, introduction of new technology, and the change in branch procedures required before computer accounting could take place.⁷²

Perhaps the most significant of these changes was the need now for cheque and paying in slip personalisation and account numbering in the branch. Prior to automation, branch staff had kept paper and card records sorted by customer name, and chequebooks were a generic standard format personalised only by the customer adding his or her signature. Bank clerks became skilled at recognising customer accounts by these signatures alone. However the introduction of computer book-keeping meant that each account now had to have a unique identifier that was in the form of a number. A team within mechanization department had the job of visiting the branch prior to take on to perform the necessary account personalisation.⁷³ The introduction of account numbers meant that automated branches now had to issue customers a book of personalised cheques. Somewhat paradoxically the process of account personalisation meant that branch staff had to deal carefully with customers who saw a pre-printed sort code, account number, and name on their stationery as representing a de-personalisation of their relationship with the bank. Initial guidance was issued to cashiers that they should gently remind customers to write their account numbers on paying in slips, but if the customer objected that they should inconspicuously fill this in instead.

The new computerised and centralised accounting system was sold to branch managers as a way of releasing space and time in branches so that their staff could enjoy better working conditions and provide a better service to customers. In the machine room space was freed as the ledger/statement posting machines were replaced with an *NCR 3208* Waste machine modified to add a paper tape punch and a *Creed 6S/6M* paper tape reader to transmit entries via GPO line to the computer centre (see Figure 5), but space was also consumed in the branch as a result of computer automation. The requirement for personalised accounts meant that space was required within the branch to hold a library of personalised cheques. A move to centralise this storage and send new chequebooks to customers by post was made later.⁷⁴ The branch also required a teleprinter in order to receive reports from the centre for checking purposes and on which to print customer statements and the copies they retained in the branch in place of ledgers.⁷⁵ It was the biggest branches, some having upwards of ten accounting machines, that realised the greatest net gains in space.

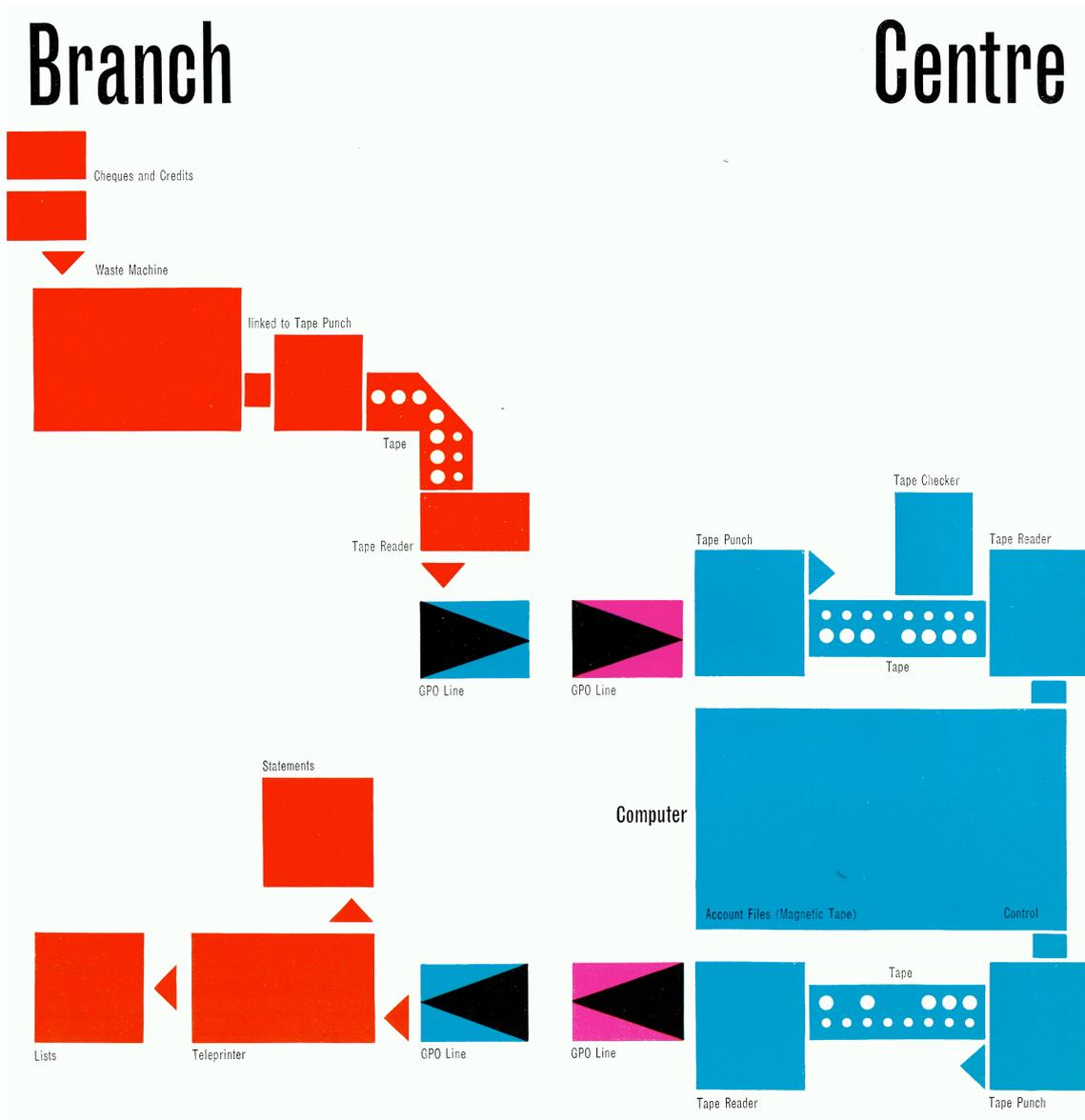


Figure 5: Communication of information between branch and centre, 1961.⁷⁶ Courtesy of Barclays Group Archives.

The increased capacity of the centralised system meant that more business could be taken on in an existing branch without additional machines or staff in the branch. The computer offered a new flexibility that could meet the growth in demand for banking services in the 1960s. As one manager from a competitor bank observed on a visit to Barclays No. 1 Computer Centre:

This [...] point was proved by one branch which obtained a new group of some 50 active accounts which under the conventional system would have meant an additional posting machine and perhaps extra staff at the branch. In fact the additional work was hardly noticed at the branch and was not significant to the computer.⁷⁷

As the automation programme progressed Barclays' head office was keen to stress to branch managers with branches planned for inclusion that they would always remain in control of their customer accounts. Head office circulars were sent out to branch managers to set an appropriate tone for the introduction of the new computerised system. One circular stressed that a preservation of the power relationship between the branch and the computer centre was central to the bank's automation strategy [italicised in original]:

[I]t is cardinal to all our thinking that the branch is the master and the computer centre the servant. So, as ways and means of improving customer services or the service to branches begin to be seen, the computer system will be subjected to O. & M. [organisation and methods] scrutiny just as our conventional services and systems have been and are being.

The branch manager continues to be responsible for *all* decision making; and the management team at the [computer] centre will never be without a man who has had experience in branch management. [...] [W]e shall be surprised and disappointed if greater distances should impair the excellent team spirit which exists today between staff at computer branches and at our No. 1 Centre.⁷⁸

At first the branch manager was firmly master and computer centre servant as the following example of statement production illustrates. In the branches overdrawn balances had always been represented in red and this was a feature branch managers were adamant remained in place when a branch was automated. The high-speed *Anelex* printers at the centre could not make use of a black/red ribbon whereas the teleprinters in the branch could. Consequently statement production was initially done via a teleprinter in the branch (Figure 5). Although this was slower than printing at the centre, it did preserve an existing structure and also allowed Barclays to further extol the virtues of its advanced telecommunications system where no paper at all passed between branch and centre. However over time existing structures formed around the branch were replaced with new ones created from the centre. Sometime before April 1963 printing was moved in-house to the computer centre as the teleprinters struggled to keep pace with statement volume and branch managers were finally persuaded to accept DR next to an overdrawn balance in place of red print.⁷⁹

There were ramifications for the branch in terms of space and the power base presided over by the branch manager, but what was the impact of the emergence of the computer centre on the branch staff themselves? After all the introduction of computers was seen as a solution to a staffing crisis and the computer promised to handle work previously done by Barclays' staff. When this was first mooted the banking unions had been worried that the introduction of computers would mean staff redundancies. Back in 1956 the unions had signposted their intentions to resist the introduction of computers if they were to displace staff and they sought assurance that staff affected would be retrained and deployed elsewhere. The back-office routine work that computers were to replace was largely done by women and an enlightened National Union of Bank Employees (NUBE) was also at this time pressing for equal pay between men and women in banking at a time when the pay gap was widening.⁸⁰ Union fears proved to be premature as the 1960s saw a boom in the business of banking. The Payment of Wages Act of 1960 began to have a real impact by the first quarter of 1963 when a section of the act authorising payment of wages by cheque came into force.⁸¹ An

account with a clearing bank was the easiest way of cashing a cheque. British banks were busier as a result as a larger proportion of the population required banking services and the number of branches to supply these services increased. Although the introduction of computerised and centralised book-keeping allowed a single branch to cope with a greater number of customers it did not alter the way the banks served their customers. The high-street branch was the means by which banks did business with their customers and in order to reach more of the population in a wider geographic area banks had to open more branches.

Peak workloads at the start of the week and end of the month were particularly difficult to manage though and computerised book-keeping smoothed out these peaks and allowed existing staff to better cope with existing volumes of work. The introduction of computers was seen as ‘relieving the pressure on existing staff.’⁸² The staff in the branch still had plenty of work to do serving increasing numbers of customers and there were still many manual processes to perform. The computer centre didn’t handle all the accounting functions within a branch. To begin with account processing was limited to the current, loan, and personal loan accounts.⁸³ It is not difficult to see why those working in the branch were not unduly worried by the introduction of a computer; most saw it as an aside as much of the work in the branches carried on as before.⁸⁴ In its first few years the computer and the computer centre was seen as an adjunct to bank business, and despite the chairman’s claims from the top, those working in automated branches below saw it as ancillary rather than revolutionary. The small minority of branches that were automated were certainly freed of some work but lots of other work carried on the same and there were an increasing number of customers to serve.

MANAGING CUSTOMER PERCEPTIONS

The introduction of new technologies and working practices in the branch as a result of computer centre automation took place in the back office. A customer looking around the banking hall of his or her branch on a routine visit to cash a cheque would have noticed no change in the arrangement of branch space, but this is not to say that customers did not experience change. The cheque itself was the site for a series of changes that directly affected the customer served by an automated branch. The inclusion of Magnetic Ink Character Recognition (MICR) characters for branch sort code and account number in the E13-B font at the bottom of cheques now bearing their pre-printed name was something to which customers had to become accustomed. It wasn’t just the cheque layout that changed: in preparation for automated clearing, paper size and thickness all had to be standardised too. These changes had an effect on common customs, as a cheque was now only supposed to be used against the account on which it was issued. In theory this meant the practice of borrowing a blank cheque from a friend when you reached the end of your chequebook had to stop. In practice however, the bank, sensitive that these stricter controls might alienate some of its customers, provided some leeway from the more stringent requirements of computerised banking. While customers grew used to the changes it allowed cheques from other accounts to be used providing that the pre-printed name and account number were deleted. When using paying in slips customers who did not write on their account number were not requested to do so, but instead a member of staff would look up the account number against a list of names held in a card index and fill in the details for the

customer.⁸⁵ This was a period of change for customers set in their banking ways and the much touted increased personal service afforded by the computer was needed for this transition period. Barclays had to manage customer perceptions so that the requirement for customers to now refer to themselves by number in certain scenarios did not in fact mean that they were merely a number to the bank.⁸⁶

Changes to cheque format, layout and use were one visible change; customers also experienced change regarding their statements. Both the look of the statement and the nature of statement ordering changed. Previously a customer would be able to visit his or her branch and request a statement that could be produced on demand. With the move to centralised accounting the flexibility of on demand statement production was lost. Customers were now required to give the branch 24 hours notice when they required a statement. This was to allow for the request to reach the computer centre from the branch and the completion of batch processing with the resulting customer statement being sent back to the teleprinter in the branch for printing the following morning.⁸⁷ Centralised production for both the initial remote and the later local printing of statements meant a change for customers too. The days and dates of weekly and monthly statements were moved to meet the computer centre's requirements rather than those of the customer.

In an attempt to carefully manage customer perceptions of automation Barclays issued each customer that would be affected with a specially commissioned leaflet entitled *Our First Computer*.⁸⁸ In this first district, the prestigious Pall Mall, customers were mainly important businesses, and it was paramount to Barclays that it avoided alienating or even losing this important customer base. It had to sell the change to them and it did so by presenting automation at the computer centre as the only practical and sensible solution to the growing cost of providing a branch banking service. The key advantage of electronic book-keeping by computer was stressed as a reduction in spiralling costs associated with staff, premises, paperwork and equipment. The response to the question 'why a computer?' was because without a computer 'it might well be that in a few years time we should be unable to provide you with an adequate banking service at a cost which you could reasonably be expected to pay'. Barclays pressed home in its direct customer communications and a number of newspaper and magazine advertisements that computers would contain and reduce the cost of banking and also allow branch staff to provide a more personal service.⁸⁹

As part of a wider discourse, anthropomorphic representations of computers were a common way of explaining computers that those unfamiliar with them could understand. The 'electronic brain' had been a powerful, if misleading, early metaphor used by the popular press to convey the electronic computer concept to a wider public audience.⁹⁰ In a number of advertisements in business magazines and newspapers Barclays now recast its computer not as a giant brain that could do thinking of its own accord, but as 'workhorse' that took away the drudgery of accounting from branch staff now freed up to provide a service that was 'proportionately more efficient.'⁹¹

But not all the bank's customers, nor its staff, were convinced that the computer was a faithful servant or that technological progress equated directly with increased customer service. One customer's polemic, 'Give Me Back My Ledger' published in *Punch* magazine and later reprinted in 1962 in the Barclays' staff publication, *Spread Eagle*, re-awakened the importance of trust in a relationship between customer and bank potentially undermined by automation efforts. The computer's negative presence was felt in two ways. First the characters in the E-13B font at the bottom of customer's

cheques were seen as a constant reminder that a computer was now in control of a customer's account. These magnetic ink characters were described as 'a string of figures of the kind beloved by electronic machines, where the 7s look like question marks and the little blobs and the chimney pots break out from time to time.' The increased visibility of the computer's presence was an irritant, but the growing invisibility of customer accounts was a bigger issue resulting in both practical and emotional concerns. Using magnetic tapes to store customer accounts was seen as a long way away from the easy readability of the branch ledger. Whilst computer media such as punched cards and paper tape were touchable with the holes representing account entries clearly visible, information on magnetic tape was both untouchable and invisible. With the ability to read this new medium now resting firmly with the computer, customer trust now had to be placed in machine as well as man.⁹²

Furthermore the creation of a special centre to house the computer served to elevate its status, and holding customer account information within the centre's walls removed the account from the long-established trust and security of the branch. In spite of efforts by the bank to explain to customers how the links between branch and computer centre would work, the presence of a number of devices involved in establishing these links brought to mind more opportunities for failure or even the possibility of random numbers being generated like those from *ERNIE*.⁹³ The computer centre and its contents were now seen as especially vulnerable to attack, with imaginings of 'the hooded representatives of a rival bank stealing into the Centre at dead of night with an enormous magnet and in an instant utterly demolishing all the records. Or they might feed false information to the computer, turning all my pluses to minuses and vice versa.'⁹⁴ Perhaps fanciful, and not wholly representative, the concerns of one customer do provide a useful articulation of the broader issues concerning customer trust, security, accountability, and personal service that Barclays needed to address as it moved from the self-contained production unit of the branch into a distributed model of accounting that connected branch with computer centre. The banks were certainly aware that vocal minorities like these could be disruptive and they sought not 'to dismiss any criticisms of our system in a cavalier way' but instead to address customer concerns in order to remove resistance to the changes introduced by automation.⁹⁵

THE OTHER BANKS

Barclays undoubtedly went to great lengths to make a powerful statement when it opened its first computer centre, but is its claim of the first computer centre for banking in Britain valid? And furthermore how did the opening of the first computer centre for banking relate to the automation efforts of the other British banks at the time?

The other clearing banks that made up the 'Big Five': Lloyds, the Westminster, the Midland, and the National Provincial were only a matter of months behind Barclays, with Lloyds the closest follower opening its computer centre in the West End of London in September 1961.⁹⁶ However it was another smaller English bank, Martins, which gave Barclays the closest run for its money. Martins, although much smaller than Barclays with only 600 branches to Barclays' 2,240, was the largest British bank not to have its head office in London at that time. Despite its smaller size, like Barclays it had also been represented on the three-man CLCB's Electronics Sub-Committee working party. Like Barclays this placed Martins in somewhat of a privileged position, and at the

start of 1960 Martins became the first British bank to successfully process the accounting and statement production of one its branches with an electronic computer. It did this at Ferranti's London Computer Centre and shortly after placed an order for its own Pegasus II to be installed at its Liverpool head office.⁹⁷ Martins could have had the first British computer centre for banking if it were not for a three-month delay as a result of a strike by Ferranti's subcontractors. As it was Martins officially opened its computer centre a month later than Barclays on 18 August 1961.⁹⁸

Barclays had also considered the Ferranti Pegasus alongside the *AEI 1010* as one of two credible alternatives to the *Emidec 1100* on its computer shortlist of three. Whilst there was a strong argument that favoured the *Emidec* because of its technical merits, including the technical and political importance of having an all transistorised machine, the final decision to go with the *Emidec* was made because EMI banked with Barclays.⁹⁹ This wasn't an unusual scenario; a bank preferring to do business with its customers was common practice. The Midland did the same when it ordered a *KDP 10* from English Electric; English Electric banked with the Midland, they shared a board member, and the *KDP* was manufactured locally in Kidsgrove.¹⁰⁰ There isn't the space to do a detailed treatment of all the British clearing banks here, so instead I continue to 'follow the actors' and summarise the position as seen through the eyes of one of the other clearing banks.¹⁰¹

Table 1: Computers and Sorter Readers Ordered by the Banks: Computers, 14 September 1961.¹⁰²

Bank	Type of Computer	Price	Remarks
Barclays	Emidec 1100	£150,000	Installed in London. To process 40,000 Accounts. Operational.
Coutts District	Univac S.S. 80 STEP	£80,000	To be installed in Spring 1962.
Lloyds	-	-	Hiring time on a Ferranti Pegasus.
	3 IBM RAMAC	£350,000	To be installed at Cox & King's Branch, London, to process 30,000 accounts.
Martins	Ferranti Pegasus II	-	Installed in Liverpool to process 30,000 Accounts. Operational.
Midland	English Electric KDP 10	£250,000	To be installed in West End of London to process 100,000 accounts.
National Provincial	Ferranti Orion	£200,000	To be installed at end of 1962. To process 150,000 accounts.
Westminster	IBM 1401.	£100,000	
	Ferranti Pegasus	?	
Bank of Scotland	IBM 1401	£100,000	To be installed in Edinburgh by the end of this year.

Table 1, produced by Manchester-based Williams Deacons Bank two months after the opening of Barclays' No. 1 Computer Centre, illustrates Barclays' leading position in relation to the rest of the 'Big Five' and to some other smaller but innovative British banks.¹⁰³ At this point it was only Barclays and Martins that were operational with computers purchased and installed on their own premises. Lloyds would open its computer centre in the West End of London with an IBM 350 installation later that month, followed by the Westminster who eventually chose IBM too, but a 1401 model. The rest of the 'Big Five' set up computer centres of their own soon after.

EXPANSION AND CLOSURE

In 1963 with a second *Emidec* in operation and statement printing moved from the branch-based teleprinters to the *Anelex* line printers in the centre, Drummond Street began operating a double shift system. Two shifts of six operators and one programmer worked from 8.00 a.m. till 4.00 p.m. and then 4.00 p.m. until midnight or till all the evening's printing had finished.¹⁰⁴ Operators not only managed the printing of the statements, but also guillotined and packed them up to be delivered to the branches the next morning. In times of need when printing carried on well past midnight, computer operators would even go as far as delivering the statements to any branches they went past on their way home in the morning after a night shift.¹⁰⁵

Working a double shift system allowed the two *Emidecs* to more than double their estimated workload capacities. In 1964 the No. 1 Computer Centre reached its rumoured automation target of 50 branches.¹⁰⁶ There was now a total of 48 staff working at the centre and 11 of these were communications 'girls' working during the day to deal with incoming paper tape transmissions across 50 GPO lines.¹⁰⁷ Take on had been cautious but the pace was steadily increased targeting in order those London branches in the Pall Mall and London Eastern districts where the shortage of staff and the pressure on existing premises was the greatest.¹⁰⁸ That year Barclays estimated it had saved 142 branch staff as a result of the new computer system and parallel developments in the automation of cheque clearing.¹⁰⁹ But a look at wider staffing figures (Table 2) shows that this figure of 142 was insignificant in comparison to the rise in the number of branches and staff over the same period. The 50 automated branches represented just 2% of Barclays' branches nationwide. The business of banking grew steadily and those staff shortages in London at the beginning of the sixties were still prevalent at its end. In spite of computer centre automation, branch staff continued to be drafted in from the provinces to the capital in order to provide relief.¹¹⁰

Table 2: Barclays Branches and Staff in England and Wales 1945-1970.¹¹¹

Year	Branches	Staff
1945	1,758	17,355
1950	2,030	19,047
1955	2,149	21,137
1960	2,240	24,951
1965	2,428	33,240
1970	3,215	54,905

As the workload of the centre and its staff expanded so too did the attractions it was able to offer. Computer centre guests were now treated to computer-generated music. A young programmer, David Parsons, who had initially programmed the *Emidec* so that it would print out a history of the No. 1 Computer Centre, now wrote a program that made novel use of the speaker built into the machine's operator control panel. EMI had originally provided this speaker to enable audible monitoring of a program's progress and for sounding alerts on successful program end or abnormal termination. An enterprising Parsons, following a tradition of computer-generated music stretching back

in Britain to 1951 and the University of Manchester's Ferranti *Mark 1* computer,¹¹² made use of the speaker to have the Emidec play a selection of carols to visitors at Christmas time. His program proved so popular that it was even featured on BBC radio.¹¹³

In August of 1964 with Barclays head office at Lombard Street attracted to the prestige of having its own computer centre, and plans afoot for a third much bigger centre to serve the whole of London, the decision was made to close down the No. 1 Computer Centre at Drummond Street. The former furniture showroom was now judged to have served its purpose for Barclays and left its mark. Those initial concessions made in the building's design for visitors and prestige were now re-classed as 'difficulties in continuing to use Drummond Street premises as a Computer Centre'.¹¹⁴ However, it would be another six years before the lights were turned off and the technologies and people within stopped performing useful work. The centre's twin *Emidecs* eventually processed the branch accounting for 58 branches and approximately 200,000 accounts.¹¹⁵ From 1967 these branches were gradually transferred to the Barclays new Greater London Computer Centre built nearby in an old piano factory on Tottenham Court Road,¹¹⁶ but the No.1 Computer Centre was still operational even as the sixties turned into the seventies. New programs were being written for the twin *Emidecs* as late as 1969.¹¹⁷

However at the beginning of the 1970s the centre finally did close. On the afternoon of Wednesday 10 February 1971 every branch in Britain had shut its doors not to re-open until the following Monday morning. Over the following weekend the No. 1 Computer Centre's grand reception area was reconfigured and put to use for one last time as a distribution point for the pre- and post-decimalisation output produced by Barclays' remaining operational London computer centres numbered 2, 3, and 4. The reception's granite floor was marked out and on it was laid a million statements and ledgers ready for collection by a newly decimalised branch network.¹¹⁸ For one last time the computer centre's space was the site of a break from tradition as a pounds shillings and pence past was replaced by a decimal future.

NOTES

¹ By the end of the 1950s Ackrill and Hannah, *Barclays: The Business of Banking, 1690-1996*, 153, has Barclays as Britain's largest bank in terms of deposits. Norman, *Banking*, 104, lists Barclays' and the Midland's branch networks as the biggest with both consisting of over 2,300 branches at the beginning of the 1960s.

² For an introduction to ideas of space and function in architecture see Conway and Roenisch, *Understanding Architecture*, chapter 4, 55-81.

³ I'm following Gieryn, in particular 'What Buildings Do', 35-74, but also influenced by the spatial approach taken in his work and others in Smith et al. *Making Space for Science: Territorial Themes in the Shaping of Knowledge*, and Golinski, *Making Natural Knowledge*. For a global look at the history of technology in use see David Edgerton, *The Shock of the Old: Technology and Global History Since 1900*. For technological structures built to achieve a specific social effect see Langdon Winner's classic 'Do Artifacts have Politics' in Winner, *The Whale and the Reactor*, 26-38, and Bernward Joerges' rebuttal: 'Do Politics Have Artefacts', 411-431, and Woolgar & Cooper's 'third way', 'Do Artifacts Have Ambivalence'.

⁴ 'The Computer Centre Opens', *Spread Eagle*, 1961, 252. The day of opening was most likely chosen as a Tuesday rather than a Monday because the first day of the week was always an especially busy day due to

the requirement to process work carried over from Saturday opening: David Parsons, interview with author, Manchester, 7 August 2008.

⁵ Barclays Group Archives, *Barclays Fact Sheet: Principal Events*, 2.

⁶ Quote taken from 'The Computer Centre Opens', *Spread Eagle*, 1961, 252. The term clearing banks is a contemporary one used to denote those banks that specialised in cheque clearing as opposed to the savings banks that predominantly accepted savings deposits.

⁷ 'Electronic methods' was a term in general use that referred in particular to the use of electronic computers. A number of articles in the 1950s hypothesised as to how computers could be applied to banking. See for example A. E. Davies, 'Banking by Electronics', in *The Institute of Bankers in Scotland Lectures*, 1953-1954, 1953; Mary S. Goldring, 'Electronics and the Banks I - Could Computers Help', *The Banker*, January - December 1953, 140-144; Mary S. Goldring, 'Electronics and the Banks II - Costs of Electronic Accounting', *The Banker*, January - December 1953, 205-208; Mary S. Goldring, 'Electronics and the Banks III - Cheque-sorting for Clearing', *The Banker*, January - December 1953, 285-290.

⁸ Ackrill and Hannah, *Barclays: The Business of Banking, 1690-1996*, 153.

⁹ Emidec was capitalised as EMIDEC by various actors. I use EMI's original form of the name here, Emidec, as recorded in EMI Electronics Ltd, 'Emidec computer news 1', ?1960. The order for the Emidec is recorded in Barclays Group Archives (hereafter BGA), 'Board Minutes', Barclays Bank Ltd, 30 July, 1959. This figure of £125,000 was probably the cost of the Emidec and its tape peripherals; it's unlikely this figure included the cost of teleprocessing equipment and teleprinters etc. that made up the whole data processing system. Others, such as the Royal Bank of Scotland and Williams Deacons, record a figure of £150,000 for Barclays Emidec purchase, see: Royal Bank of Scotland Group Archive (hereafter RBS) WD/366/2, 'Computer and Sorter Readers Ordered by The Banks', 14 September 1961; and RBS RB/3146, 'Computer and Sorter Readers Ordered by The Banks', 1962.

¹⁰ The official history of Barclays Bank sketches Tuke as a cautious and conservative man in his later years, Ackrill and Hannah, *Barclays: The Business of Banking, 1690-1996*, 123.

¹¹ RBS WES/1177/62, John D. Cowen, 'Report of the Electronics Sub-Committee to the Chief Executive Officers', 9 May 1958.

¹² For a succinct critical analysis of office automation and computing see Booth, *The Management of Technical Change*, chapter 6 'Office Automation: Computers, Clerical Work and Management Systems', 117-140 and chapter 7 'Bank Automation', 141-154.

¹³ The Barclays press release for the opening of the computer centre cited 'an ever increasing volume of work, presenting problems of overcrowding of Bank premises and staffing difficulties, particularly in London' as the impending crisis the introduction of the computer was averting. Personal archive of Jim McClymont, Barclays Bank Ltd, 'Barclays Bank Limited No. 1 Computer Centre Press Release', 3 July 1961.

¹⁴ 'The Computer Centre Opens', *Spread Eagle*, 1961, 252.

¹⁵ Davey-Thomas, interview with author, Penzance, 15 October 2008.

¹⁶ 'The Computer Centre Opens', *Spread Eagle*, 1961, 254.

¹⁷ There were rumours that the building was former car showroom, see David Parsons, interview with author, Manchester, 7 August 2008; and Barry Matthews, interview with author, Bollington, 3 October 2008. But records [details] in Camden Local Archives show the premises previously belonged to Oetzmann and Co. House Furnishings, a long established furniture and piano retailer. Barclays were in the habit of acquiring property from bankrupt customers and this is possibly the manner in which they acquired the lease for this building; Jean Perkin, telephone interview with author, 21 July 2008.

¹⁸ Barclays had its central Head Office at 54 Lombard St, but maintained a uniquely devolved (for British banking at the time) Local Head Office (LHO) structure operating at a level below. Each LHO oversaw a number of branches grouped by district inherited from acquired banks: Eric Chilton, interview with author, Wilmslow, 9 October 2008; Ackrill and Hannah, *Barclays: The Business of Banking, 1690-1996*, 130.

¹⁹ 'The Computer Centre Opens', *Spread Eagle*, 1961, 253-254.

²⁰ Campbell-Kelly and Aspray, *Computer: A History of the Information Machine*, 115.

²¹ Personal Archive of Jim McClymont, Barclays Bank Ltd, 'Barclays Bank Limited No. 1 Computer Centre Press Release,' 3 July 1961; Jim McClymont, interview with author, Bethersden, 4 September 2008; David Parsons, interview with author, Manchester, 7 August 2008.

²² Modern architecture had established itself in Britain by the middle of the 1950s, but banks were typically conservative in their approach to architectural change. Bank branches typically projected an

image of a strength and stability in order to engender customer trust. For an introduction to modern architecture in post-war Britain see: Bullock, *Building the Post-war World*. On changing styles in bank architecture see Nisbet et al., *Money Matters* and de Wit's review in *The Journal of the Society of Architectural Historians*, 50, no. 4 (December 1991): 450-452. For more recent work on the relationship between form and function in finance, see: McGoun, 'Form, Function, and Finance: Architecture and Finance Theory,' 1085-1107.

²³ Barry Matthews, interview with author, Bollington, 3 October 2008; David Parsons, interview with author, Manchester, 7 August 2008; David Bound, e-mail message to author, 19 September 2008.

²⁴ Personal Archive of Jim McClymont, Barclays Bank Ltd, 'Barclays Bank Limited No. 1 Computer Centre Press Release,' 3 July 1961, 7.

²⁵ Barry Matthews, interview with author, Bollington, 3 October 2008.

²⁶ 2nd generation was a contemporary term - see, 'The Computer Centre Opens', *Spread Eagle*, 1961, 253 - used to differentiate computers built using transistors from their vacuum-tube-based counterparts. Computers would later be categorised as 1st, 2nd or 3rd generation machines according to the incorporation of successive innovations from the electronics industry: (1) vacuum tubes, (2) transistors, and (3) integrated circuits: Campbell-Kelly and Aspray, *Computer: A History of the Information Machine*, 222.

²⁷ The transistor had been invented in 1946 by William Shockley but it was ten years before it became widely available in commercial devices. Campbell-Kelly and Aspray, *Computer: A History of the Information Machine*, 226.

²⁸ John D. Cowen and Donald S. Travers, 'Electronics Sub-Committee Visit to the United States,' September – November 1957. For more on ERMA see: Fisher and McKenney, 'The Development of the ERMA Banking System: Lessons from History,' 44-57.

²⁹ Fisher and McKenney, 'The Development of the ERMA Banking System: Lessons from History,' 55.

³⁰ EMI Electronics Ltd, 'Emidec computer news 1,' ?1960, 3.

³¹ 'The Computer Centre Opens', *Spread Eagle*, 1961, 253.

³² Donald Travers, 'The Actualities of Bank Automation', in *Automation in Banking* (London: The Institute of Bankers, 1965), 11.

³³ Personal Archive of Jim McClymont, Barclays Bank Ltd, 'Barclays Bank Limited No. 1 Computer Centre Press Release,' 3 July 1961, 1.

³⁴ Davey-Thomas, interview with author, Penzance, 15 October 2008; EMI Electronics Ltd, 'Emidec computer news 1', ?1960, 4.

³⁵ EMI Electronics Ltd, 'Emidec computer news 1', ?1960, 5.

³⁶ The LEO is an early British business computing exception here. See Georgina Ferry, *A Computer Called LEO: Lyons' Tea Shops and the World's First Office Computer* (Fourth Estate, 2003).

³⁷ Donald Travers, 'The Actualities of Bank Automation', in *Automation in Banking* (London: The Institute of Bankers, 1965), 11. Note the shifting use of language later to data processing centre rather than computer centre; even back in 1961 language to describe the centre was fluid, visitors were issued with leaflets that referred to the computer centre as the 'Data Processing Centre', see: BGA B262, Barclays Bank Ltd, 'Barclays Bank Limited: Our First Computer', 1961. Whereas the official press release described the new building as a 'Computer Centre', see Personal archive of Jim McClymont, Barclays Bank Ltd, 'Barclays Bank Limited No. 1 Computer Centre Press Release', 3 July 1961.

³⁸ Personal Archive of Jim McClymont, Barclays Bank Ltd, 'Barclays Bank Limited No. 1 Computer Centre Press Release,' 3 July 1961; Personal Archive of Barry Matthews, Barclays Bank Ltd, 'Operator's Manual No. 1 Computer Centre,' c. 1965; David Parsons, interview with author, Manchester, 7 August 2008.

³⁹ BGA B262, Barclays Bank Ltd, 'Barclays Bank Limited: Our First Computer', June, 1961.

⁴⁰ BGA B262, Barclays Bank Ltd, 'Barclays Bank Limited: Our First Computer', June, 1961.

⁴¹ Jim McClymont, interview with author, Bethersden, 4 September 2008.

⁴² The figure for 1960 is given as 2,240 rising to 2,428 in 1965 in Ackrill and Hannah, *Barclays: The Business of Banking, 1690-1996*, 399.

⁴³ McRae and Cairncross, *Capital City: London as a Financial Centre*, 1.

⁴⁴ *The Banker*, August 1961, 521.

⁴⁵ Oudshoorn and Pinch, *How Users Matter: The Co-Construction of Users and Technology*.

⁴⁶ Personal archive of Jim McClymont, Barclays Bank Ltd, 'Barclays Bank Limited No. 1 Computer Centre Press Release', 3 July 1961.

- ⁴⁷ BGA 80/2827, Donald S. Travers, ‘The Actualities of Bank Automation’, *Automation in Banking*, 1965, 13.
- ⁴⁸ BGA 80/2827, Donald S. Travers, ‘The Actualities of Bank Automation’, *Automation in Banking*, 1965, 13.
- ⁴⁹ Davey-Thomas, interview with author, Penzance, 15 October 2008; Personal Archive of Jim McClymont, Barclays Bank Ltd, ‘Barclays Bank Limited No. 1 Computer Centre Press Release’, 3 July 1961.
- ⁵⁰ The co-existence of the high tech alongside the low tech is a point well made by Edgerton, *The Shock of the Old*, chapter 2.
- ⁵¹ Davey-Thomas, interview with author, Penzance, 15 October 2008.
- ⁵² Personal Archive of Jim McClymont, Barclays Bank Ltd, ‘Barclays Bank Limited No. 1 Computer Centre Press Release,’ 3 July 1961.
- ⁵³ Many of those interviewed who worked at the early computer centres had held the position of OC Mech. Some examples are: David Parsons, interview with author, Manchester, 7 October 2001; Stan Gray, interview with author, Haslington, 22 July 2008; Gerry Jarvis, interview with author, Macclesfield, 26 September 2008; David Prior, telephone interview with author, 15 September 2008.
- ⁵⁴ BGA 725/30, Jim McClymont interview with Nicholas Webb, 16 August 2001.
- ⁵⁵ RBS WD/366/2, ‘Report on a visit to Barclays No.1 computer centre’, Management of Williams Deacons bank, 7 February 1962. It goes without saying that these were young *white British* men.
- ⁵⁶ Stan Gray, interview with author, Haslington, 22 July 2008.
- ⁵⁷ Ken Cannell, telephone interview with author, 29 September 2008; Jim McClymont, interview with author, Bethersden, 4 September 2008.
- ⁵⁸ David Parsons, interview with author, Manchester, 7 August 2008.
- ⁵⁹ ‘The Computer Centre Opens’, *Spread Eagle*, 1961, 254
- ⁶⁰ Jim McClymont, interview with author, Bethersden, 4 September 2008. David Bound, email message to author, 19 September 2008.
- ⁶¹ Jim McClymont, interview with author, Bethersden, 4 September 2008; Jean Perkin, telephone interview with author, 21 July 2008; Davey-Thomas, interview with author, Penzance, 15 October 2008.
- ⁶² The importance of the initial statement a building has to make over its practical long-term use is not uncommon in architecture. See Stewart Brand’s, *How Buildings Learn*, for discussion of workable alternatives.
- ⁶³ Jim McClymont, interview with author, Bethersden, 4 September 2008.
- ⁶⁴ RBS WD/366/2, ‘Report on a visit to Barclays No.1 computer centre’, Management of Williams Deacons bank, 7 February 1962.
- ⁶⁵ Ron Lewis, telephone interview with author, 28 July 2008.
- ⁶⁶ RBS WD/366/2, ‘Report on a visit to Barclays No.1 computer centre’, Management of Williams Deacons bank, 7 February 1962.
- ⁶⁷ Brian Hull, interview with author, Wilmslow, 21 October 2008.
- ⁶⁸ David Parsons, interview with author, 7 August 2008, Manchester; Stan Gray, interview with author, Haslington, 22 July 2008. The use of out of hours computing time in which to develop new programs is a key component of the computing subculture explored in Levy’s *Hackers*.
- ⁶⁹ RBS WD/366/2, ‘Report on a visit to Barclays No.1 computer centre’, Management of Williams Deacons bank, 7 February 1962.
- ⁷⁰ David Parsons, interview with author, 7 August 2008; Ian Russell, telephone interview with author, 5 August 2008.
- ⁷¹ RBS WD/366/2, ‘Report on a visit to Barclays No.1 computer centre’, Management of Williams Deacons bank, 7 February 1962, has the Emidec processing 5 branches’ (15,000) accounts at the start of February 1962: RBS WD/266/2.
- ⁷² Ron Lewis, telephone interview with author, 28 July 2008; Ian Russell telephone interview with author, 5 August 2008.
- ⁷³ Neil Savigear, telephone interview with author, 21 July 2008.
- ⁷⁴ “The Automation Programme,” Barclays Group Archives, 80/2827.
- ⁷⁵ Press publicity pack, Jim McClymont personal archive. The NCR machines were modified at a cost of £3,000 to add a paper tape punch that punched out account number, transaction type, and reference

number as a by-product of each transaction: RBS WD/366/2, 'Report on a visit to Barclays No.1 computer centre', Management of Williams Deacons bank, 7 February 1962.

⁷⁶ BGA B262, Barclays Bank Ltd, 'Barclays Bank Limited: Our First Computer', June, 1961.

⁷⁷ RBS WD/366/2, 'Report on a visit to Barclays No.1 computer centre', Management of Williams Deacons bank, 7 February 1962.

⁷⁸ BGA 80/2827, A.H.F. [?], 'The Automation Program', 2 December 1965,10.

⁷⁹ David Prior started at No. 1 Computer Centre in April 1963 and printing was then done at the centre: David Prior, interview with author, 15 September 2008.

⁸⁰ *Guardian*, 'Automation in Banking Union Not Obstructive', 15 May 1956.

⁸¹ In an article looking at the impending enactment of an order of the Wages Act, the *Guardian* examines the impact on Bank opening hours as more working people require banking services at a time when opening hours were 9 a.m. to 3.30 p.m. Monday to Friday and 9 am to 12 midday on a Saturday. See Kenneth Fleet, 'Banks may alter hours – wage cheques pose problems', *Guardian*, 15 January 1963.

⁸² Personal archive of Jim McClymont, Barclays Bank Ltd, 'Barclays Bank Limited No. 1 Computer Centre Press Release', 3 July 1961.

⁸³ RBS WD/366/2, 'Report on a visit to Barclays No.1 computer centre', Management of Williams Deacons bank. 7 February 1962.

⁸⁴ BGA 725/25, Sue Hargreaves, interview with Barclays Group Archives, 14 August 2001; Jean Perkin, telephone interview with author, 21 July 2008.

⁸⁵ BGA B262, Barclays Bank Ltd, 'Barclays Bank Limited: Our First Computer', June, 1961.

⁸⁶ A.W. Brooks 'The people concerned in automation', 20, expresses general concerns regarding depersonalisation, and more specifically that the requirement for customers to include the account number on a credit slip is 'apt to create in the customer's mind that he [sic] is merely a number.'

⁸⁷ RBS WD/366/2, 'Report on a visit to Barclays No.1 computer centre', Management of Williams Deacons bank, 7 February 1962, states that 'branches get their statements (non-narrative) between about 10 and 11 each day.'

⁸⁸ BGA B262, Barclays Bank Ltd, 'Barclays Bank Limited: Our First Computer', June, 1961.

⁸⁹ BGA B262, Barclays Bank Ltd, 'Barclays Bank Limited: Our First Computer', June, 1961.

⁹⁰ Lean, *From Mechanical Brains To Microcomputers*, 184-185; Martin, 'The myth of the awesome thinking machine', 120-133.

⁹¹ For example see *Economist*, 'Miss Wolveridge is now handling 40,000 accounts', display advertising, 8 July 1961 and *Economist* 'Our computer has a twin', display advertising, 5 January 1963.

⁹² H. F. Ellis, 'Give Me Back My Ledger', letter to *Punch*, reprinted in the *Spread Eagle*, Vol. 37, pp. 144-145.

⁹³ ERNIE is the Electronic Random Number Indicator Equipment. It was developed by the GPO and in 1957 quickly established itself as part of British popular culture when it was first used to randomly draw the month's winning Premium Bonds.

⁹⁴ H. F. Ellis, 'Give Me Back My Ledger', letter to *Punch*, reprinted in the *Spread Eagle*, Vol. 37, pp. 144-145.

⁹⁵ A. W. Brooks, 'The People Concerned in Automation', in *Automation in Banking* (London: The Institute of Bankers, 1965), 21.

⁹⁶ *The Banker*, 'Computer Banking A Survey: Action by the clearing and Scottish banks', August 1961, 497.

⁹⁷ 'Enter Pegasus', *Martins Bank Magazine*, Spring 1960, 12.

⁹⁸ BGA 25/1202, Martins Bank Limited Head Office, 'Announcement by Martins Bank Limited', 18 August 1961; Edna Devaynes, interview with author, Birkdale, 1 August 2008.

⁹⁹ BGA 80/850, Barclays Bank Ltd, 'Directors' Inspection of advances', 3. EMI had its account with Barclays in Hayes, Middlesex, which was the location of EMI headquarters. There were strong rumours that the final decision came down in favour of EMI because it was a bank customer: David Parsons, interview with author, Manchester, 7 August 2008.

¹⁰⁰ Booth, 'Technical change in branch banking at the Midland Bank, 1945-75', 285; Booth, *The Management of Technical Change*, 146. Reference in the first of these sources is made to a KDP 8 – a machine that did not exist: there *was* a KDP 10 that was upgraded and rebadged in 1964 to the KDF 8. The second Booth source has the order as a KDF 8, but in 1961 the order would have been for a KDP 10. See Table 1 from a primary source later in the text.

- ¹⁰¹ One of the earliest uses of the term “follow the actors” is in Law and Callon, ‘Engineering and Sociology in a Military Aircraft Project: A Network Analysis of Technological Change’, 284.
- ¹⁰² *The Banker*, ‘Computer Banking A Survey: Action by the clearing and Scottish banks’, August 1961, 497; Booth, *The Management of Technical Change*, 146.
- ¹⁰³ RBS WD/366/2, ‘Computers’ in ‘Computers and Sorter Readers Ordered by The Banks,’ Group Electronics File, Williams Deacons Bank.
- ¹⁰⁴ BGA 80/2827, A.H.F. [?], ‘The Automation Program’, 14 August 1964, 5; Brian Hull, interview with author, Wilmslow, 21 October 2008.
- ¹⁰⁵ David Bound, interview with Janet Sykes, Gloucester, 19 October 1990.
- ¹⁰⁶ BGA 80/2827, A.H.F. [?], ‘The Automation Program’, 14 August 1964, 9, lists a total of 54 branches taken on by the No. 1 Computer Centre at this point.
- ¹⁰⁷ BGA 80/2827, A.H.F. [?] ‘Greater London Computer Centre’, 14 August 1964, 7.
- ¹⁰⁸ Press publicity pack, Jim McClymont personal archive.
- ¹⁰⁹ BGA 80/2827, A.H.F. [?] ‘Greater London Computer Centre’, 14 August 1964, 9.
- ¹¹⁰ Paul Reckin and Jeff Metcalfe, interview with author, Goostrey, 10 November 2008.
- ¹¹¹ Figures taken from Ackrill and Hannah, *The Business of Banking*, 399.
- ¹¹² Hally, *Electronic Brains*, 100-101; BBC, ‘Oldest’ computer music unveiled’, June 17, 2008, <http://news.bbc.co.uk/1/hi/technology/7458479.stm>.
- ¹¹³ Jean Perkin, telephone interview with author, 21 July 2008; David Parsons, telephone interview with author, 21 July 2008. The speaker’s function was derived from ‘EMIDEC 1100 Computer’, <http://www.emidec.org.uk/>, author unknown.
- ¹¹⁴ BGA 80/2827, A.H.F. [?] ‘Greater London Computer Centre’, 14 August 1964, 4.
- ¹¹⁵ BGA 80/2827, A.H.F. [?], ‘The Automation Program’, 2 December 1965, 1, lists 58 branches; BGA 80/2827, a year previously, A.H.F. [?], ‘Greater London Computer Centre, 14 August 1964, 3, listed 54 branches and 180,000 accounts.
- ¹¹⁶ Frederick Deane, telephone interview with author, 17 July 2008; Jean Perkin, telephone interview with author, 21 July 2008.
- ¹¹⁷ Barry Matthews, interview with author, Bollington, 3 October 2008.
- ¹¹⁸ John Evans, interview with author, Congleton, 22 July 2008. The figure of a million is taken from David Bound, interview with Janet Sykes, Gloucester, 19 October 1990.

REFERENCES

- Ackrill, Margaret, and Leslie Hannah. *Barclays: The Business of Banking, 1690-1996*. Cambridge: Cambridge University Press, 2001.
- Booth, Alan. "Technical Change in Branch Banking at the Midland Bank, 1945-75," *Accounting, Business & Financial History*, 14, no. 3 (November 2004): 277-300.
- Booth, Alan. *The Management of Technical Change: Automation in the UK and USA since 1950*. Basingstoke: Palgrave Macmillan, 2007.
- Brand, Stewart. *How Buildings Learn: What Happens After they are Built*. Penguin, 1995.
- Bullock, Nicholas. *Building the Post-war World*. Routledge, 2002.
- Campbell-Kelly, Martin, and William Aspray. *Computer: A History of the Information Machine*. New York: BasicBooks, 1996.
- Conway, Hazel, and Rowan Roenisch. *Understanding Architecture: An Introduction to Architecture and Architectural History*. London: Routledge, 1994.
- de Wit, Wim. "Review: [untitled]." *The Journal of the Society of Architectural Historians*, 50, no. 4 (December 1991): 450-452.
- Edgerton, David. *The Shock of the Old: Technology and Global History since 1900*. London: Profile Books, 2006.
- Ferry, Georgina. *A Computer Called LEO: Lyons Tea Shops and the World's First Office Computer*. Fourth Estate, 2003.
- Fisher, Amy and James McKenney. "The Development of the ERMA Banking System: Lessons from History," *Annals of the History of Computing*, IEEE 15, no. 1 (1993): 44-57.
- Gieryn, Thomas. "What Buildings Do," *Theory and Society* 31, no. 1 (February 2002): 35-74.
- Golinski, Jan. *Making Natural Knowledge*. Cambridge: Cambridge University Press, 1998.
- Hally, Mike. *Electronic Brains: Stories from the Dawn of the Computer Age*. London: Granta Books, 2005.
- Joerges, Bernward. "Do Politics Have Artifacts?" *Social Studies of Science*, 29 (1999): 411-431.
- Law, John, and Michel Callon. "Engineering and Sociology in a Military Aircraft Project: A Network Analysis of Technological Change." *Social Problems* 35, no. 3 (June 1988): 284-297.

Lean, Thomas. "From Mechanical Brains to Microcomputers: Representations of the Computer in Britain 1948-1984." In *Science and its Publics*, edited by Alice Bell, Sarah, Davies, and Felicity Mellor. Newcastle: Cambridge Scholars, 2008: 181-202.

Levy, Steven. *Hackers: Heroes of the Computer Revolution*. Updated. London: Penguin, 2001.

McGoun, Elton, "Form, Function, and Finance: Architecture and Finance Theory." *Critical Perspectives on Accounting*, 15, no. 8 (November 2004): 1085-1107.

McRae, Hamish and Frances Cairncross. *Capital City: London as a Financial Centre*. London: Eyre Methuen, 1973.

Martin, C. Dianne. "The Myth of the Awesome Thinking Machine." *Communications of the ACM*, 36, no. 4 (1993): 120-133.

Norman, G. C. *Banking*. Plymouth: Clarke, Doble and Brendon, 1962.

Nisbet, Robert, Anne Tucker and Susan Wagg. *Money Matters: A Critical Look at Bank Architecture*. New York: McGraw-Hill, 1990.

Oudshoorn, Nelly and Trevor Pinch. *How Users Matter: The Co-Construction of Users and Technology*. MIT Press, 2005.

Smith, Crosbie, Jon Agar and Gerald Schmidt, eds. *Making Space for Science: Territorial Themes in the Shaping of Knowledge*. St. Martin's Press, 1998.

Wilson, John. *Ferranti: Building a Family Business, 1882-1975*. Carnegie Publishing Limited, 2007.

Winner, Langdon. *The Whale and the Reactor*. University of Chicago Press, 1988.

Woolgar, Steve, and Geoff Cooper. "Do Artefacts Have Ambivalence? Moses' Bridges, Winner's Bridges and Other Urban Legends in S&TS." *Social Studies of Science*, 29, no. 3 (June 1999): 433-449.