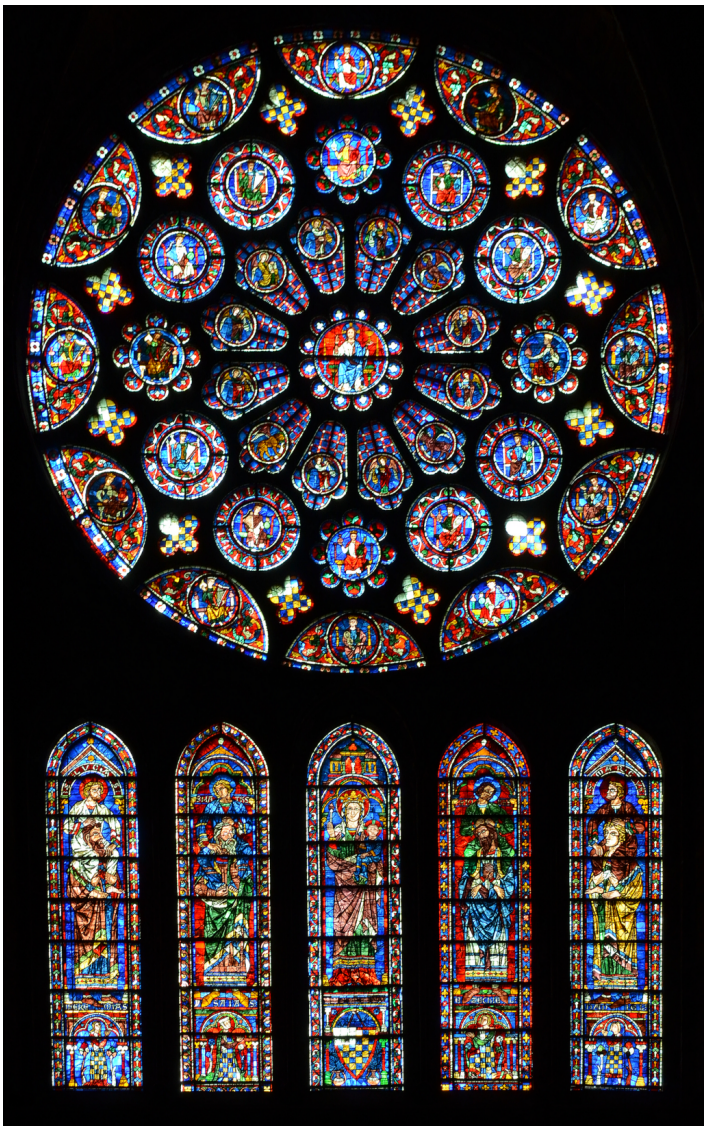
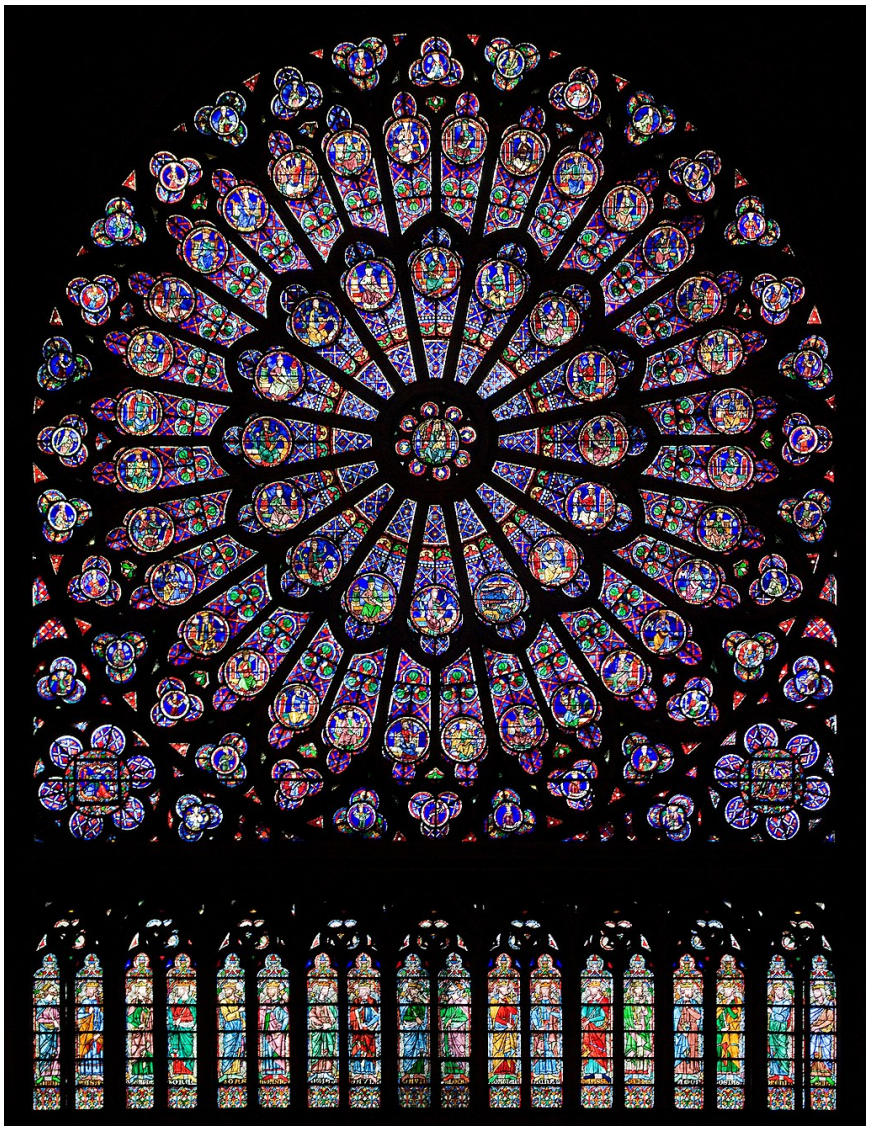
UGED 1533

Planar Patterns

Rose window, Chartres Cathedral (Chartres France)

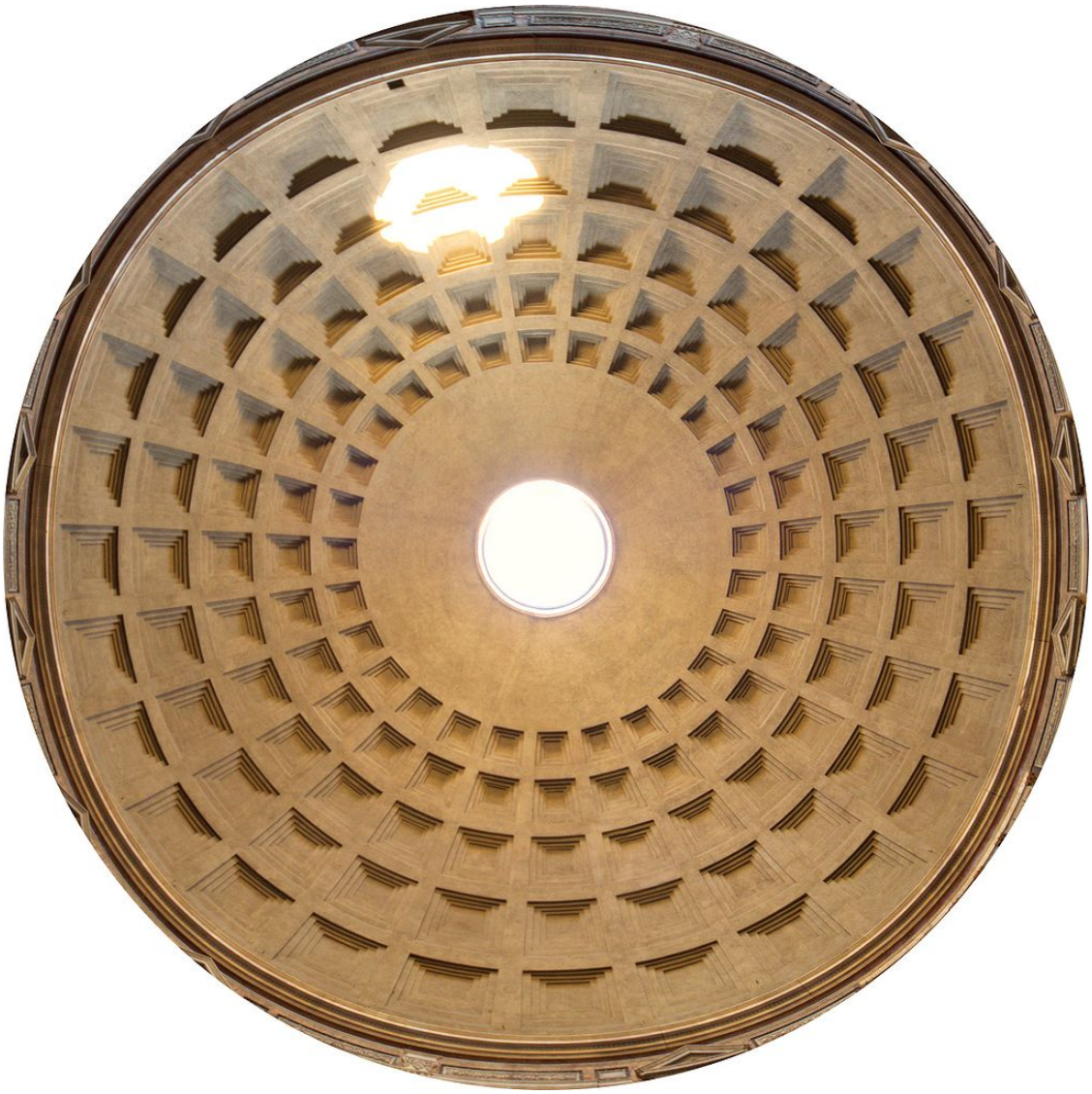


Rose window, Notre Dame Cathedral (Paris, France)



Pantheon (Rome, Italy)


DOMINVM IN SANCTIS EIVS
LAVS EIVS IN ECCL



Finite Designs

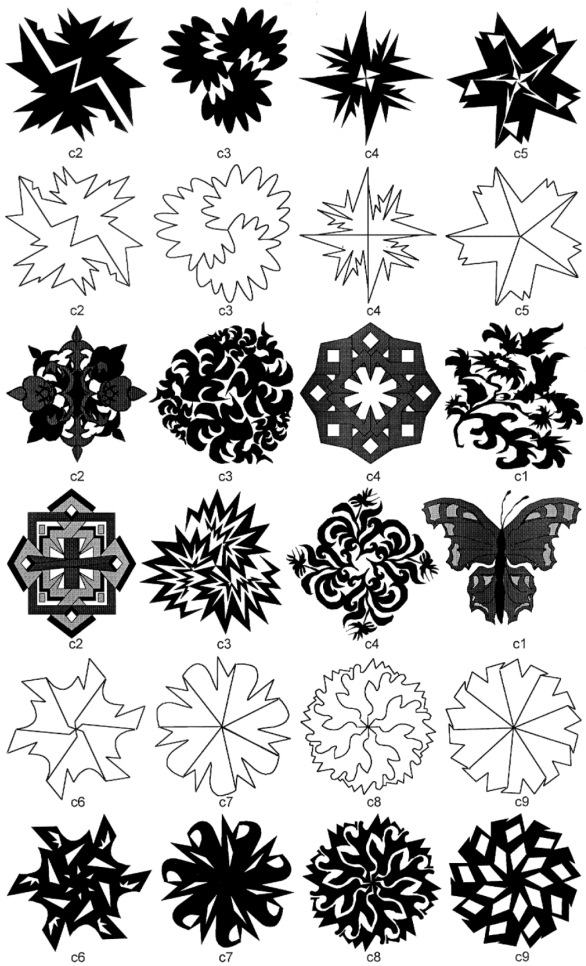


Figure 2.3 Illustrations of finite designs, symmetry group *cn*.

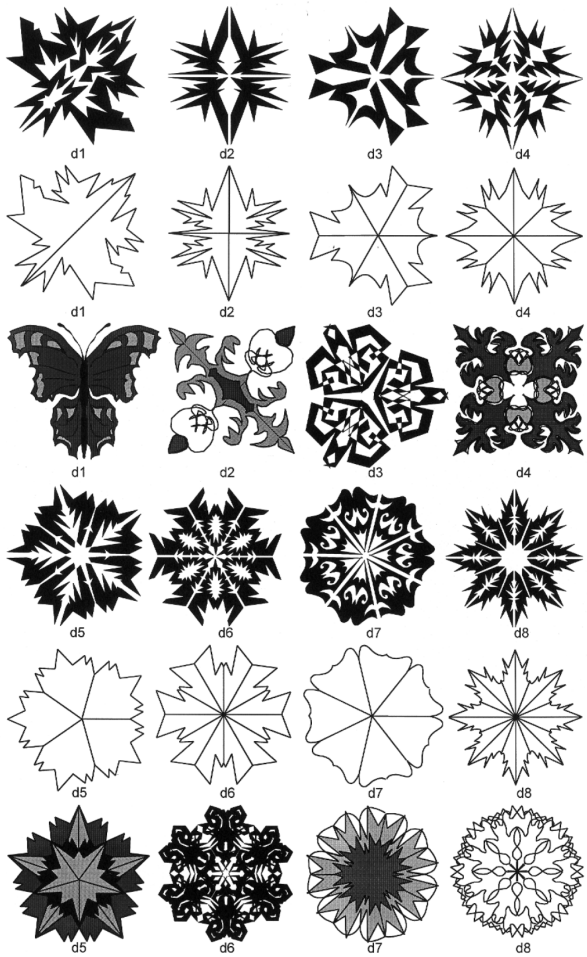


Figure 2.4 Illustrations of finite designs, symmetry group *dn*.

Geometric Symmetry in Patterns and Tilings, Clare Horne.

Dihedral Group D_n

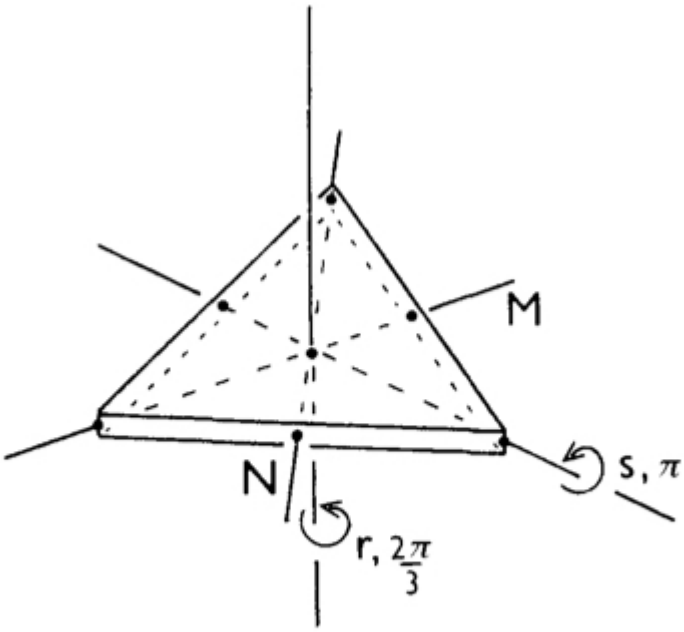


Figure 4.1

Groups and Symmetry, M. A. Armstrong

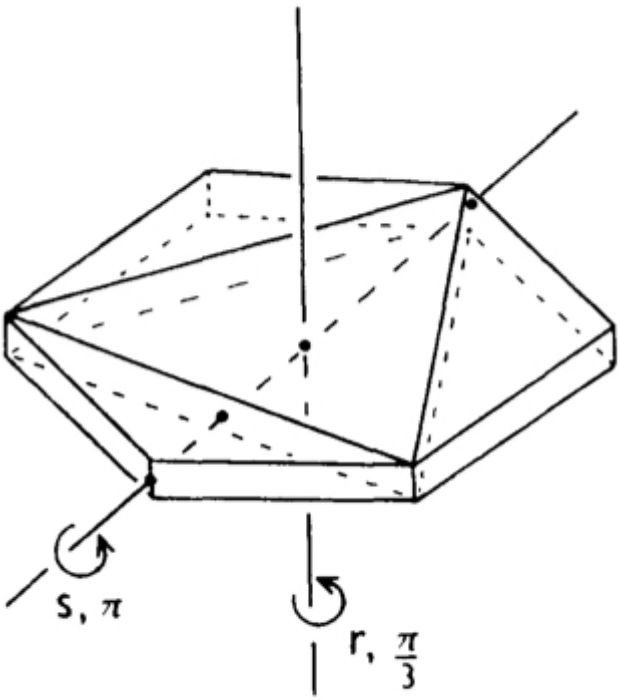
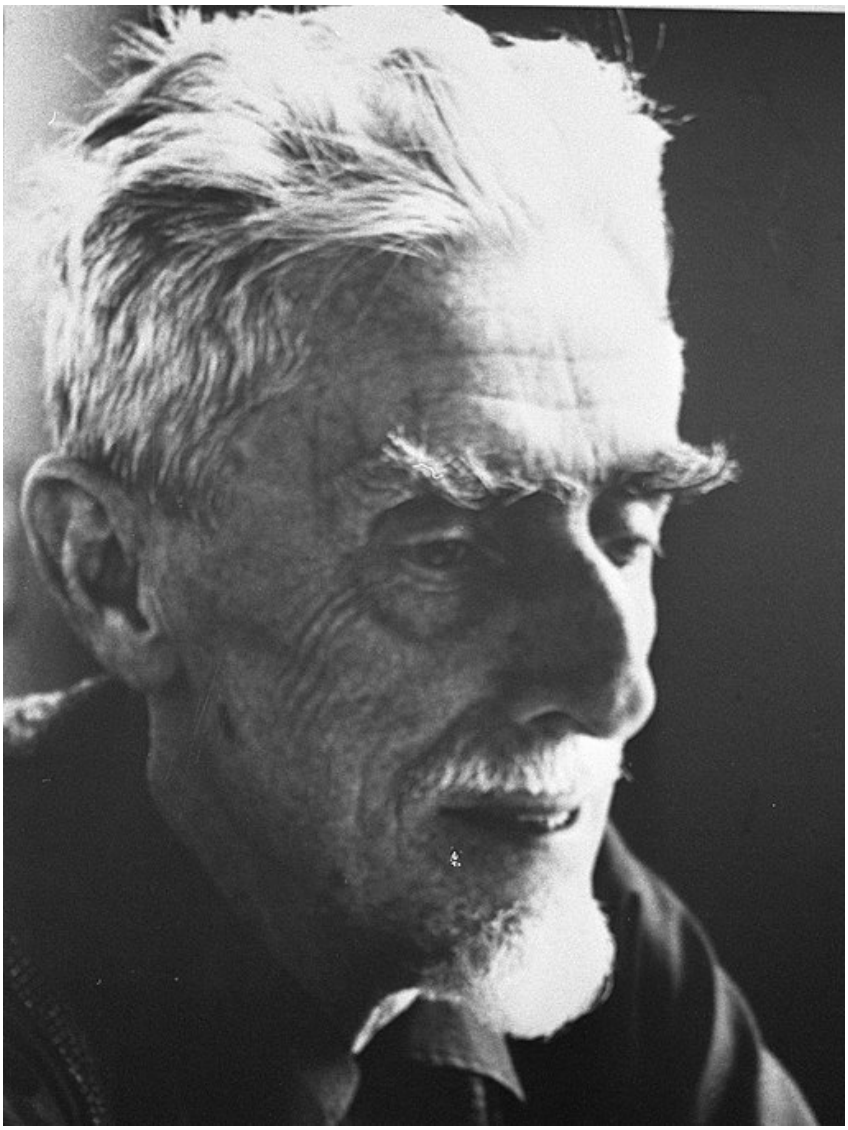


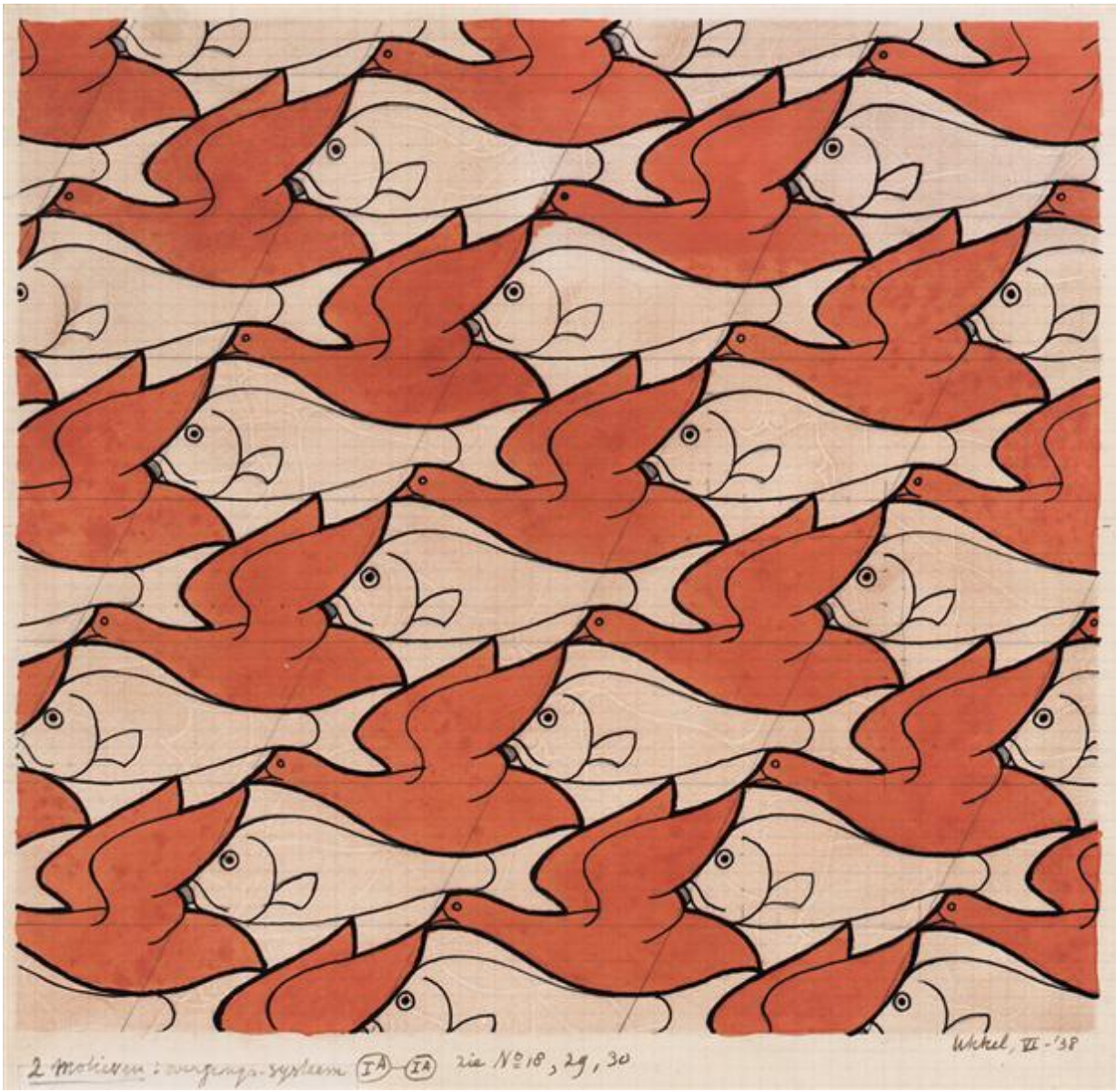
Figure 5.1

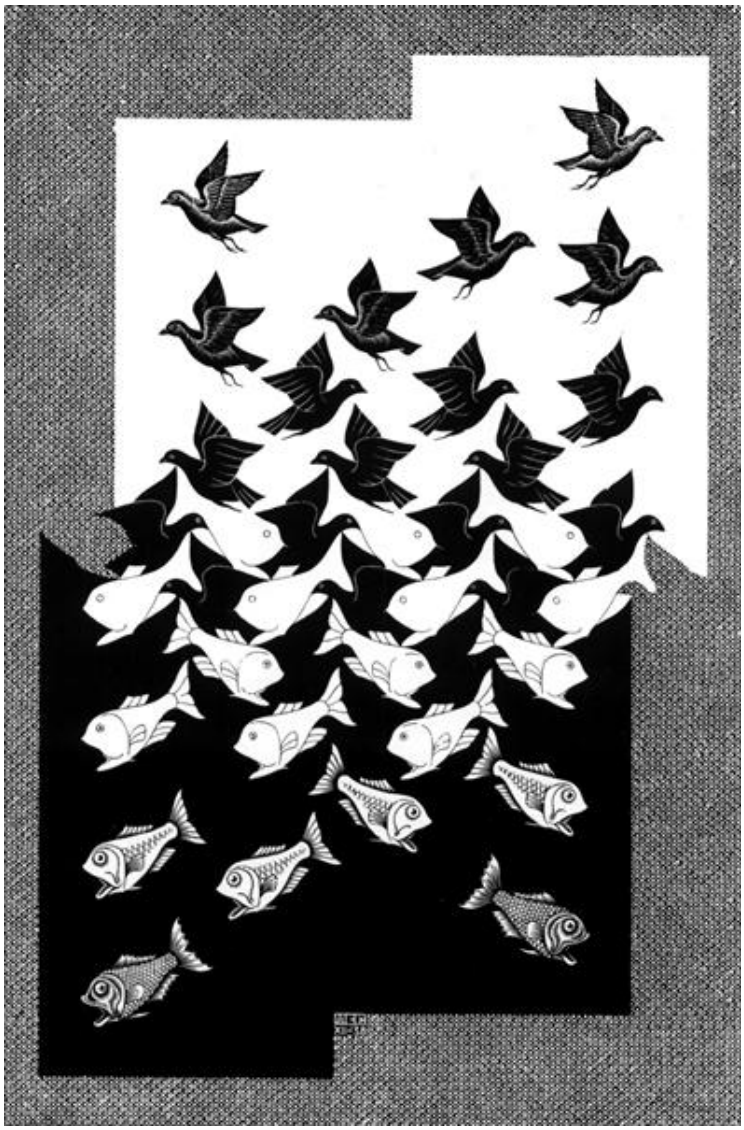
Groups and Symmetry, M. A. Armstrong

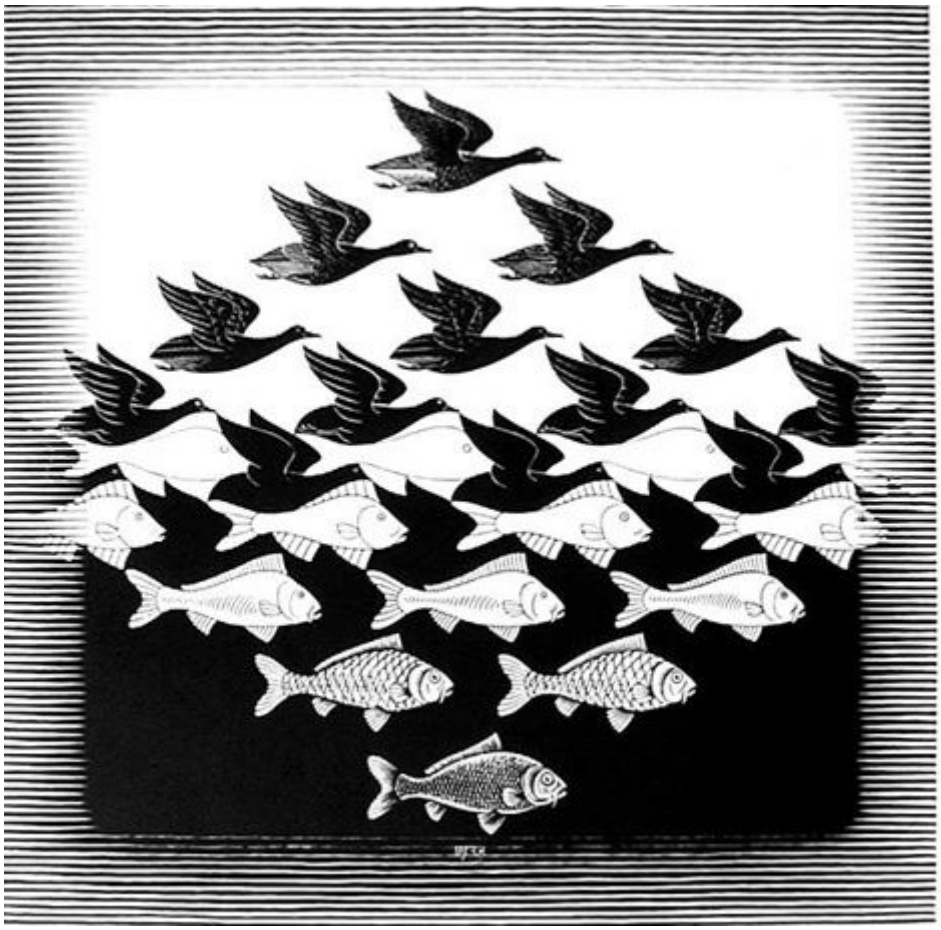
M. C. Escher (Dutch 1898 -1972)

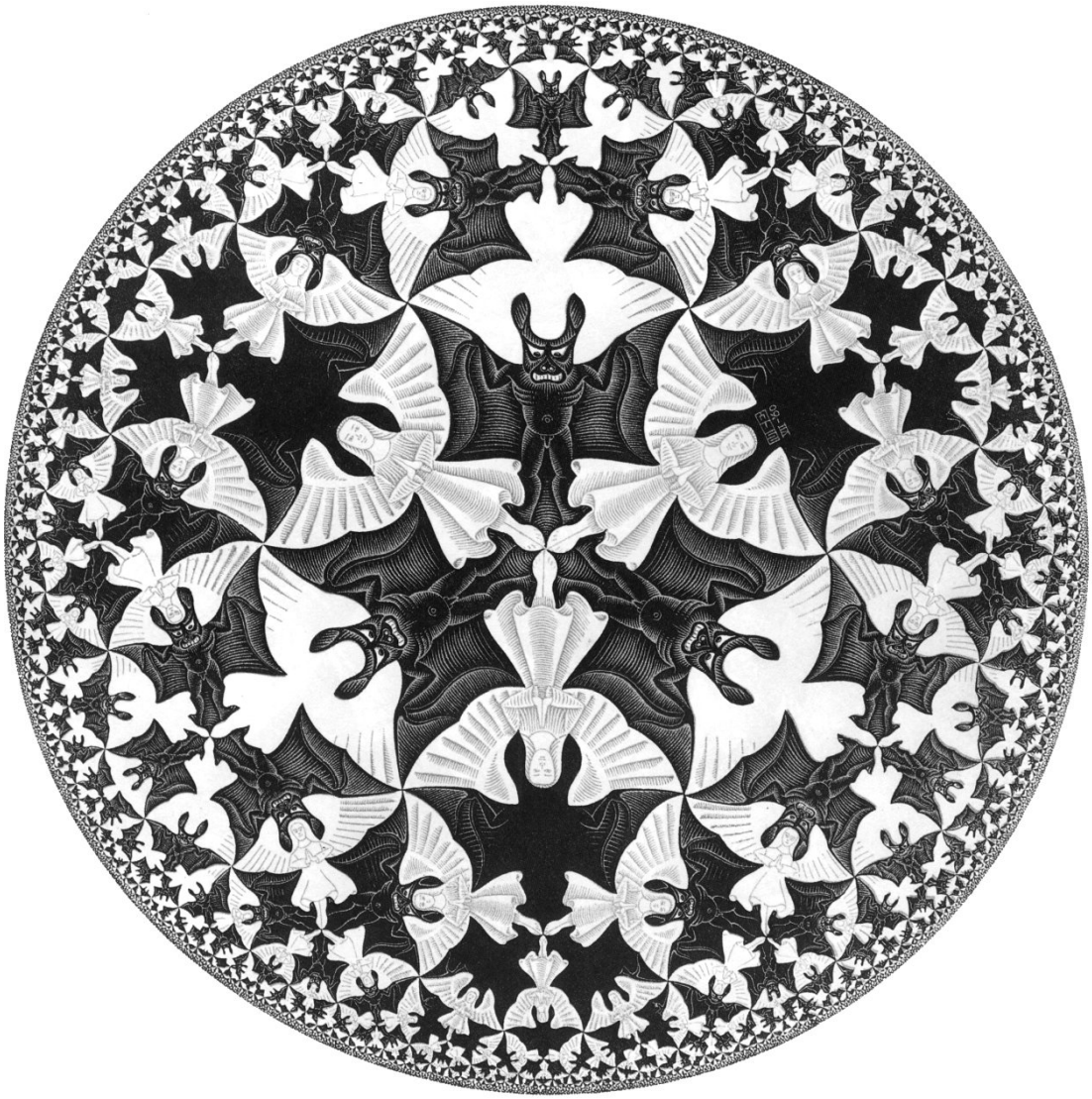



Uhkel, II-'38
2-motieven: overgangs-systeem IA IA zie № 22, 29, '30


2 motieven : overgangs-systeem (IA)-(IA) zie N° 18, 29, 30
Wikkel, VI-'38

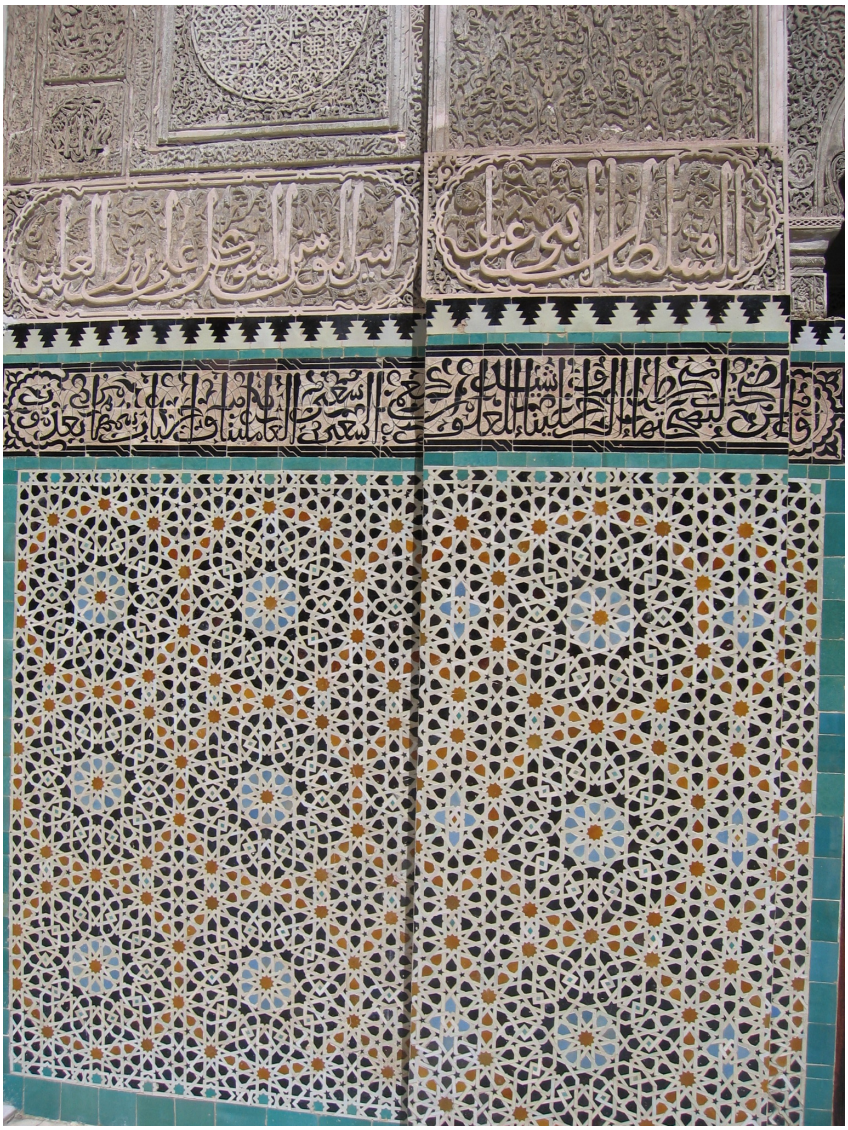


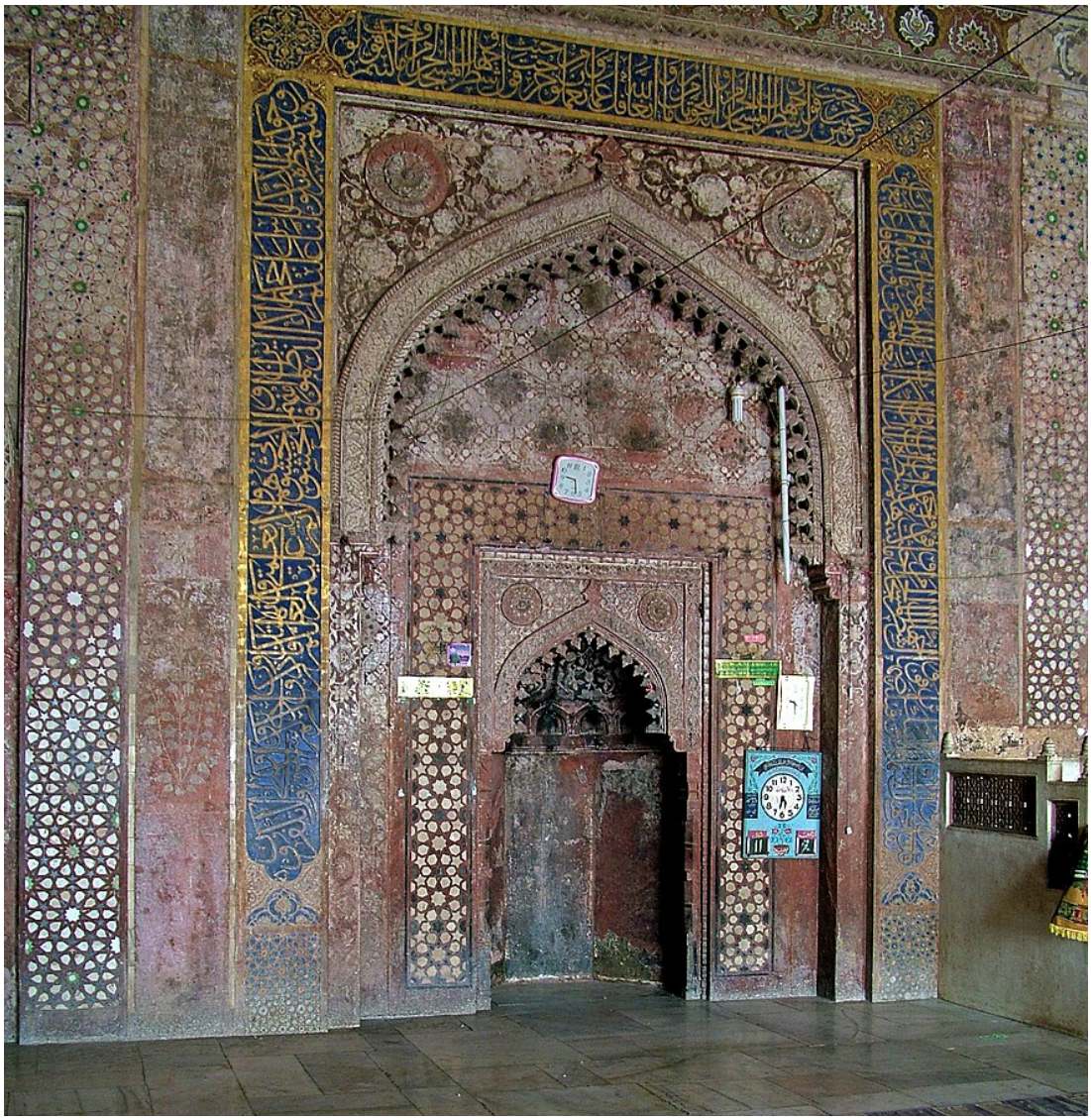




Alhambra

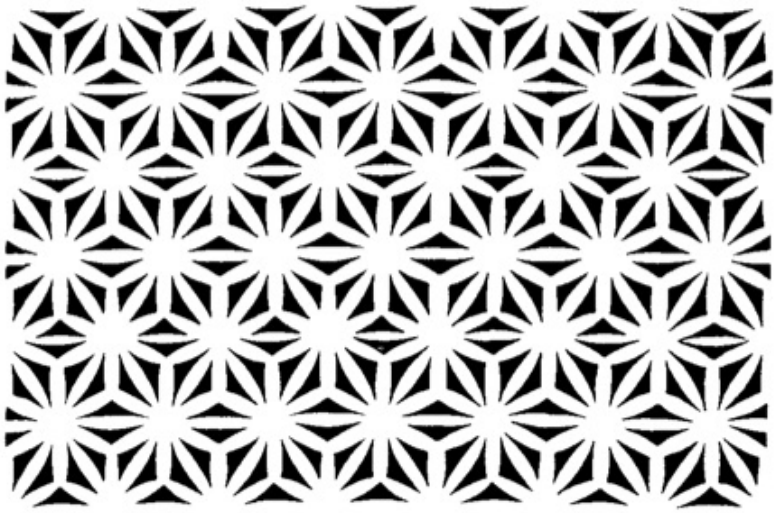
Islamic Art

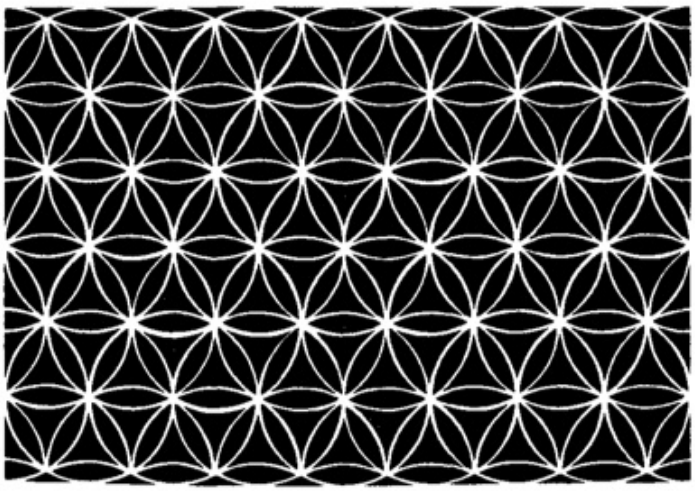




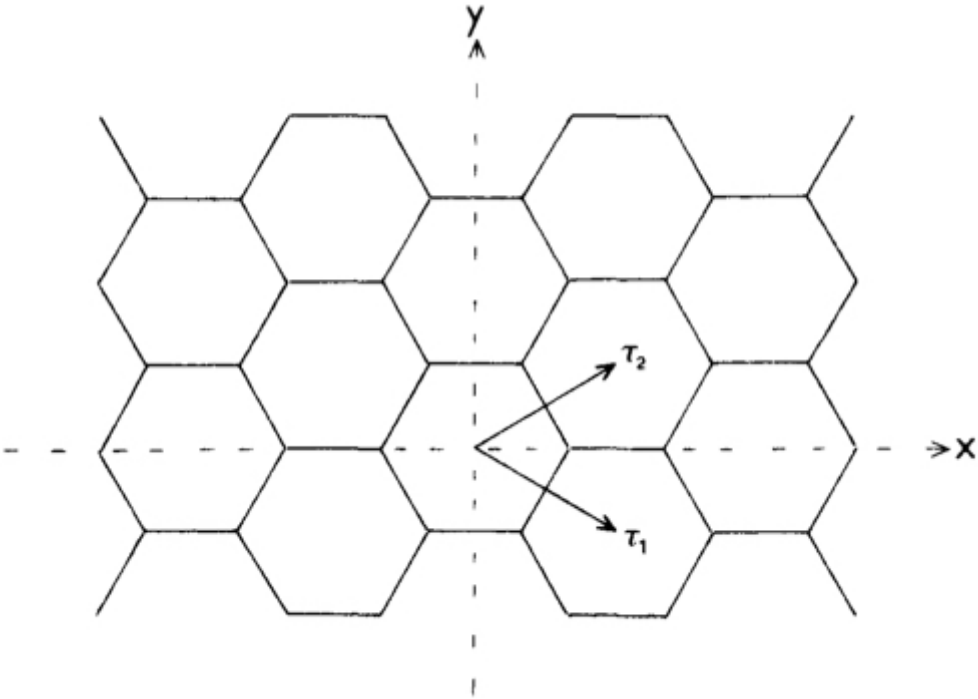
Jean-Léon Gérôme (French, 1824 - 1904)


AL. GEROME.

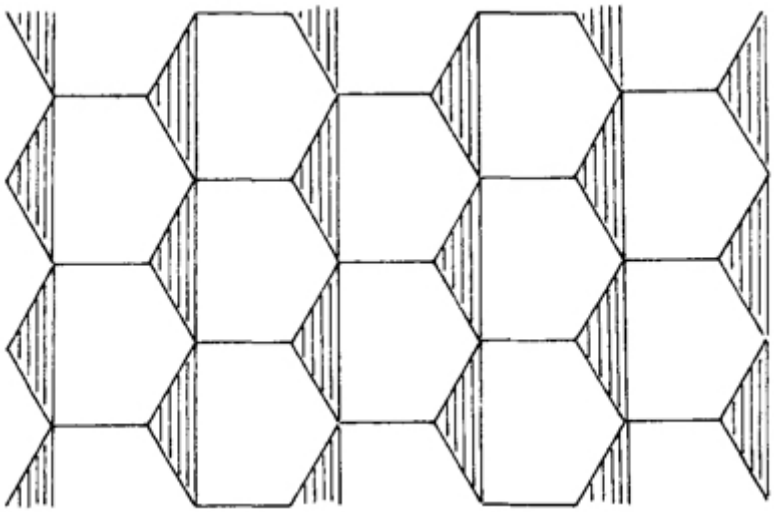




Groups and Symmetry, M. A. Armstrong



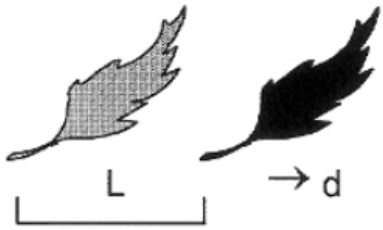
Groups and Symmetry, M. A. Armstrong



Groups and Symmetry, M. A. Armstrong

A *symmetry* of a wallpaper pattern is a transformation which leaves the pattern unchanged. Such a transformation can be one of the following:

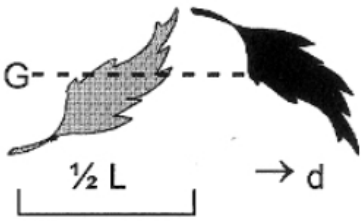
- translation (**shift**)



- rotation (**turn**)

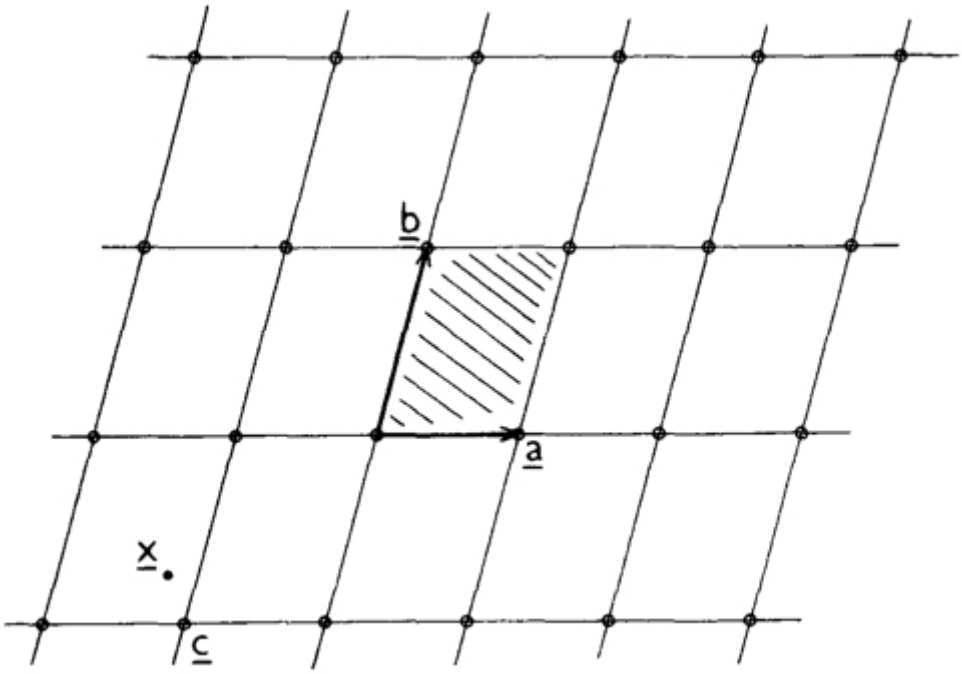
- reflection (**flip**)

- glide reflection



(Illustration from *Geometric Symmetry in Patterns and Tilings*, Clare Horne.)

We will work with wallpaper patterns which have two shift symmetries. Any such wallpaper is associated with an underlying *lattice*, which is obtained by applying the shift symmetries repeatedly to a fixed point (the origin) in the pattern.



Groups and Symmetry, M. A. Armstrong

There are five types of lattices generated this way:

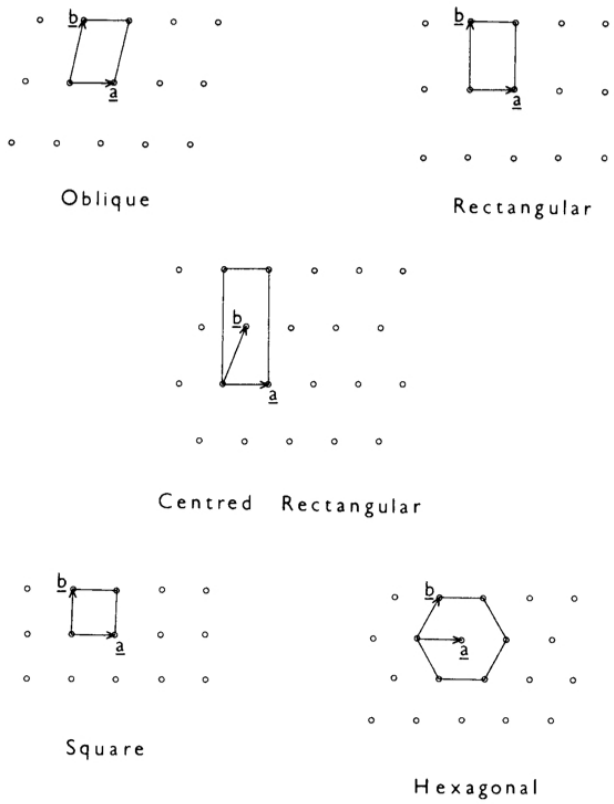


Figure 25.5

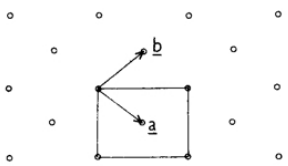


Figure 25.6

Groups and Symmetry, M. A. Armstrong

Note that a rotational (turn) symmetry of a wallpaper pattern may correspond to a rotation (clockwise or anticlockwise) by 60, 90, 120 or 180 degrees only.

There is no rotational symmetry which corresponds to a rotation by, say, 72 degrees.

The set of shift, turn, flip and glide reflection symmetries of a wallpaper pattern form its **wallpaper group**. There are exactly 17 possible wallpaper groups.

They are enumerated by a combination of letters and integers. For example:

$$p6m, p4g, cm$$

- "p" stands for a **primitive lattice**, namely a lattice made up of cells with no lattice points in their interiors.
- "c" stands for a **centred lattice**, namely a lattice each of whose building block is a non-primitive cell plus a centered interior lattice point (Centred Rectangular).
- "m" stands for reflection (m for **mirror**).
- "g" stands for **glide reflection**.

- "1" stands for the identity transformation (i.e. do nothing).
- Each of "$2, 3, 4, 6$" stands for a rotation of the corresponding order.

A pattern is encoded in 4 characters "$x_1x_2x_3x_4$" as follows:

- x_1 is either p or c, depending on the lattice structure.
- x_2 is one of $1, 2, 3, 4, 6$, depending on the type of rotational symmetry. (1 stands for no rotational symmetry.)
- x_3 is one of 1, m, or g, depending on whether there is mirror or glide symmetry with respect to the "main" translation axis.
  (We choose the "main" axis to be any one of the two translational axes which has a mirror perpendicular to it. If none of the two axes has a mirror perpendicular to it, then either one may be chosen to be the main one.)
- x_4 is one of 1, m, or g, depending on whether there is mirror or glide symmetry with respect to some other axis besides the main one.

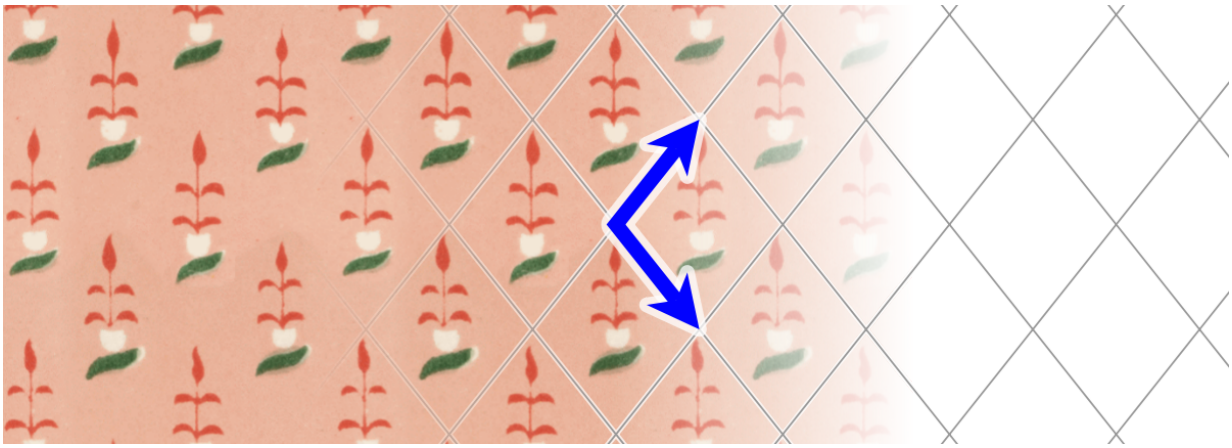
The following table serves as a useful guide in identifying the wallpaper group of a given wallpaper pattern:

[Guide to recognizing wallpaper groups (Wikipedia).]

Click to Load.

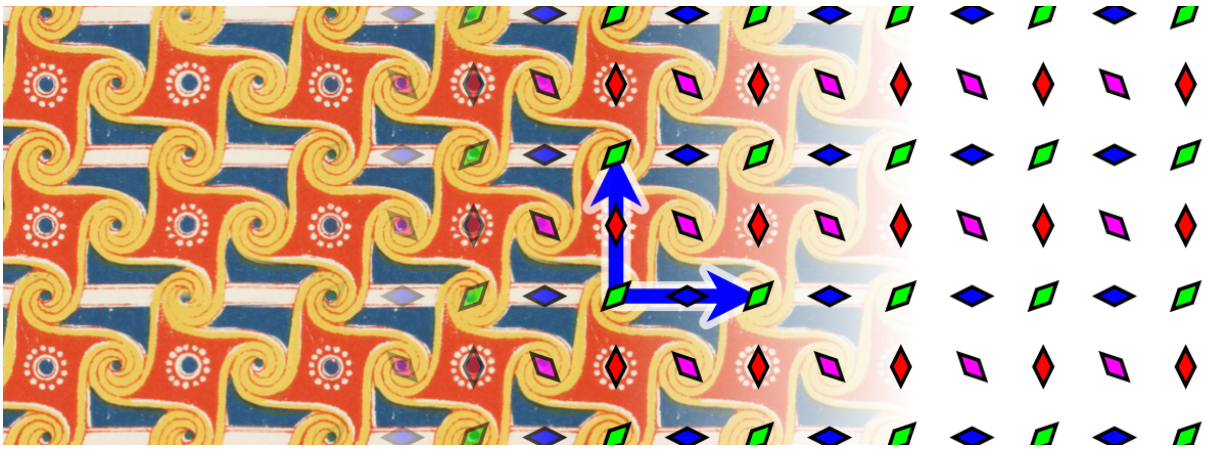
Examples

(from http://www.morenaments.de)



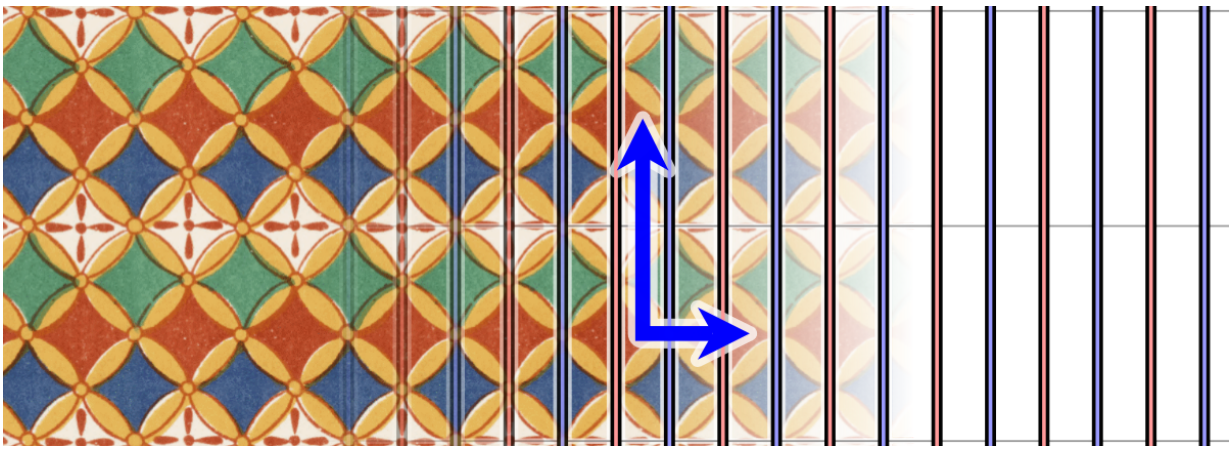
By Martin von Gagern

$p1$



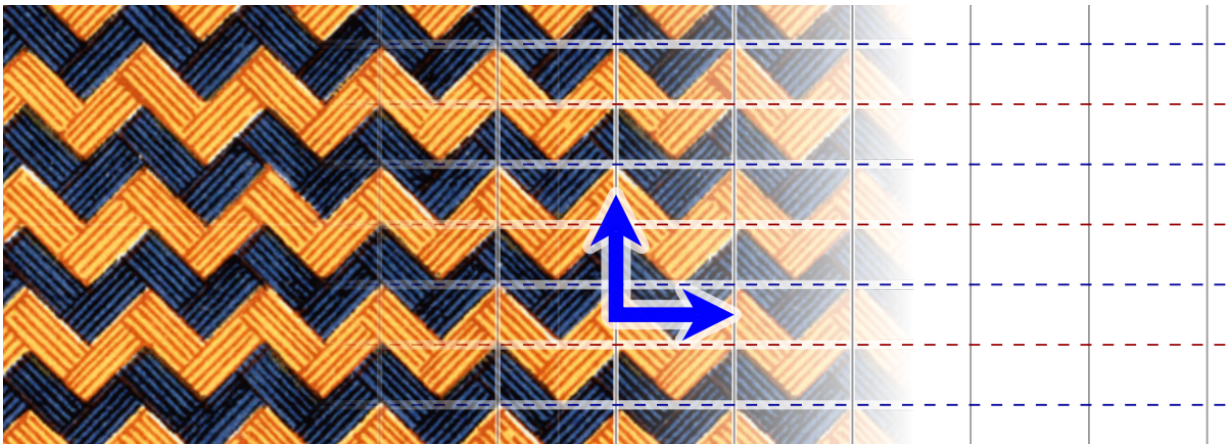
By Martin von Gagern

$p2$



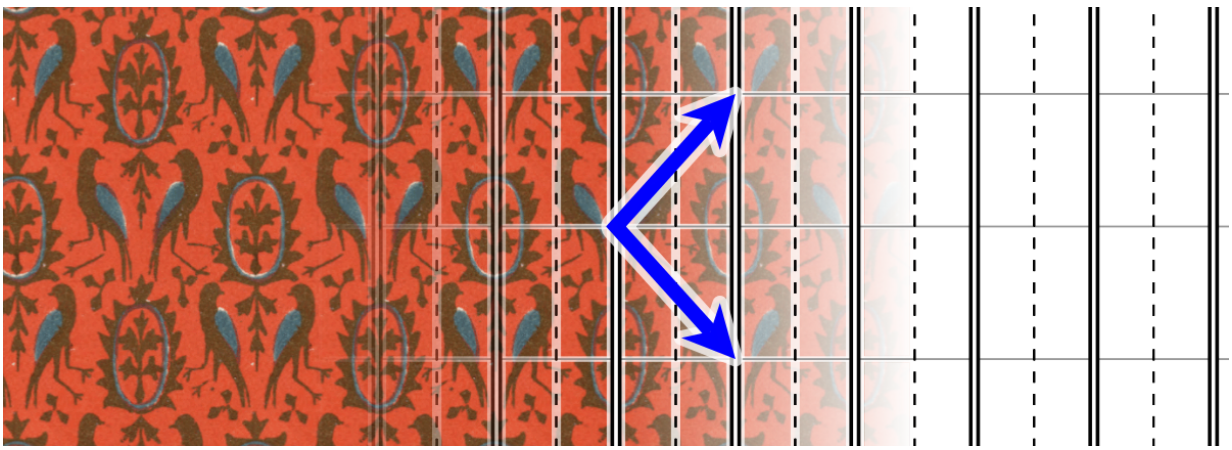
By Martin von Gagern

pm



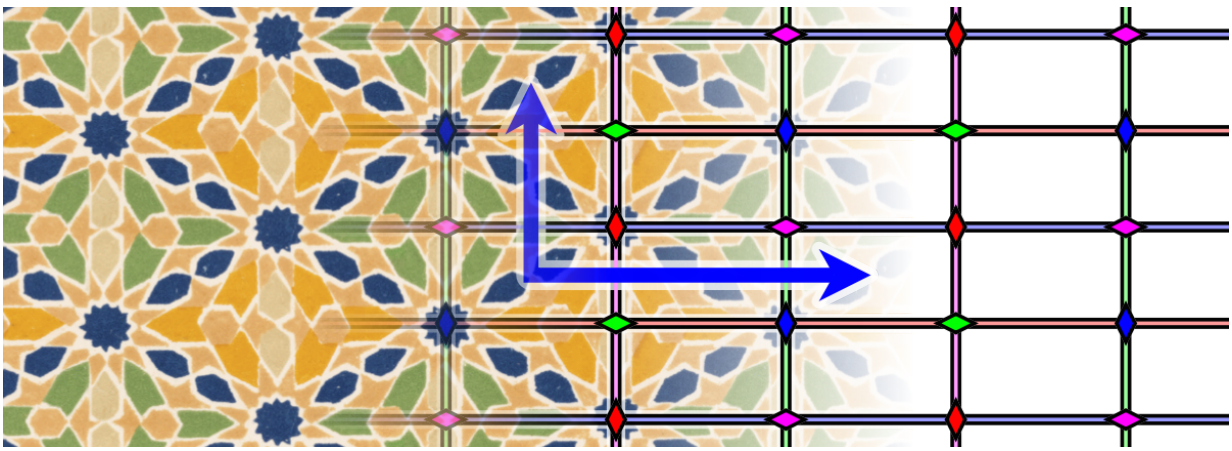
By Martin von Gagern

pg



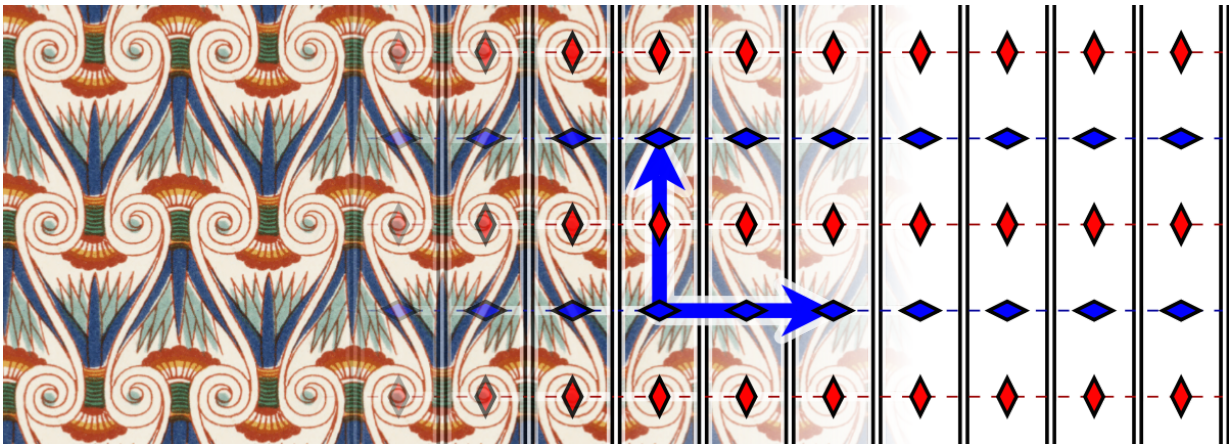
By Martin von Gagern

cm



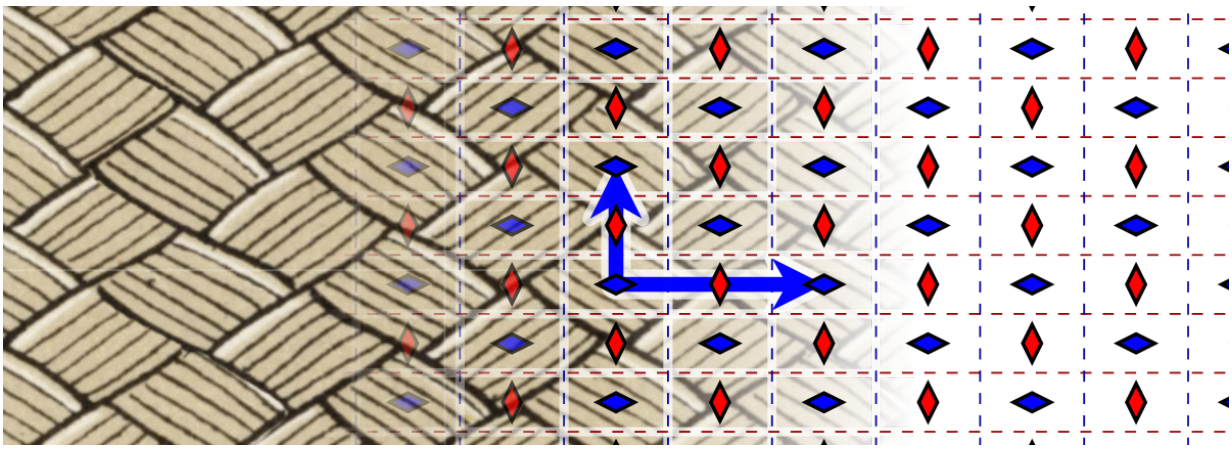
By Martin von Gagern

pmm



By Martin von Gagern

pmg



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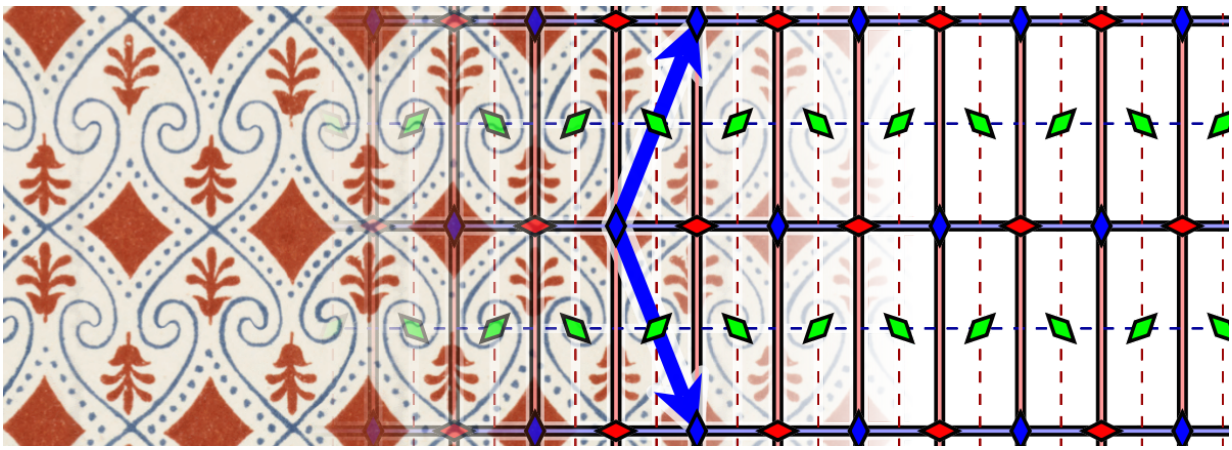
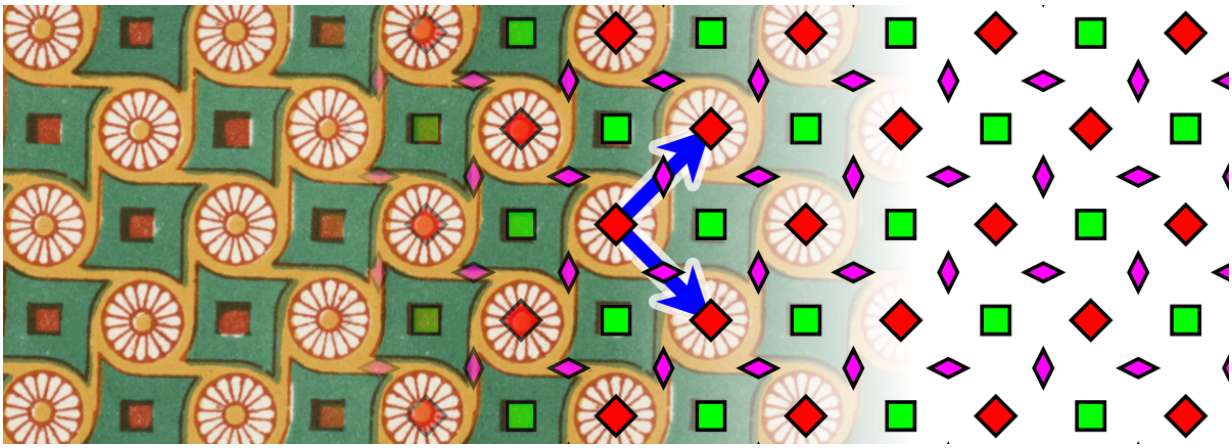
pgg



By Martin von Gagern

cmm



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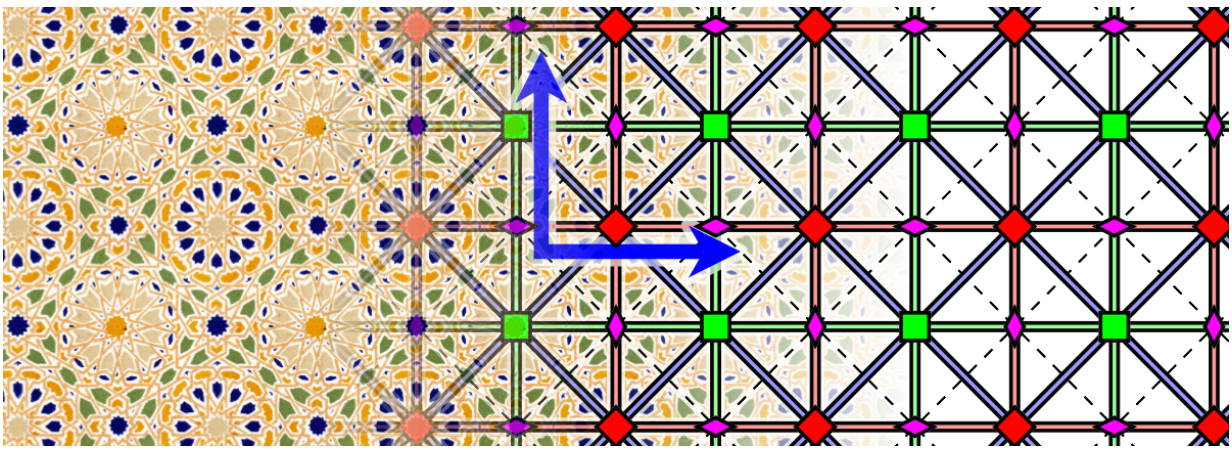
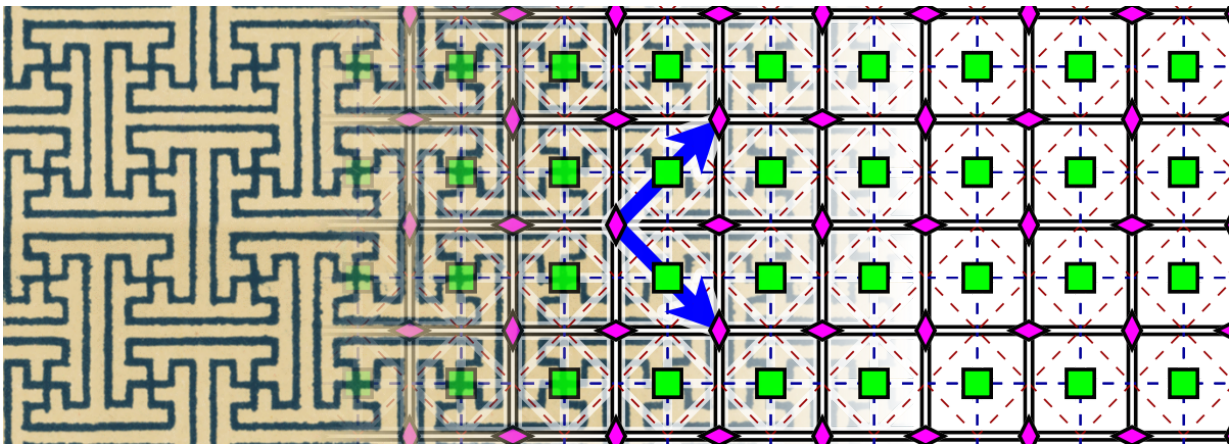
$p4$



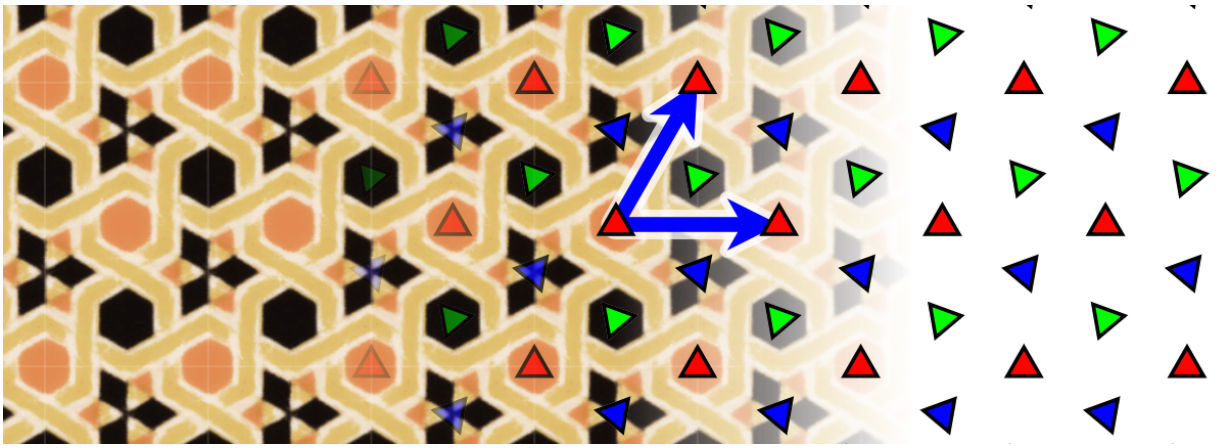
By Martin von Gagern

$p4m$



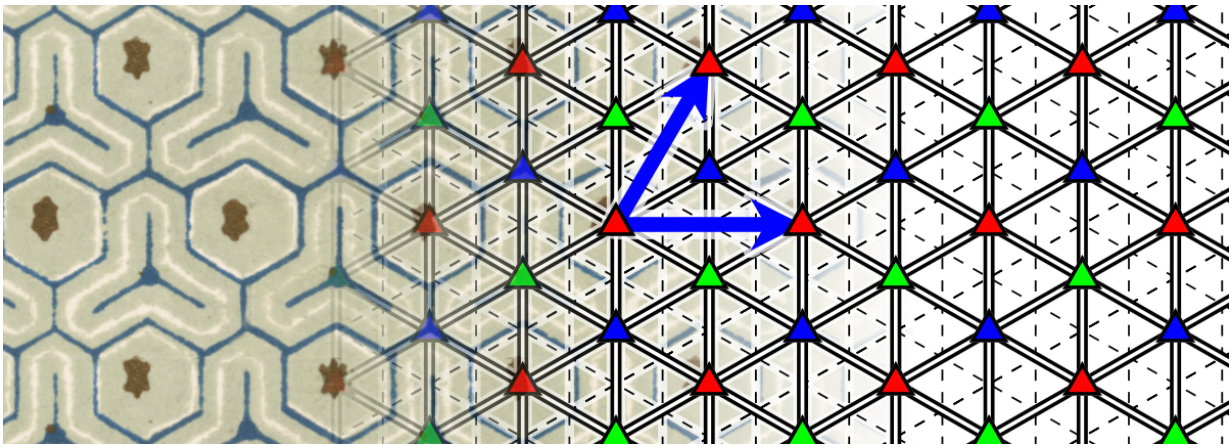
By Martin von Gagern

$p4g$



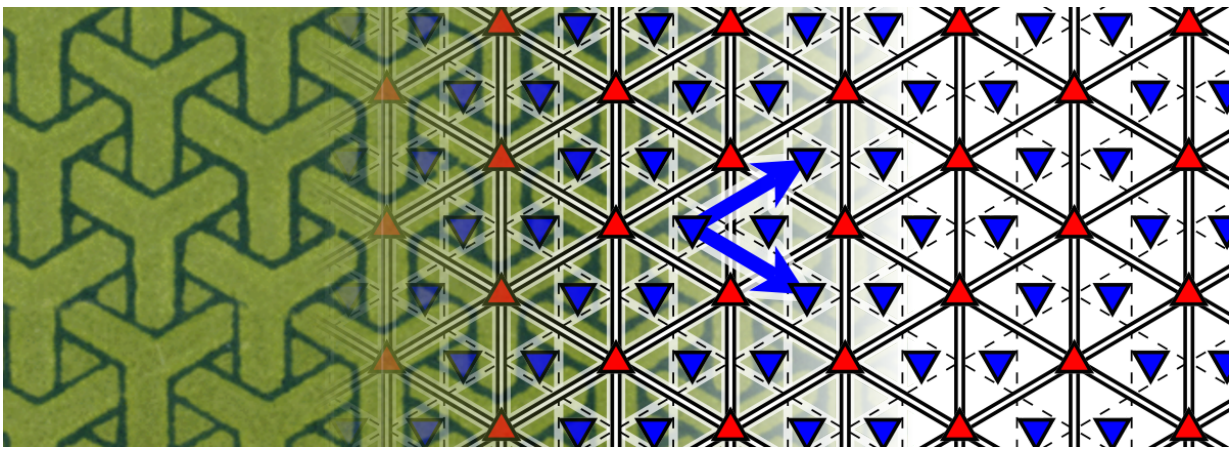
By Martin von Gagern

$p3$



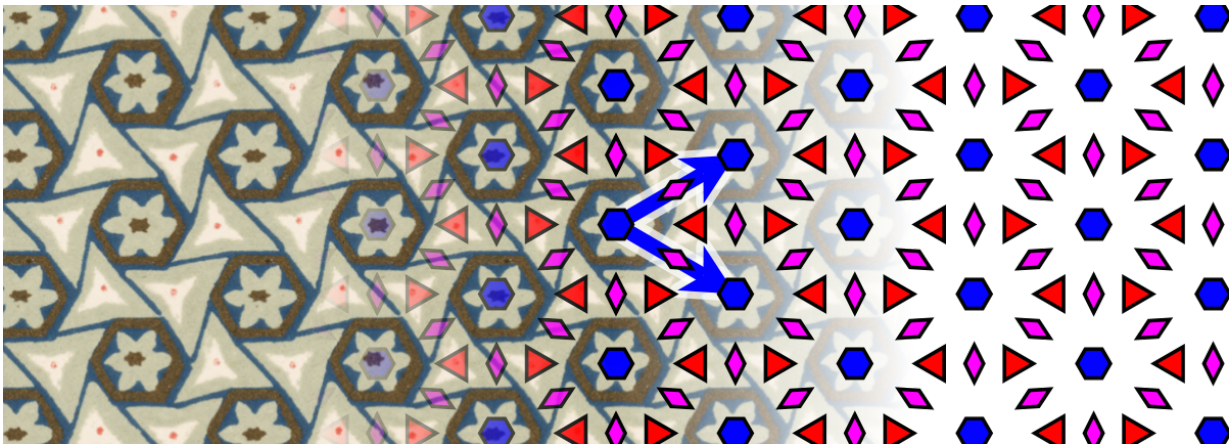
By Martin von Gagern

$p3m1$



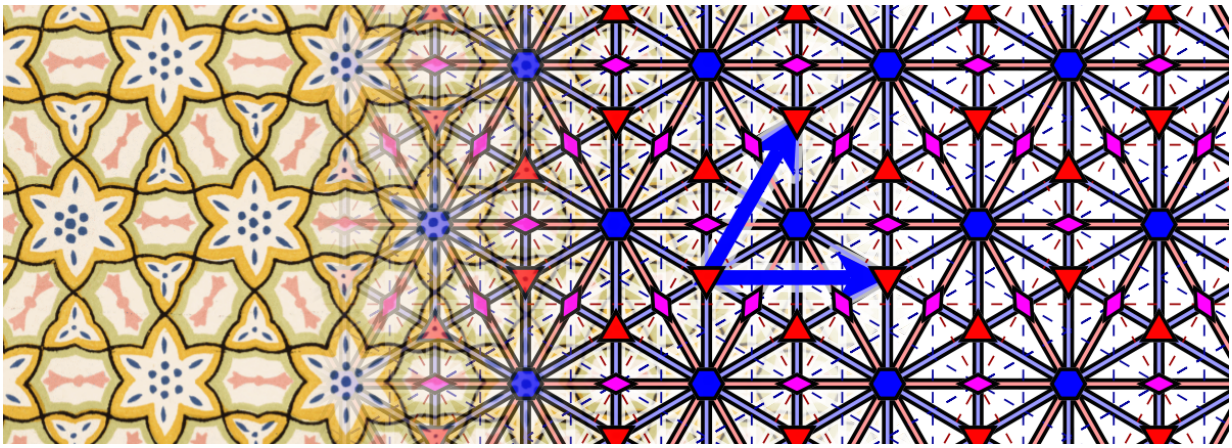
By Martin von Gagern

$p31m$



By Martin von Gagern

$p6$



By Martin von Gagern

$p6m$


来一笼
规格：52cm