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Pure data:
moments in a history of machine-readable type

ERMA, MICR, AND E13B

It isn't very often that typographic history – perhaps the most academic of graphic design's specializations – intersects with the grand narratives of economics, banking, and the globalization of finance. In fact, the year 1958 represents an important moment in both histories, for it marks the introduction of the Electronic Recording Method – Accounting (ERMA) system, its Magnetic Ink Character Recognition (MICR) technology, and the font E13B. Better known as the peculiar-looking set of 10 numbers and 4 additional characters printed in magnetic ink at the bottom of every check, E13B allowed checks to be sorted and recorded electronically for the first time, an initial step on the way to our contemporary electronic banking system. Unchanged to this day, E13B remains one of the most enduring typographic innovations of the 20th century and a particular graphic vestige of the 50-year-old computer technologies that determined its letterforms.

E13B was developed under the direction of Kenneth Eldredge at the Stanford Research Institute (SRI) during a 10-year project to develop an electronic, automated personal check processing system initiated by Bank of America. By the late 1940s, Bank of America was the largest in the country and faced mounting difficulties in check processing. The emergence of a post-war consumer banking industry and its personal checks had resulted in unprecedented labor required to convert these paper promises to hard currency. In 1950, Bank of America commissioned SRI to find an electronic solution to this problem. The solution was ERMA.

Prior to ERMA, all checks were painstakingly sorted and recorded by hand, requiring bank branches to close by 3 pm each day. Charged by Bank of America Vice President S. Clark Biese with developing a fast, accurate, automated, electronic check accounting system, SRI encountered a fundamental graphic design problem. The paper check, Bank of America explained, represented the customer's emotional link to the entire banking system and was not to be drastically altered or reformatted. Bank of America also imposed a number of material constraints: the newly designed check should cost the same to print as a traditional check, using widely available printing processes that would resist being rubbed off or made illegible with normal use.

A number of alternatives were considered, including a punch-card system and various 'carrier' methods using specially marked envelopes and attachments. These were quickly ruled out as too cumbersome, and it was decided that the check itself should carry the means for its electronic encoding. Fluorescent ink was the leading contender, allowing an input device to 'read' the check when placed under ultraviolet light. But fluorescent inks were ultimately found to be too easily obscured by stray marks and the traditionally fluorescent cancellation stamps used by many banks. Inspired by the use of magnetic recording and data storage tape in the ERMA computer itself, SRI began working with the Williams Pigment Company to develop a less expensive machine-readable magnetic ink that could be read through overlaid marks, smudges, and tape. (Tellingly, the printed code and its dematerialized digital doppelgänger would be made from the same magnetic material, as if the numbers printed on the bottom of a check desired to be converted into a binary electronic format.)

The Magnetic Ink Character Recognition (MICR) technology developed by SRI initially utilized a large barcode printed directly on the back of the check. While quite reliable, this method could not be easily read by human users, and Bank of America feared it might look too unfamiliar to wary customers. Having seen an early computerized Optical Character Reading (OCR) system, Kenneth Eldredge and his team began exploring a specially designed Arabic numeral character set that could be readily recognized by both humans and computers. A simplified set of linear forms were developed and the font E13B was approved as a standard in December 1958 by the American Bankers Association.

TYPOGRAPHIC CURRENCY

If money is what makes the world go around, then E13B is what makes money go around the world. Printed at precisely 1/8" height, each character in the E13B set can be read electronically in two ways. Under a single-pass magnetic reader each character generates a distinct wave form that is readable even when completely obscured. Alternatively, when scanned along a more precise 7 by 10 square matrix, each character can be differentiated even when folded, misaligned, or partially missing. Printed along the bottom of each check, E13B carries both the checking account number and the issuing bank's individual routing number. The routing number printed in magnetic ink on every North American check is divided into three groups of numbers with a fourth encoded by the receiving bank after it is written. The MICR E13B font includes the characters 0,1,2,3,4,5,6,7,8,9 and four additional characters named Transit, Amount, On-Us, and Dash (see Figure 1).

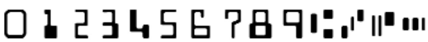

Figure 1: The complete E13B character set.

From left to right at the bottom of the check are three fields of digits, each with a specific purpose for electronic check processing (see Figure 2). The first field of nine digits is the Routing/Transit number. These first two digits identify the Federal Reserve District; 01 identifies this check as the province of the Boston district. The next two digits identify the specific Federal Reserve Branch Office that will process the check. The remaining five digits in the Transit field are the Bank ID and serve to identify the particular bank and branch on which the check is drawn. In this case, 00571 identifies Fleet First Community Bank of New Haven, Connecticut (now Bank of America, the originators of this system). The Routing Number begins and ends with the Transit character. Continuing from the left, the next field indicates the customer's account number and is marked at the end with the On-Us character; 9451689153 at the Fleet Bank of New Haven is the personal checking account of David Reinfurt (see Figure 2). The next field of digits identifies the check number in sequence. In this case, check number 754.

When the check is first received by a bank, a MICR encoding machine is used to add the fourth field of digits. This field is bracketed by the E13B Amount character and records the dollar amount of the check as the final bit of information in the complete MICR number ($25.00 in our example). The MICR encoding of the check is now complete and the paper check is ready to begin its journey. The routing number works left to right from least to most specific – Federal Reserve Branch to Bank, Branch, Account Number, and Amount, mirroring the physical route that the slip of paper and its corresponding

Figure 2: Personal check.

Figure 3: *1984*, by Ed Ruscha (1967).
Image courtesy of Fisher Landau Center for Art, Long Island City, New York.

immaterial cash flows follow in converting the promise of a check into the cash transaction of funds electronically transferred from one account to another.

POPULAR TYPOGRAPHY

By the 1960s, E13B had entered the popular imagination and quickly became a typographic signifier of the emergent human/computer interface and the intersection of money and technology. The awkward, technically derived forms of E13B came to represent the ‘pure data’ of information networks, pointing towards a post-industrial future that lay just on the horizon. It is a vision that is perhaps first legible in Ed Ruscha’s 1967 drawing titled *1984* (Figure 3), in which Ruscha, himself trained in the hand-lettering skills of the working typographer, meticulously rendered the date in MICR characters using powdered graphite. Evoking the dystopian near-future of George Orwell’s novel just a year prior to the worldwide student protests of 1968, Ruscha’s use of E13B registers a moment of potent cultural anxiety.

In 1970, British designer Bob Newman, working for the Letraset Type Studio, designed the font Data 70, which expanded the look of the E13B numeral set into a full upper and lowercase alphabet. In a host of vernacular and pop-cultural applications, Data 70 and its variants became the decade’s favoured typeface for evoking computerization and the new discourse of cybernetics. Film title designer Phil Norman put the new font to use in the title sequence for Sydney Pollack’s 1975 espionage thriller *Three Days of the Condor*, starring Robert Redford and Faye Dunaway. Here, names set in Data 70 animate on screen in lines that mimic the movements of a book-reading computer that CIA operative Redford, code name Condor, uses to uncover a global political conspiracy.

The late 1960s and early 1970s also saw a proliferation of popular editions of science, economics, and technology titles, and Data 70 became a favourite font on such book covers as *The Story of Cybernetics* (1971), *The Money Game* (1974), and *The Artist and Computer* (1976) (see Figures 4, 5 and 6). The futuristic connotations of E13B and Data 70 extended to the realm of architecture as well, where it featured prominently on the cover of Charles Jencks’s classic volume of predictions, Architecture 2000 (1971) (see Figure 7). As a signifier of the future, Data 70 was thus equally loaded with utopian promise as well as Orwellian dread. This is particularly evident in its use by the British visionary architects Archigram in their techno-social visionary drawings of the late 1960s (see Figure 8).

By the end of the 1970s, this typographic choice had become a familiar shorthand whose meanings could be dispensed with quickly. For example, the cover for *Rust Never Sleeps* (1979), juxtaposes the electronic forms of Neil Young and Crazy Horse with the immediate

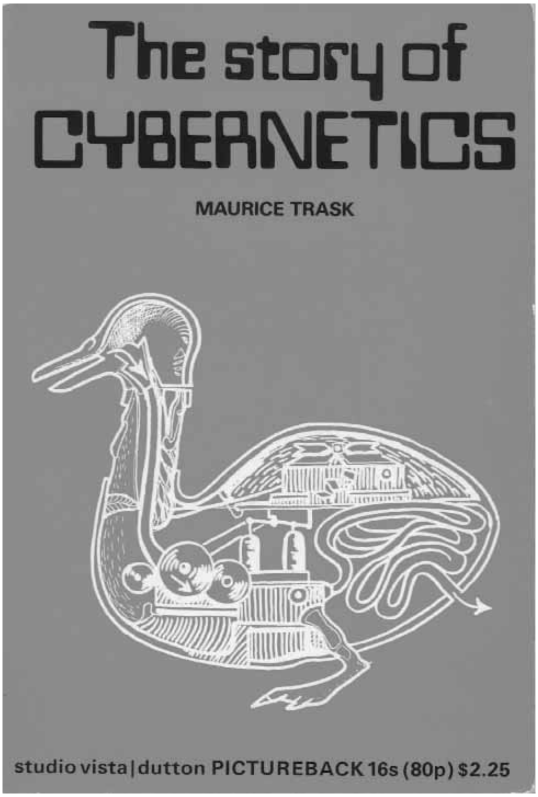

Figure 4: *The Story of Cybernetics* (1971).

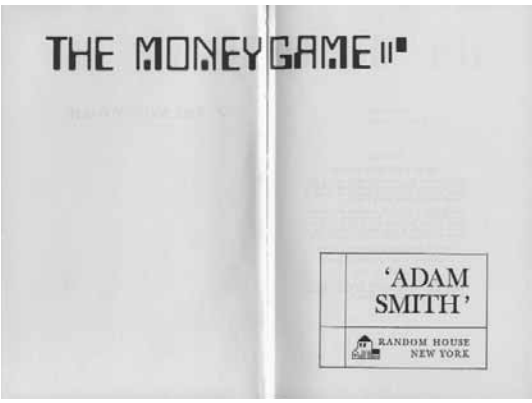

Figure 5: *The Money Game* (1974).

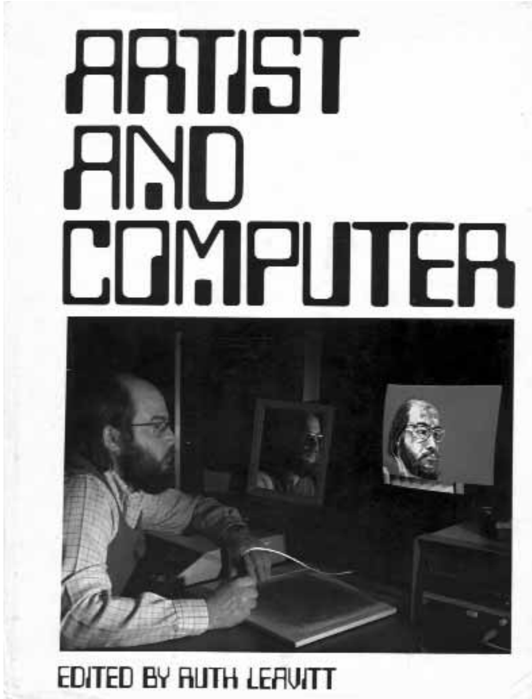

Figure 6: *The Artist and Computer* (1976).

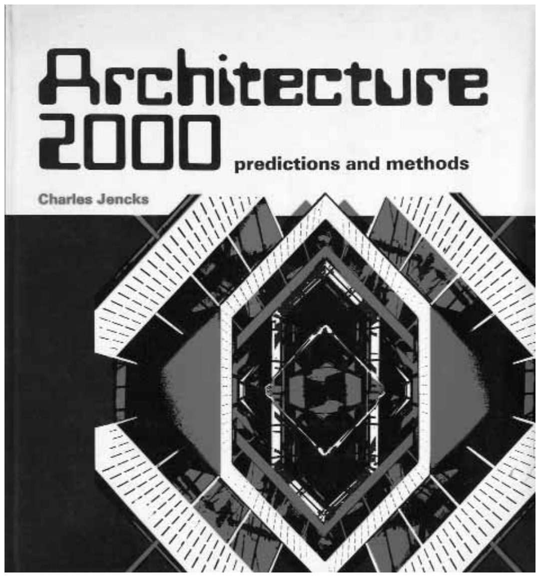

Figure 7: *Architecture 2000* (1971).

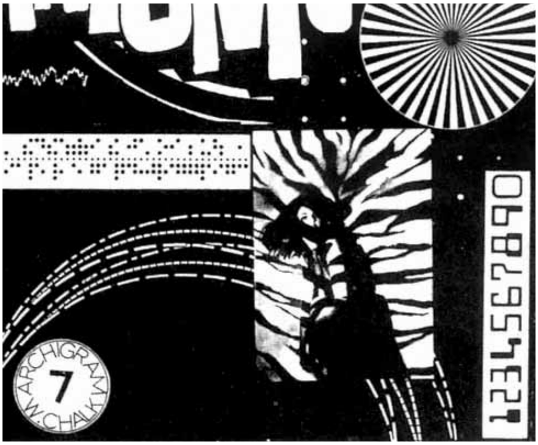

Figure 8: Detail from '"Ghosts" – "Phantoms": The Hangups and Fears of One's Past and Future Cultures', in *Archigram* (1966), edited by Warren Chalk, published by Princeton Architectural Press.

Figure 9: *Rust Never Sleeps*, Neil Young & Crazy Horse (1979).

hand-drawn typography of the title to concisely communicate the essence of this high-tech/lo-fi album (see Figure 9). By this time, E13B and the expanded character set of Data 70 had completed a typographic somersault – the letterforms, designed with essential and functional considerations, now registered immediately as signifiers of the kinds of automated systems that they were originally designed to facilitate.

CATCH ME IF YOU CAN

Today, the forms of E13B can be produced by non-specialists with consumer level hardware, a potential security catastrophe that almost certainly signals the final death knell for this typography. Purchased and downloaded on the web, full E13B character sets optimized for production in different conditions, laser printer toner cartridges filled with magnetic ink, and simple templates give new meaning to the phrase 'personal check'. Such checks, printed using a common personal computer in a bedroom or small office, are virtually indistinguishable from the checks issued by the Bank of America. Furthermore, the magnetic ink typography produced in this fashion can float electronically through the globalized banking system undetected, facilitated by the 1/8"-high characters of E13B.
The cultural resonance of these kinds of typographic hijinks is explored in the recent Steven Spielberg film, *Catch Me If You Can* (2002), based on the true story of con-man and graphic artist Frank Abagnale Jr. Using a battery of design techniques including decal transfers, solvents, and rapidograph pens, Abagnale is able to exploit the check processing and electronic banking system. He lives in luxury, flies first-class, dines delicately, and enjoys a lifestyle of largesse considerably beyond his means – all with fraudulent money acquired through his masterful manipulation of E13B typography (see Figure 10). FBI check fraud expert Carl Hanratty, played by Tom Hanks, describes the particular game being played by Abagnale with the magnetic ink characters. As Hanratty explains, when a check is presented to a bank for payment, it is passed through the magnetic ink reading and sorting machine and routed for delivery to one of 12 Federal Reserve clearing banks. Frank's game is to alter the first two digits of this routing number, sending the check to San Francisco, for example, instead of New Jersey, causing a delay in the processing of the transaction and allowing the bad check to go undetected for a significant amount of time – time enough to

Figure 10: *Catch Me If You Can*, (dir. Steven Spielberg 2002).
Image courtesy of the Kobal Collection.

write dozens of bad checks in one location before moving on somewhere else. Using this method, Abagnale is free to roam the country, passing over 3 million dollars in bad checks that are hopelessly waylaid in the quasi-automated check routing system.

Anchored much more clearly in the mechanics of a specific hardware technology than the infinitely fluid, anyformwhatsoever of computer software, checks themselves are fast disappearing as increasing numbers of financial transactions dissolve into the electronic ether of online PayPal payments, check card debits, and electronic wire transfers – no typography required. And as this cultural evolution plays out, the typographic forms of E13B and its myriad offspring like Data 70 take on the appearance of a typographic vestige. Perhaps not unlike the signifying capabilities of the condensed woodtype forms of Ponderosa to evoke broadsides of the late 19th century, or of Fraktur blackletter typography to recall the earliest books printed with moveable type, the magnetic characters of E13B have come to stand in for a particular historical moment of technological, economic, and typographic convergence in the second half of the 20th century.

As an alternative use for this character set, we would like to make a proposal:

> Using a professional font of the MICR E13B typeface downloaded on the internet, we propose to set all the page numbers for this issue of *Visual Communication* using these characters. All page numbers should be set at exactly 1/8" high to correspond to the ABA standards for Machine Readable typography. This can create an analog of the Routing Numbers which will soon be replaced on checks, leading a reader through the pages of the journal and suggesting one possible future for this particular typographic innovation that enabled and presided over a series of profound cultural shifts – from paper tocomputer, from physical to virtual, from dollars to digits and from hard cash to pure data.

REFERENCES

Bartram, Alan (1962) ‘Reading by Machine’, *Typographica* 5, June: 3–11.

Fisher, Amy Weaver and McKeeney, James L. (1933) ‘The Development of the ERMA Banking System: Lessons from History’, *IEE Annals of the History of Computing*, 15(1): 44–57.