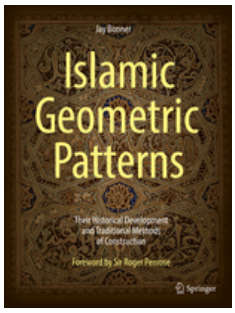
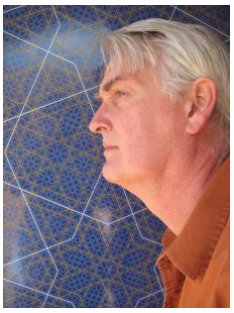
Islamic Geometric Patterns by *Jay Bonner*. Springer Verlag, New York, 2017, isbn 978-1-4419-0216-0 (hbk) xxv+595 p.



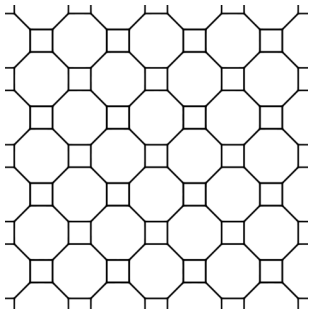


Jay Bonner

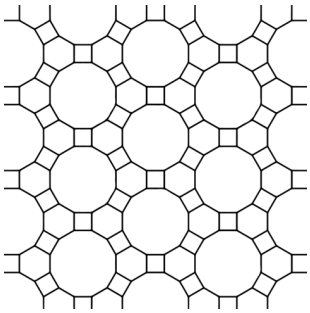
Jay Bonner is a graphic designer from New Mexico who specializes in Islamic geometric designs. These geometric patterns are very recognizable by their beautiful symmetric structures, often with characteristic pointed stars. Many different patterns can be found on walls and domes of numerous Islamic mosques, their grills, woodcuts, etc. since the earliest Eastern caliphates in the seventh century and all the other Muslim territories up to the medieval al-Andalus.

In this book Bonner explains the polygonal design methodology, which he believes was the general method used throughout Islamic culture. Therefore he has collected many historical examples that he surveys in his first chapter, which is richly illustrated with many photographs. Very few documents are available from which one might deduce the method that was used by the historical artists. The Topkapi scroll shows several polygonal construction grids and this has inspired Bonner to propose his polygonal design technique as a general principle.

The polygonal methodology consists in first defining a polygonal tessellation of the plane. That can be regular like an isometric, a triangular, square, or hexagonal grid, but in most cases there is a mixture of polygons of different sizes and shapes, and not all of them are regular (i.e. with equal edges and angles). One particular kind of almost regular grid that is often used consists of regular octagons and squares with matching edges. This is a 4.8.8 grid since such grids are indicated by enumerating the n-gons that coincide at the vertices as in the schemes on the left. Pattern lines are then added in these polygons that will generate the stars of the designs. There are four possibilities to generate these patterns (see next page). Three of them are lines that emerge at the midpoints of the edges under certain angles that will depend on the number of edges in the polygon. Depending on these angles that will generate the points of the stars, the design is called acute, median or obtuse. The fourth possibility is that the patterns lines start at two symmetric points on the edges. The next page gives examples of the effect of these methods applied to a tessellation of a grid consisting of squares and hexagons in the top two rows leading to fourfold symmetries. More complicated polygonal patterns with decagons, pentagons and hexagons are used in the bottom rows resulting in sixfold symmetries.

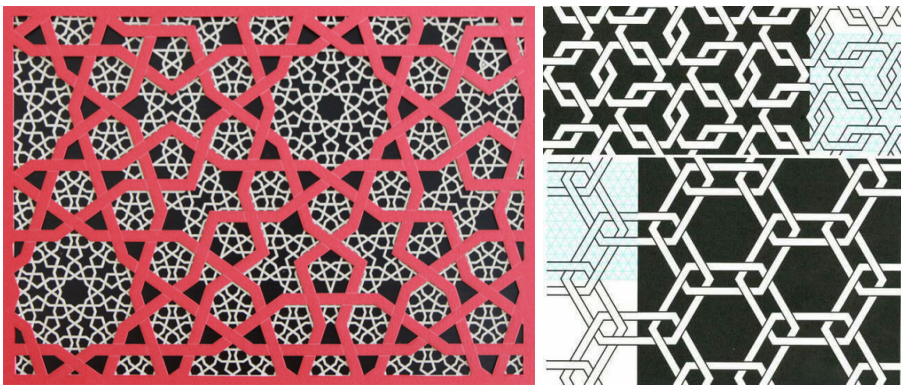


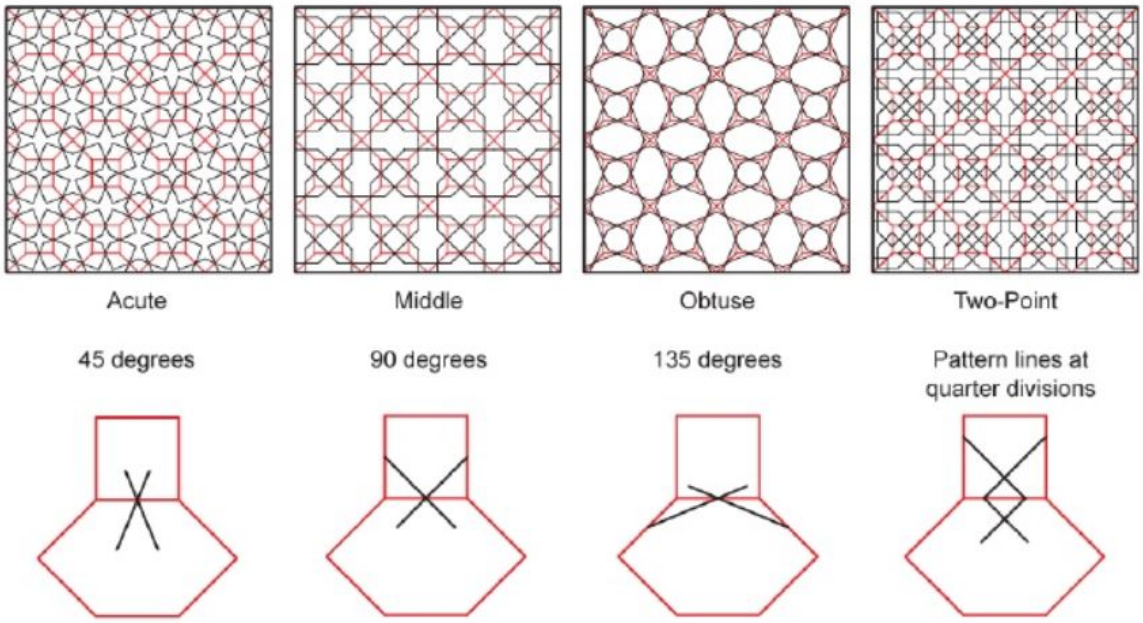
4.8.8= 4.8^2 grid and

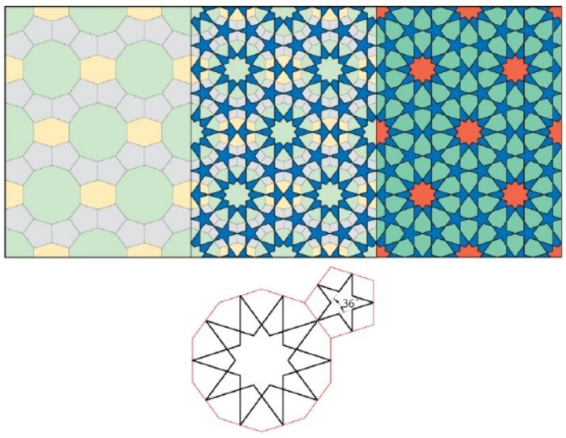


4.6.12 grid

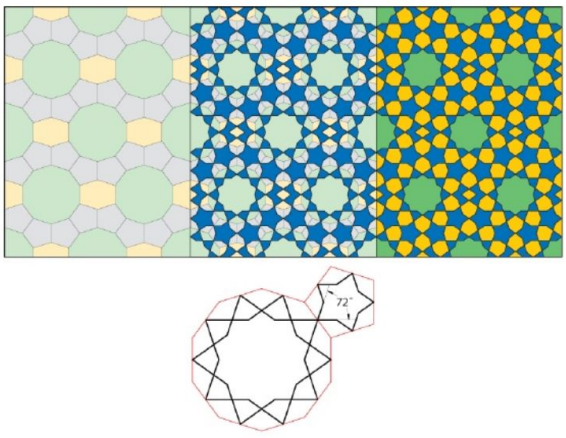
Here is another example on the right where the polygonal system is made clear. Once the pattern is on all the polygonal tiles the overall design appears and then the polygonal grid can be dropped. What remains is a tiling of the plane that gives a pleasing pattern when coloured appropriately as seen on the next page. On the other hand, the pattern lines can be widened, to form strips like the red ones in the image above. But most often these strips are not just crossing each other, but they are used to form some interweaving where one strip is on top of the other. On several occasions the strip is even split into two parallel narrower strips with possibly a different weaving pattern for each like in the right picture above.



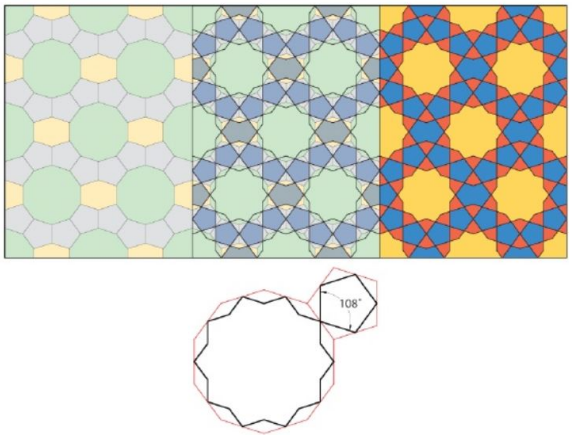




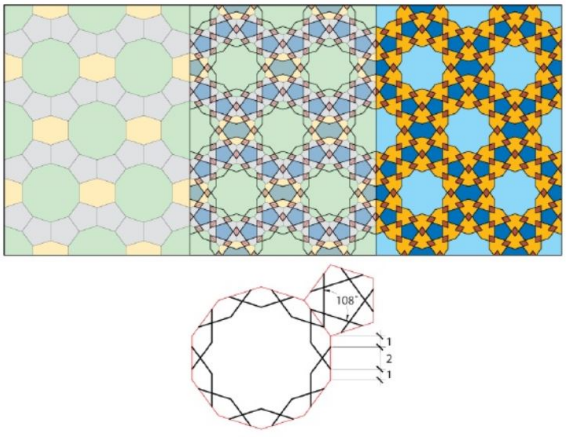
Acute



Median

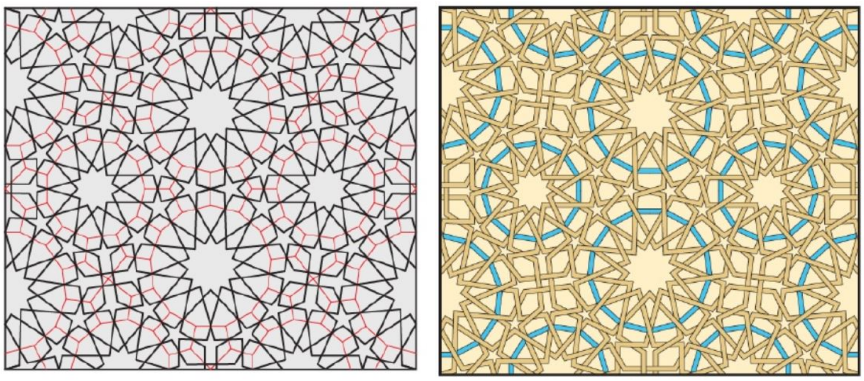


Obtuse



Two-point

*The images on this page are copied from slides of a lecture by Jay Bonner that he shared on SlideShare.

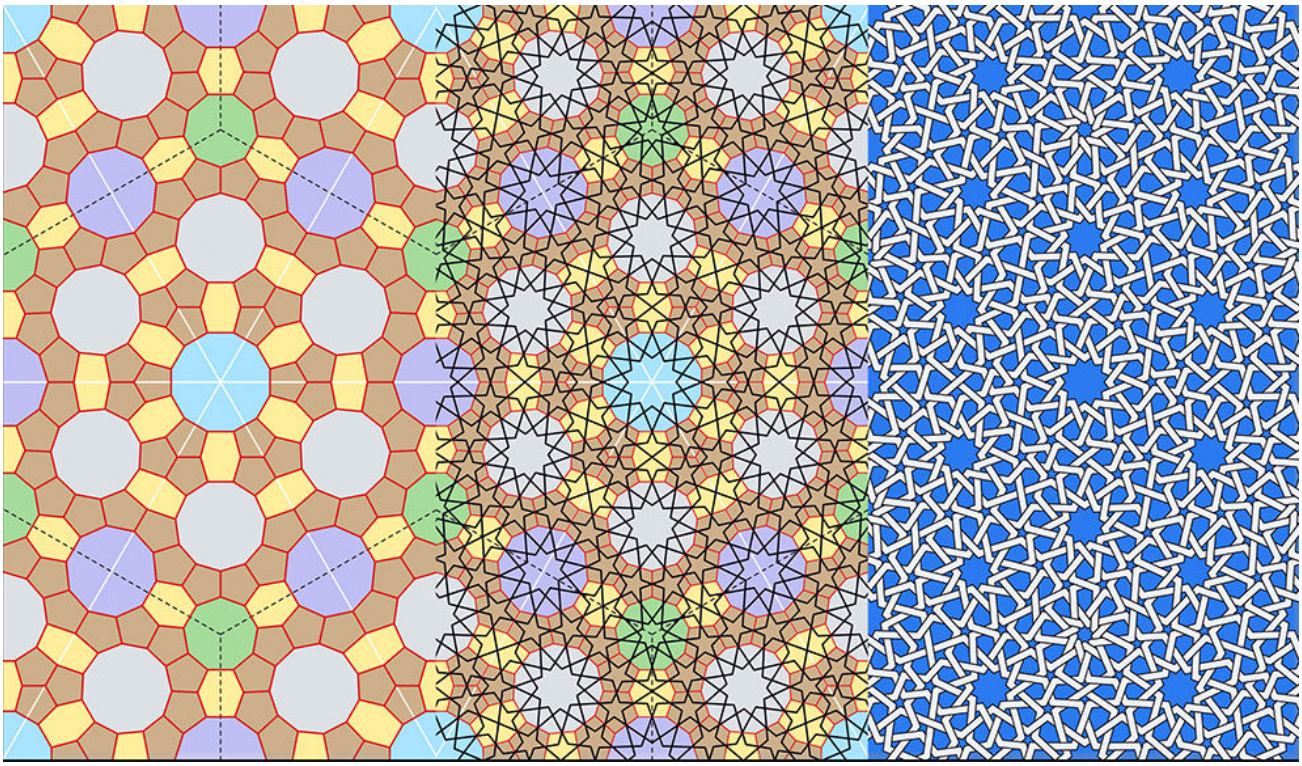


Polygonal grid with 11- and 13-pointed stars and te resulting design.

Here is another particularly nice example where 11 and 13-pointed stars are mixed in one design. On the left you see the polygonal pattern and on the right the eventual design with interweaving strips after the polygonal net has been removed.

Bonner has compiled an encyclopedic survey of the topic. In his chapter 2 he gives classifcation methods, in particular generalities about the polygonal design methodology and in his chapter 3, which is the most extensive one, he gives more details about the latter and the different implementation methods. What is explained here are just general principles, but Bonner describes the practical details of what angles should be allowed to obtain certain effects. Also the techniques that can be applied are more diverse than what I presented here. At some point, a dual level design is proposed in which a coarse grid is considered and in the wide strips a finer grid is used with stars at the intersection of the coarse grid lines. The finer grid is then extended to the whole plane. This gives two steps of what in principle could be a self-similar design. With the coarse structure removed, this has the effect that the design looks unstructured in a puzzling kind of way. The mathematics that one needs are very elementary. Bonner is an artistic designer and not a mathematician. The 17 wallpaper groups are mentioned as a possible classification method, but these are not relevant to understand the proposed construction methods.

In a last short chapter Craig Kaplan gives some details about how the designs can be generated on a computer, but the description is high level, so it requires a skilled programmer to generate the graphical software that would be able to generate the marvellous graphical illustrations of this book. This is a heavy weight book (about 1.750 kg) but oh so beautifully illustrated.



Polygonal grid + pattern lines = combination of 5-, 9-, 10-, 11- and 12-pointed stars.
This is just one of the hundreds of wonderful illustrations from Bonner's book.

Adhemar Bultheel