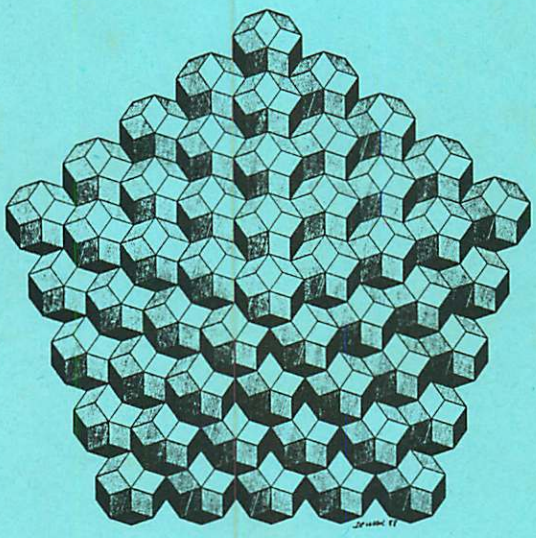
Symmetry of STRUCTURE

an interdisciplinary Symposium

Abstracts

I.



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DYNAMIC SYMMETRY: FILMS

by Michele Emmer

«.....A succession of gradually changing figures can result in the creation of a story in pictures. In a similar way the artists of the Middle Ages depicted the lives of Saints in a series of static tableaux.....The observer was espected to view each stage in sequence. The series of static representations acquired a *dynamic* character by reason of the space of time needed to follow the whole story. Cinematic projection provides a contrast with this. Images appear, one after the other, on a still screen and the eye of the observer remains fixed and unmoving. Both in the medieval pictorial story and in the developing of a regular division of the plane the images are side by side and the time factor is shifted to the movement the observer's eye makes in following the sequence from picture to picture. It is possible to look at a film strip in the same way when it is held in the hand.»

These are words from Escher's book "The Regular Division of the Plane" [1]. It is well-known the interest of the Dutch graphic artist in the creation of figures that tassellate the entire plane and his attraction for mathematical forms. In the same book, a sort of theory on his own way of working, he claims [2]:

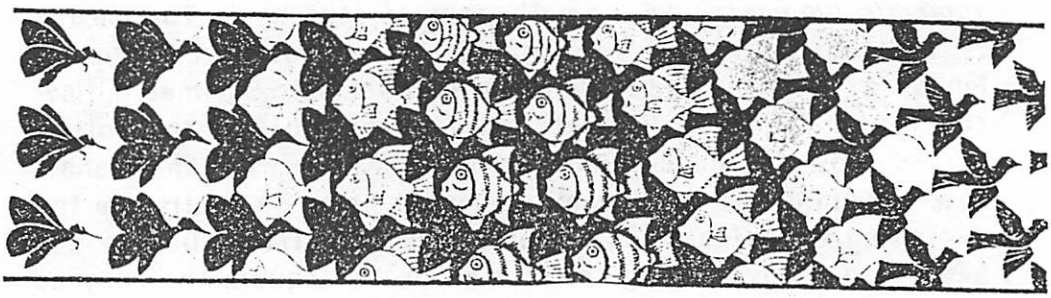
« In this book it is the images and not the words that come first.....For me it remains an open question whether the play of white and black figures as shown in the six woodcuts of this book pertains to the realm of mathematics or that of art.»

All the various aspects of the art of Escher were discussed at the Congress held at the University of Rome in 1985 [3]. In my introduction to the special issue dedicated to Escher by the journal *Structural Topology* I wrote that [4] : « the congress and the volume of the Proceedings cannot be considered in any case a final event but more correctly a starting point.»

But let go back to the Escher's words. In the creation of his symmetry figures a very important element was what Escher called « the dynamic equilibrium between the motifs» . In his book he asks the crucial question : « Is it possible to create a picture of recognizable figures without a background ?» and the answer is no .« Composition do not have a visual static balance but a dynamic one;.....a static balance is possible only if the whole figures seen as a pattern, separate from the representation of birds and fish.» As he pointed out, the fish and birds motifs were among the most useful for resolving the problem of creating interlocking patterns with easily recognizable objects.

The idea of create a dynamic symmetry patterns is a very old one.[5] As an example I can recall the following: « In the autumn of 1917, Jay Hambidge was giving a series of talks on *Dynamic Symmetry* to a small group of students.» The phrase is written in the foreword of a little volume by Edwards B. Edwards "Patterns and the design with Dynamic Symmetry: How to create Art Deco Geometrical Designs" [6]. In the introduction Edwards adds : « This book has been written to show how the principles of dynamic symmetry may be applied to the designing of pattern. The name Dynamarhythmic Design has been coined advisely by the writer to distinguish the subject from the term Dynamic symmetry, used by Mr. Hambidge..... In Dynamarhythmic design, not only are the forms related harmoniously, but the areas are related as well. Within these areas the artists may use such forms, natural or otherwise, as his caprice or fancy may dictate, providing that he keeps in mind the proportional relationships.... or, in other words, the parts consistently to the whole. »

Coming back to Escher, he wrote as a description of his work "Metamorphosis II": «First the black insect silhouettes join; at the moment when they touch, their white background has become the shape of a fish. Then figures and background change places and white fish can be seen swimming against a black background. A succession of figures with a number of metamorphoses acquires a dynamic character. Above I pointed out the difference between a series of cinematographic images projected on a screen and the series of figures in the regular division of plane. Although in the latter the figures are shown all at once, side by side, in both cases *the time factor* plays a part.»



Escher, before his death in 1972, partecipate to the making of a short movie in which drawings animation technique was used for two of his works. After his death his works on symmetrically repeating figures have been a source of inspiration for computer graphics animation.[7] As I pointed out elsewhere, in the making of the film series "Art and Mathematics" [8] I was attracted by the cinematographic quality of most of the Escher's works. If we use Escher's images in regard to the figure-background problem and the cinema technique, especially animation, it is possible to SEE the instant in which the instability is created, the passing

from one form to another. And this is only an example of the various possibilities in using a camera with the symmetry drawings of Escher [9]. But of course in making a film, you always reach something new: the images flow quickly by, they are in real movement, not just side by side. In a sense we have teaken Escher's suggestions and extended them: a world of symmetry according to Escher, which moves and changes in the three dimensional space.

I have used the camera not only for the symmetry drawings of Escher but also to show various dynamic aspects of symmetry in three of the films in the series, including the famous mosaics of the Alhambra in Granada. With Roger Penrose we made an animation of his non periodic tiling of the plane with two birds.[10]

Looking at all these really dynamic symmetry images it is possible to quote from Escher's phrase: In these films, it is the images and not the words that come first.

REFERENCES

[1] M.C.Escher, *Regelmatige Vlakverdeling*, De Roos Foundation, Utrecht, 1958, reprinted in J.L. Locher (ed.), *La Vie et l'Oeuvre de M.C. Escher*, Chêne, Paris, 1981.

[2] M.C.Escher, p. 155.

[3] H.S.M. Coxeter, M. Emmer, R. Penrose, M. Teuber, (eds.), *M.C. Escher: Art and Science*, North-Holland, Amsterdam, 1986[1],1987[2],1988[3].

[4] M. Emmer, *Introduction*, special issue of Structural Topology on M. C. Escher, with papers by Coxeter, Schattschneider, Senechal and Shephard, vol. 15 (1988), p. 5-8. In volume 17 will appear papers by Dress, Emmer and Penrose.

[5] See for example M.L. Teuber, *Perceptual Theory and Ambiguity in the Work of M.C. Escher against the Background of 20th Century Art*, in [3], p. 159-178.

[6] E.B. Edwards, *Pattern and Design with Dynamic Symmetry: How to Create Art Deco Geometrical Designs*, The Century Company,1932; reprinted by Dover Publ. Inc., New York, 1967. See also J. Hambidge, *The Elements of Dynamic Symmetry*, reprinted by Dover.

[7] N. Greene, *Animating Escher with Computer Graphics*, in [3], p. 263-268. See in particular the movie *Symmetry Test IIA* by Paul Allen Newell.

[8] M. Emmer, *Movies on M.C. Escher and their Mathematical Appeal*, in [3], p. 249-262.

[9] M. Emmer, *M.C. Escher: Symmetry and Space*, movie in the series *Art and Mathematics*, 16 mm., 27 minutes, Film 7, Rome, 1983.
M. Emmer, *M.C. Escher: Geometries and Impossible Worlds*, movie in the series *Art and Mathematics*, 16 mm., 27 minutes, Film 7, Rome, 1985.

[10] M. Emmer, *Symmetry and Tessellations*, movie in the series *Art and Mathematics*, 16 mm., 27 minutes, Film 7, Rome, 1980.