# The Hellschreiber

Rudolf Hell devised a technique based on converting the five-unit Baudot code into a special 84-unit Hellschreiber code. The Hellschreiber code had far more potential code combinations than the Baudot code, although only thirty-two of them were used. The vast majority of the possible code combinations were thus unused, or redundant. The redundancy was employed to ensure that printed signals did not look like one another and could thus be easily distinguished.

The Hellschreiber code used 'marks and spaces', the same as the Baudot code. A Hellschreiber converter unit received (an already enciphered) stream of five-unit Baudot code teleprinter signals, converted each five-unit coded character into its equivalent in the 84-unit Hellschreiber code. The transmitter then sent each 84-unit coded character over the airwaves, where they was detected at the receiving end. The received signal was sent straight to a special Hellschreiber printer – in cipher form. The printer then reacted to each unit in the received code, printing a small black block when it detected a mark and leaving the paper blank for each space. The Hellschreiber code had been carefully designed so that printing the marks in each received character code combination would produce an image of the original character from the joined up black blocks.

As can be seen from the image of the Hellschreiber alphabet, the printed characters were formed from a mosaic, not dissimilar to the image seen when a character is greatly enlarged on a modern computer monitor screen, with the diagonal lines turning into stepped blocks. Hell's invention was an early implementation of such techniques. The redundancy is seen in the white space that surrounds each character. This blank framing accounts for a significant proportion of the total number of units in each code combination. Any corruption of these units would simply cause the black blocks to appear where they

shouldn't, but would be highly unlikely to impinge on the ability of the reader to distinguish the printed character.  Similarly, as the mosaic for each letter is quite different, the letters remain recognizable even when several of the marks are corrupted and get 'printed' as a blank white patch.  The survivability of distinguishable characters depended, however, on the human interpreter's ability to recognize underlying patterns – rather like the primitive visual telegraph of the Napoleonic era.  And, the Hellschreiber printed the cipher text, necessitating a further manual stage to produce a plain version.  Thus the Hellschreiber was true hybrid: digital/analogue and machine/manual.  Taking a machine produced digital input, it converted it to a digital code that was use directly to print an analogue image of the character that had to be read manually.

Various versions of the Hellschreiber were widely used in Germany during the war, not just for the high-level army links which are the subject of this book.  The 'Wehrkreis' (Army military districts within Germany) used the Hellschreiber extensively, as did other organizations within the armed forces and the administration of the Reich.  The Hellschreiber system could also be used with Morse code input instead of the Baudot code.  There was also a lightweight, portable 'Field Hellschreiber' system used near the front.  And Hellschreibers were supplied to the Japanese military and diplomatic service.  They were also used by the Allies and commercially, especially by the press.