CATALOGUE ENTRY C5 | CODING

ABC TELEGRAPH TRANSMITTER

KING'S COLLEGE LONDON ARCHIVES. K/PP107/11/1/5

In 1840 sending a telegram was a time consuming business. First you had to visit your local telegraph office, fill out the message form, pay the clerk, wait for the nosy clerk to send the message about your private business and then wait again while a second (probably equally nosy) clerk copied it out at the other end. At this point a telegraph boy walked it the last mile or so to its final destination. You would then wait, all over again, for the process to be repeated in reverse and the reply to arrive. Telegraph pioneer, Charles Wheatstone, had a rather different vision for telegraphy.

Wheatstone dreamed of a universal system where everybody, every home, office, bank, factory and workshop would have access to instant 'electric mail'.[1] The bureaucracy of telegraph clerks, engineers and offices could be wiped out in a stroke and messages sent promptly, privately and directly from one personal machine to another. He designed and built the ABC transmitter to make this dream a reality. It was to be the simplest of machines and was intended to be operated safely by anyone, regardless of age, sex or training. If you could spell the word then you could telegraph it with a simple turn of the handle.

The system had three working parts: the generator, the communicator and the indicator. The generator was built to eliminate the need for batteries. The Daniell cell battery - despite being a great advance - was still heavy, required knowledge to put together, and – most important from a public safety standpoint – filled with sulphuric acid. To power the ABC telegraph Wheatstone designed an electro-magneto generator. It exploited Faraday's recent (1831) discovery that if you set an iron rod wrapped in copper wire (an armature) spinning inside some magnets, electricity is produced. Wheatstone attached the copper armature to a handle on the outside of the case. When the handle was turned it created a small pulse of electricity that could be used to send the signal.

The communicator was a toothed disc with all the letters of the alphabet, numbers and common punctuation marks marked upon the face. The sender pressed the button for the letter he or she wanted to send and then turned the handle. Each pulse from the handle moved the disc on one letter. When the disc got round to the required letter it automatically broke the circuit and set the machine back to its zero state. The sender then pressed the button for the next letter and again began turning the handle. At the indicator, or receiving end, was a second dial marked with letters and numbers. Each time an electrical pulse was received down the line the dial moved on one letter. The person at the receiving end wrote down the letter and the dial was set back to zero. With practice up to 15 words per minute could be sent (compare with our average mobile-phone texting speed of 35 words per minute!).[2]

Wheatstone improved on his *ABC Telegraph* and in 1858 patented the *Universal Telegraph Receiver*. In 1860 he founded *The Universal Private Telegraph Company* and began building his visionary system. By 1868 20% of all telegraph lines belonged to private companies and individuals, all of which were swept away after the nationalisation of the telegraph companies in 1870. The GPO changed the system's name back to the *ABC Telegraph* and distributed the easy-to-use devices to the new – and largely untrained – telegraph staff in local post offices. The world had to wait more than a hundred years for Wheatstone's dream of 'electric-mail' to finally become a reality.

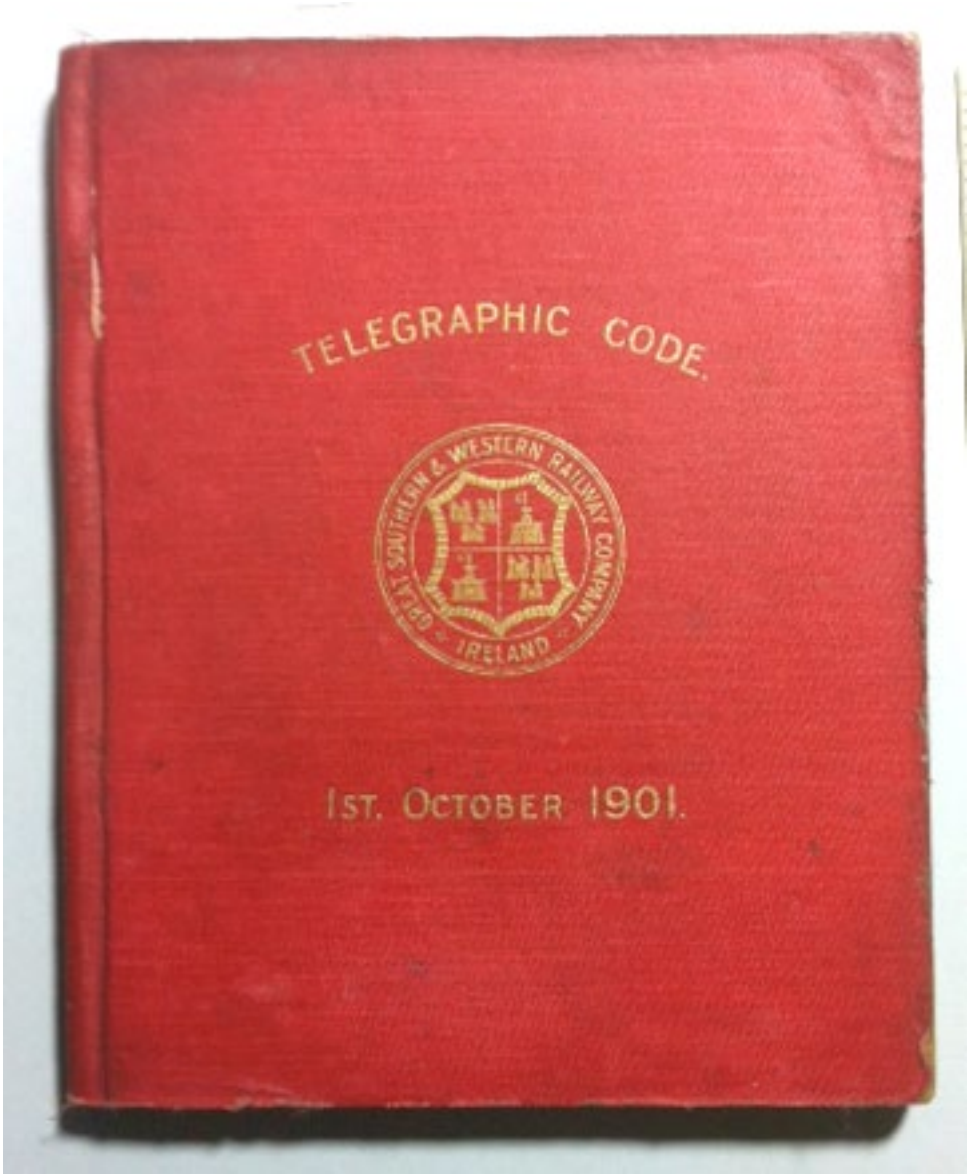
CN

1. S. Roberts, *Distant Writing* (2012), http://distantwriting.co.uk/privatetelegraphy.html (consulted 4 September 2016).

2. Roberts, *Distant Writing* (2012).

CATALOGUE ENTRY C6 | CODING

CODE BOOKS



Telegrams may have been astonishingly fast but they were anything but private. In the UK, large businesses and other organisations could invest in one of Wheatstone's Universal Telegraph Company's private systems to connect their personal workshops, factories and offices. Longer distance messages - and certainly all international traffic - had to pass under the eyes of multiple telegraph clerks and telegram delivery boys. For many organisations this message transparency was totally unacceptable.

The police, for example, deal in information which needed to be widely shared but was too sensitive to be relayed on public lines. Williamson's Police Telegraph Code (1885) was produced to keep police messages private and also allow them to be usefully shortened.[1] It is divided into thematic headings, such as 'suspect appearance' or 'crime wanted for'. A single code word can stand for a whole phrase, for example 'FELONY FENCEFUL FETLOCK' decodes as 'the suspect has two teeth out in front, a slightly turned up nose and is a smooth talker'. For speed, police code books are often laid out in the order that a police report is written.

Individual businesses and industries developed their own code books. Not only did they preserve company secrecy but also allowed messages to be shorter and cheaper by having one code word stand for whole sentences. It helped with the accurate sending of jargon and industry related words and also reduced the monotony of sending frequently repeated information.

The same issue of privacy also applied to all personal telegraph traffic, and code books were produced for the use of private individuals. *Unicode: the Universal Telegraphic Phrase Book* (1894) was a long-running and often reprinted code book of cipher words for 'Commercial, Domestic and Familiar Phrases in Ordinary Use'. Used all over the world, Unicode covered everyday occurrences such as births, deaths, lunch engagements, marriages, racing, hotels and theatre engagements.[2]

Even on private systems code books were still useful. They saved time and freed up the system so more messages could be sent. From the very beginning the railways were heavy users of the telegraph (indeed it was initially designed as a railway safety system). Individual railway companies had their own code books tailored to meet their needs.[3] They also shared important standard words across the railway network such as EARWIG (meaning: 'following urgently required') to avoid confusion and accidents!

Coding didn't always save time, however! Being non-words, or indeed numbers (such as the popular Slater's Telegraphic Code) it was incredibly hard for the clerk to check for accuracy.[4] A reversed letter or missing digit would often slip through, meaning that when the message arrived at its destination it was either decoded as a different word or in some other way indecipherable. This problem was so frequent that the more popular code book producers (such as McNeill's who produced a Mining and General Telegraph Code, 1899) also published a 'terminal index', a list of code words by the order of their backwards spelling, last letter first.[5] The receiver of the scrambled code could work backwards through the encoded word, find the mistake and unscramble the message.

CN

1. Williamson (Chief Superintendent), *Telegraphic Code for the Use of the Police* (London: Eyre and Spottiswoode, 1885).

2. Anon, *Unicode: The Universal Telegraphic Phrase Book* (London, Paris and Melbourne: Cassell and Company, 1894, 9th ed.).

3. Great Southern and Western Railway Company, *Code Book* (Ireland, 1901).

4. R. Slater, *Slater's Telegraphic Code to Ensure Secresy in the Transmission of Telegrams* (London: W R Gray, 1870).

5. B. McNeill, *Mining and General Telegraph Code. Terminal Index - for use with McNeill's Code* (London: Whitehead, Morris & Co., 1899).

CATALOGUE ENTRY C7 | CODING

CRYPTOGRAPHS AND CIPHER POST

KING'S COLLEGE LONDON ARCHIVES. K/PP107/11/1/22

Baron Lyon Playfair, great friend of Charles Wheatstone (and for whom Wheatstone's 'Playfair' cipher is named), recalls that he and Wheatstone would amuse themselves by deciphering the ciphered personal adverts in *The Times*. These were sometimes secretive business dealings but more often they were clandestine romantic correspondences. At one point Wheatstone even took out an advert in *The Times* himself to advise a young woman against the elopement she and her beau had been planning. He made sure to encrypt it in her own cipher code of course.[1]

The reason why Wheatstone was able to decipher these codes so easily was the frequency of certain letters or combinations of letters. In a cipher, a letter is substituted for another

letter to encode it.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z			
			A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

In this example the key is A=D, the cipher is to move three letters further down the alphabet. This is called the 'Caesar' cipher (and was purportedly used by Caesar). A message reading:

THE CAESAR CIPHER IS NOT THE BEST

once enciphered would read:

QEB ZXBPXO ZFMEBO FP KLQ QEB YBPQ.

The word 'the' is a very common word in English so if the code cracker starts with the assumption that QEB may = THE we get the phrase:

THE ZXEPXO ZFMHEO FP KLT THE YEPT

More importantly, the cracker also notes that Q is three letters back from T, E is three letters back from H and B is three letters back from E. The key to the cipher must be therefore 'move three letters down the alphabet'. Code cracked.

The cryptograph is designed to thwart deciphering by disguising letter – and therefore word – frequency. The device looks like the face of a clock, with a long hand and a short hand. The letters A to Z appear printed in a circle around the outside of the face. Within this is a second circle of letters, this time printed on a moveable card to enable the user to choose the key. Once the key is set, say A=D again, the big hand is pointed at the desired letter on the outer alphabet, the small hand then points to the inner, ciphered alphabet, which is copied down. Vitally, the hands are linked to each other via a gear so that every time the big hand moves through the 26 letters of the outer alphabet, the small hand moves through 27. As the hands only turn in a clockwise direction, every time the big hand passes the 12 o'clock point, it moves the whole cipher key along one letter.[2] High frequency words, such as 'the' are therefore never enciphered the same way twice and are much harder to crack!

Wheatstone had good reason to manufacture and market the Cryptograph. Not only could it keep personal messages from prying eyes but it could also increase telegraphic traffic, as Wheatstone notes in the instruction booklet which accompanied the device:

The number of telegraphic messages relating to domestic occurrences are very much limited by the disinclination of parties to let their family affairs to be known to officials in their neighbourhood; and there can be no doubt that were this difficulty removed, this class of message would be significantly augmented, to the benefit of the telegraphic department as well as the public (Wheatstone, c.1854).

CN

1. B. Bowers, *Sir Charles Wheatstone FRS, 1802-1875*, IEE History of Technology Series, vol. 29 (London: The Science Museum, 2001).

2. Museum of Applied Arts and Science, *The Cryptograph* (2011), http://tinyurl.com/htg39s5 (consulted 4 September 2016).


CODING

from VICTORIANS DECODED: ART AND TELEGRAPHY

Edited by
Caroline Arscott and Clare Pettitt

With contributions by:
Caroline Arscott
Anne Chapman
Natalie Hume
Mark Miodownik
Cassie Newland
Clare Pettitt
Rai Stather

Exhibition Catalogue for the exhibition *Victorians Decoded: Art and Telegraphy* held at The Guildhall Art Gallery, London from 20th September 2016 to 22nd January 2017.

Published by The Courtauld Institute of Art
Somerset House, Strand, London WC2R 0RN and King's College London, Strand, London WC2R 2LS.

ISBN: 987-1-907485-053

All sections of this catalogue are available for free download at the project website for *Scrambled Messages: The Telegraphic Imaginary 1857-1900*
http://www.scrambledmessages.ac.uk/
This website is hosted by King's College, London

Designed by Olivia Alice Clemence

BACK AND FRONT COVER:
James Tissot, *The Last Evening*, 1873 (details), The Guildhall Art Gallery, Corporation of London.

KING'S College LONDON

THE COURTAULD Institute of Art

UCL

Institute of Making