Master of Tessellations: M. C. Escher, 1898–1972

This article gives a brief account of the contributions to geometry of a well-known artist.

England lost its poet laureate in 1972—Cecil Day Lewis. If there is such a thing as an artist laureate, and there seems to be, those of us in the field of geometry lost ours in 1972 when Maurits Cornelis Escher died. Escher, a Dutch painter, was born in the Netherlands at Leeuwarden on 17 June 1898. His early training in art was traditional. Escher spent many years under the tutelage of S. Jessurun de Mesquita. From Mesquita he learned graphic techniques and became proficient in the art of the woodcut. Escher migrated to Italy in 1922, settled in Rome, and remained there until 1934. Plates 1 and 2 are typical of this period of Escher’s work. The rendering of Italian landscapes and Italian buildings, particularly those of southern Italy, appealed to him. There is little here to suggest the Escher who was to come, the Escher of repetitive patterns and periodic drawings. Present, however, is the expertise of the master craftsman, the obvious command of his favorite medium—the woodcut.


A word on the editorial approach to reprinted articles: Obvious typographical errors have been silently corrected. Additions to the text for purposes of clarification appear in brackets. The use of words and phrases now considered outmoded, even slightly jarring to modern sensibilities, has likewise been maintained in an effort to give the reader a better feel for the era in which the articles were written.—Ed.

Plate 1. Coast of Amalfi
Later Escher lived in Switzerland, then in Belgium, then in Holland. He finally settled in Baarn, the Netherlands, in 1941. Most of the rest of his life was spent there. The Escher most people know, the artist preoccupied with space filling of a repetitive nature, developed from an interest in the work of Moorish artists. The Moors occupied Spain from 711 to 1492. They were forbidden by their religion to depict animate objects. Escher says (1970, p. 11):

This is the richest source of inspiration that I have ever struck; nor has it yet dried up . . . a surface can be regularly divided into, or filled up with, similar-shaped figures (congruent) which are contiguous to one another, without leaving any open spaces. The Moors were past masters of this. They decorated walls and floors, particularly in the Alhambra in Spain, by placing congruent, multi-coloured pieces of majolica (tiles) together without leaving any spaces between. What a pity it is that Islam did not permit them to make “graven images.” They always restricted themselves, in their massed tiles, to designs of an abstract geometrical type. Not one single Moorish artist, to the best of my knowledge, ever made so bold (or maybe the idea never occurred to him) as to use concrete, recognisable, naturalistically conceived figures of fish, birds, reptiles or human beings as elements in their surface coverage. This restriction is all the more unacceptable to me in that the recognizability of the components of my own designs is the reason for my unfailing interest in this sphere.

Plate 3 and plate 4, taken from notes of Escher, illustrate certain of the Moorish plane tessellations.

It is a curious fact that Escher’s paintings should be so inextricably tied up with mathematics; he was
no trained mathematician. In the preface to *Symmetry Aspects of M. C. Escher's Periodic Drawings*, used as a text in university courses in crystallography, Escher has this to say (Macgillavry 1965):

In the course of the years I designed about a hundred and fifty of these tessellations. In the beginning I puzzled quite instinctively, driven by an irresistible pleasure in repeating the same forms, without gaps, on a piece of paper. These first drawings were tremendously time-devouring because I had never heard of crystallography; so I did not even know that my game was based on rules which have been scientifically investigated. Nor had I visited the Alhambra at that time.

Again he says (Escher 1970, p. 9):

Although I am absolutely innocent of training or knowledge in the exact sciences, I often seem to have more in common with mathematicians than with my fellow artists.

Escher, who made his own first periodic woodcut in 1922—a collection of eight different human heads—found in the Moorish approach the key to much of his life’s work. (Plate 5) He simply adapted Moorish solutions, with a prodigious inventiveness of his own. He seems to have discovered on his own the seventeen fundamental ways of covering a plane through repetitive patterns. He applied axial symmetry, radial symmetry, elements of Poincaré’s geometry; the list could go on and on. Another of his own comments on the fundamentally intuitive approach he had to his art is illuminating (Macgillavry 1965, p. viii):

The dynamic action of making a symmetric tessellation is done more or less unconsciously. While drawing I sometimes feel as if I were a spiritualist medium, controlled by the creatures which I am conjuring up. It is as if they themselves decide on the shape in which they choose to appear. They take little account of my critical opinion during their birth and I cannot exert much influence on the measure of their development. They usually are very difficult and obstinate creatures.

Plates 6 and 7 illustrate other typical Escher tessellations.

Plates 8 and 9 illustrate still other Escher protean characteristics. I call this the optical-illusion Escher. His own comments on plate 8, *Concave and Convex*, bear repetition (Escher 1970, p. 11):

Three little houses stand near one another, each under a cross-vaulted roof. We have an exterior view of the left-hand house, an interior view of the right-hand one and an either exterior or interior view of the one in the middle, according to choice. There are several similar inversions illustrated in this print; let us describe one of them. Two boys are to be seen, playing recorders. The one on the left is looking down through a window on the roof of the middle house; if he were to jump down in front of it, he would land one story lower, on the dark coloured floor before the house. And yet the right-hand recorder player who regards that same cross-vault as a roof curving above his head will find, if he wants to climb out of his window that there is no floor for him to land on, only a fathomless abyss.
He has this to say about Plate 9, *Belvedere* (Escher 1970, p. 22):

In the lower left foreground there lies a piece of paper on which the edges of a cube are drawn. Two small circles mark the places where edges cross each other. Which edge comes at the front and which at the back? In a three-dimensional world simultaneous front and back is an impossibility and so cannot be illustrated. Yet it is quite possible to draw an object which displays a different reality when looked at from above and from below. The lad sitting on the bench has got just such a cube-like absurdity in his hands. He gazes thoughtfully at this incomprehensible object and seems oblivious to the fact that the belvedere* behind him has been built in the same impossible style.

On the floor of the lower platform, that is to say indoors, stands a ladder which two people are busy climbing. But as soon as they arrive a floor higher they are back in the open air and have to re-enter the building. Is it any wonder that nobody in this company can be bothered about the fate of the prisoner in the dungeon who sticks his head through the bars and bemoans his fate?

* summer-house

The obituary of Escher that appeared in *Time* magazine of 10 April 1972 merely says this:

**Died:** Maurits Cornelis Escher, 73, Dutch artist known for his surrealistic woodcuts and lithography, in Hilversum, the Netherlands. Escher worked in almost complete obscurity for 30 years, until, in the early '30s, his vivid sense of fantasy and unusual uses of perspective won recognition in the U.S. His creations over half a century, about 270 works, now appear in museums on both sides of the Atlantic.

Like most obituaries, this one is too cold. Teachers of mathematics, especially those with an interest in the spatial aspects of geometry, can well pay homage to this remarkable man by using what he gave the world. What better tribute to the artist than to include some of his work in the class in geometry?

For teachers with an interest in symmetry groups, books by Cadwell (1966, chap. 8) and Coxeter (1967, chap. 2) are recommended.

**Bibliography**


