

M.C. Escher's Word-Puzzle Wrapping Paper for De Bijenkorf

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Abstract

In 1933, M.C. Escher designed gift-wrapping paper for the De Bijenkorf department store. He described it as a “word puzzle”; it is a puzzle to solve how it was produced from a small woodblock.

Introduction

In 1933, the graphic artist M.C. Escher (1898-1972) was living in Rome with his wife Jetta and two young sons Arthur and George. The previous fall he had finished the last of his woodcut illustrations that had been commissioned for the book *The Terrible Adventures of Scholastica*, written by his friend Jan Walch. At the beginning of the year, Escher had sold more than 20 prints to the print room at the Rijksmuseum in Amsterdam; later in the spring he made a sketching trip to Corsica with a friend, spending almost the whole month of May there, producing 19 drawings to later turn into woodcuts and lithographs [1]. It was likely during that summer that he decided to try to get some new commissions and turned to his hobby of what he called “word-puzzles.” His idea was to design gift-wrapping paper for several well-known department stores.

The first design would be for the Dutch department store De Bijenkorf (The Beehive). A bit like the Macy's department store in the US, De Bijenkorf has a long history and is very much a presence today. Founded in 1870, De Bijenkorf advertises itself as “the most renowned chain of premium department stores in the Netherlands. With flagship stores in Amsterdam, The Hague, Rotterdam and Utrecht and smaller stores in Amstelveen, Eindhoven and Maastricht...” [2]. Through the years, the store has had many logos, each reflecting the style of design in its time. In the first half of the 20th century, the logos featured a classic domed beehive [3] and Escher was aware of this. (Today their design emphasis is more on honeycombs than on beehives.)

Gift-wrapping paper is used to decoratively cover packages of many different sizes and shapes, and so Escher's challenge was to design an interesting pattern from which the store's name would be immediately recognizable. His design would contain a beehive and the words “De Bijenkorf” that could be easily read from any of four directions: up, down, left, or right. On September 26, 1933, Escher signed



Figure 1: Escher's design for wrapping paper for De Bijenkorf. His signature is at lower right.



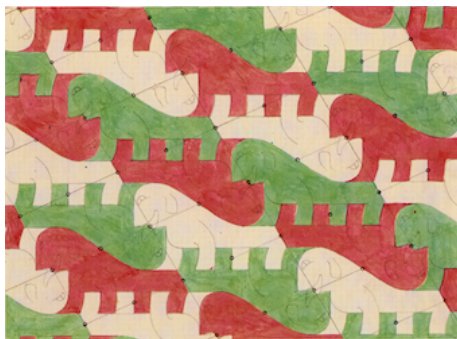
Figure 2: *Imprint of Escher's block to create the allover design for gift-wrapping paper for De Bijenkorf. Shown exact size: 6 x 9 cm. (Right) The block has an underlying grid of 20 squares, each 1.5 cm².*

a contract with the Van Der Spruyt Paper products factory in Enkhuizen, transferring the copyright of his design for gift-wrapping paper to be manufactured for De Bijenkorf. Attached to the contract was an imprint of his woodblock (Figure 2, left) that gave no hint of the allover design that it would produce [4]. A few weeks later, Escher wrote to his good friend Bas Kist, "To my delight, I managed to sell the Bijenkorf design (for 60 guilders). This gives me confidence." [5].

From Block to Allover Pattern

Escher's block has an underlying grid of 20 unit squares, each 1.5 cm² (Figure 2 right). Two unit squares each house a beehive; two others are occupied by the perfectly round letter O. Other unit squares hold two or three letters each. Two large squares, each 3x3 units, are side-by-side; each contains the words DE BIJENKORF (horizontally and bent), while two unit squares atop them contain DE. The large squares can exchange places under a counterchange rotation of 180° (a half-turn) about the midpoint of their joined sides, interchanging the black and white colors. The two small squares containing DE are also related by a counterchange half-turn. These local half-turns hint as to how that small block can repeat to fill the plane.

Although it would be four years before Escher embarked on an intensive investigation into the many ways that a single tile could fill the plane, he was already very familiar with the technique of using half-turns to create jigsaw-like tessellations with a single shape. His earliest tessellations, made in 1926 – 27, feature only half-turns and translation symmetries. They were hand-printed on silk using small individual carved wooden blocks to print the lion-like creatures, and the blocks could easily be rotated to produce the



patterns [7, pp.11, 286]. About ten years later he recorded these patterns as his numbered symmetry drawings 1 and 2 in what would become a folio of over 150 such drawings. On his drawings 1 and 2, he marked the half-turn centers with small circles (Figure 3) [7, p.116]. Each half-turn center is the midpoint of a *centrosymmetric* edge of a tile: a half-turn about the center of that edge leaves the edge invariant, that is, it maps the edge exactly onto itself and the tile with that edge onto an adjacent one, upside down. Any line segment is centrosymmetric, and the letters N and S, for example, are centrosymmetric.

Figure 3: *Escher's symmetry drawing no. 1 in his folio of hand-drawn and colored tessellations.*

The L-shaped block with Escher's design can be translated, matching same-color opposite edges (Figure 4 left), to fill the plane with a periodic design. It can also fill the plane periodically using only half-turns if it can be partitioned according to the Conway Criterion (CC) (that evidently Escher had discovered for himself long before it was published) [6].

(CC) The boundary of the tile can be partitioned by six consecutive points $v_1, \dots, v_6$ so that edge v_1v_2 matches edge v_5v_6 by a translation and the other four edges v_2v_3 , v_3v_4 , v_4v_5 , and v_6v_1 are centrosymmetric.

It is possible to have up to three pairs of consecutive vertices reduce to a single point.

In less technical terms, the CC says that a tile's boundary can be partitioned into 6 “edges”, two of which are congruent and “parallel”, and the others are all centrosymmetric. Figure 4 shows that *any* L-shaped block satisfies the CC and can satisfy it in many ways. In all cases, the four half-turn centers on the boundary of the L block are vertices of a parallelogram.

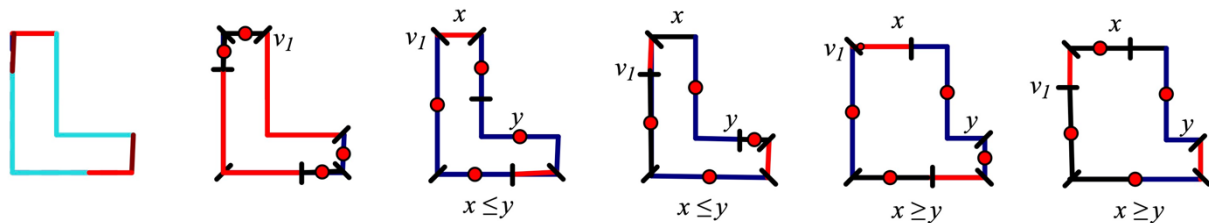


Figure 4: L-block tiles partitioned to show how they can tile the plane. Vertices are at hatch marks, half-turn centers are red dots, colored edges match by translation. Vertex v_1 is labeled; five others follow consecutively, in clockwise order. Each block's width is $x+y$. Here the height of the L block is greater than its width; rotating or reflecting blocks (through a diagonal) shows the cases of width greater than height.

Figure 5 shows that Escher's L-block can be partitioned as shown at the far right of Figure 4. Rotating 180° about any of the four red half-turn centers produces a double tile that can fill the plane by translations that are compositions of two of the half-turns with red centers on the boundary of the tile. Each double tile contains the words “De Bijenkorf” that can be read in the four compass directions (north, south, east, west) in black or in white, with the orthogonal names sharing the letter O.

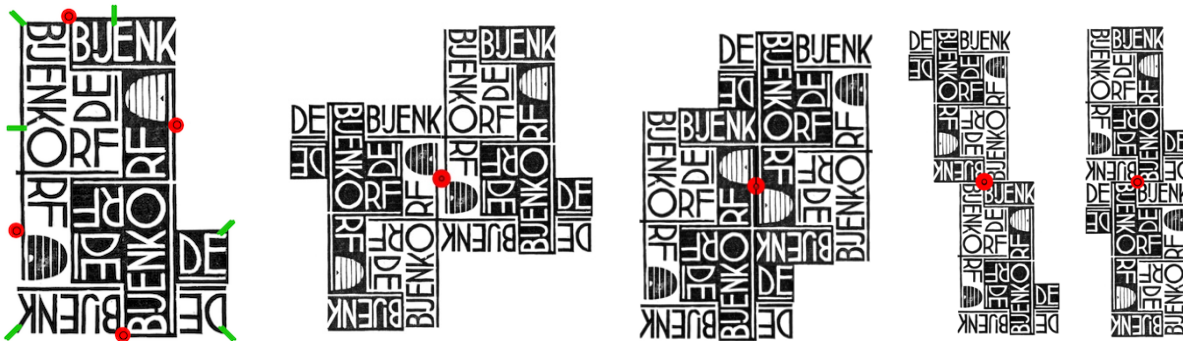


Figure 5: (Left) Escher's block satisfies CC. (Right) Four translation units from a half-turn of the block.

I chose the pinwheel-shaped translation unit in Figure 5 to see how this tiled the plane. Looking at the tiling by its outline (Figure 6), it is clear that the pinwheel repeats diagonally, not horizontally and vertically as would be needed for manufacturing a roll of wrapping paper with edges aligned to Escher's squares. The obvious question then is: what is the size of the smallest rectangular region of the allover design that can produce the design by horizontal and vertical translations parallel to the edges of the block? That region is outlined in Figure 6; it contains five complete pinwheels (10 repetitions of the block, 200 small unit squares), and measures 15x30 cm. Figure 6 (right) shows this region filled with Escher's pattern 25% actual size. There are numerous publications that show fragments of Escher's design for De Bijenkorf wrapping paper, but none (not even [3]) shows a full rectangular translation unit of the pattern.

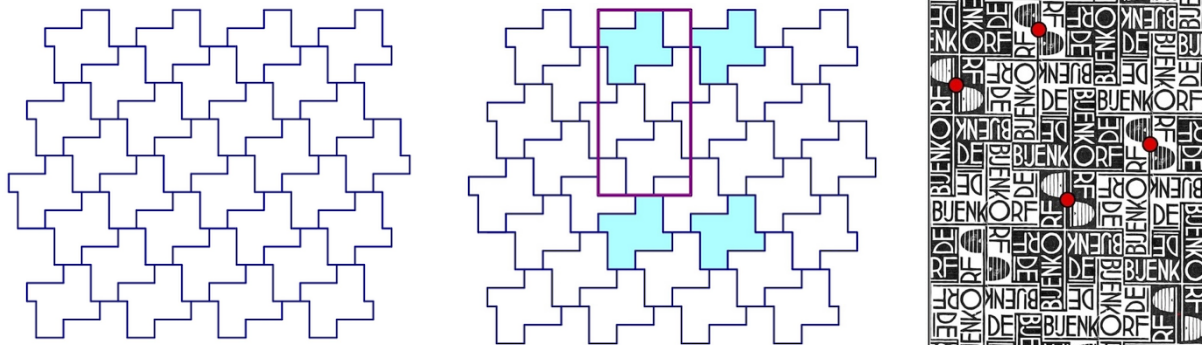


Figure 6: Tiling by pinwheel translation units. The first horizontal and vertical repeats are colored. A minimal rectangle to produce the tiling by horizontal and vertical translations is outlined. (Right) A minimal rectangle that can translate to fill the plane (or produce a roll of wrapping paper) with Escher's pattern. Red half-turn centers form a parallelogram translation unit.

I have been unable to find information on exactly how the Van der Spruyt company manufactured the wrapping paper with Escher's design. Surely Escher must have shown them how the woodblock could produce the allover design, and likely the design was somehow transferred to a roller to produce rolls of the wrapping paper. How long De Bijenkorf used the paper is not known. In 1998, to commemorate the centennial of Escher's birth, De Bijenkorf produced a reproduction of Escher's design [3], this time a bit sleeker, the giftwrap in shiny black and white; it was in use in its shops for several years afterwards.

In his letter to Bas Kist, Escher wrote, "I would like to offer a similar puzzle to the company Gerzon, for which I already have a successful puzzle in mind. ... would you be so kind as to send me a piece of wrapping paper or something similar that Gerzon is currently using and on which their trademark (if they have one) appears." [5]. Later that year, Escher made designs for wrapping paper for Gerzon as well as three other European stores: Zingone, Jemoli, and Korall. Unfortunately, none were accepted for production. Some of these designs, along with the one for De Bijenkorf, can be found in [1, pp.250–251].

Summary and Conclusions

Escher's "word-puzzle" wrapping paper presents a puzzle to anyone who views it: how was this dizzying design created? The surprising answer: a small woodblock carved with crossing words and two beehives.

Acknowledgements

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References

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