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Crystallographic patterns in nature and Turkish art

Hacali Necefoglu *

Department of Chemistry, Kafkas University, Dereici, 36100 Kars, Turkey

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Abstract

In this paper, crystallographic aspects of ancient, medieval and modern Turkish ornaments are dealt with. Crystallographic patterns (CPs) are considerably different from other patterns. The following are characteristic of CPs: the edge of ornament elements draws the edge of the figure; maximal compactness of the ornament elements; lack of background or transformation of background to ornament elements; minimization of the variety of ornament elements; symmetry is not used for form creation. In the process of the construction of CPs, symmetry appears as a result of combination, not as a means of its formation that is characteristic of other ornaments. Their symmetries are analogous to symmetries of natural objects. The atoms and molecules dispose themselves in crystals just as elements arrange themselves in CPs. In other words, CPs are constructed according to the same principles of crystal formation, i.e. the principle of tight packing. The similarity (isomorphism) of crystals and ornaments enables us to describe the ornaments with structural analysis terms, and the similarity between ornaments and crystal structures can be also used in chemistry education. This will bring an aesthetical aspect to education. An invisible part of nature can be studied as ornament creation. Each newly created CP is the structural scheme of a number of possible compounds. The familiarity with such ornaments and the ability to create them are important for solving compound structures. Similarity of patterns with some crystal structures enables us to reach the following conclusions: mankind may make use of the principles from which nature was created, and he may achieve a resemblance to the creation of nature in ideal; mankind may create nothing whose prototype does not exist in nature.

Keywords: Crystallographic patterns; Symmetry; Tight packing; Turkish ornaments

* Tel./fax: +90-474-212-2706.
E-mail address: alinecef@hotmail.com (H. Necefoglu).

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The famous Dutch painter M. Escher (1898–1972) is one of those who attract a great deal of attention among the most eminent European artists.

Sticking to his own creative principles, M. Escher created a series of interesting art works, some of which are patterns without background, which made most crystallographers interested [1,2].

Art critics have tried to explain that the reason why geometrical patterns were created in the Middle Ages in the places where Islam was dominant is that Islam prohibited the figuring of living things; yet this view may not be strictly true because the advent of geometrical pattern goes back as far as to many years BC.

M. Escher's works draw the crystallographer's attention from the beginning. The exhibitions of these works were held in various congresses. Besides, they began to be used in teaching of crystallography, and the books which study these works in respect of crystallography were published. How can we explain such an interest of crystallographers for M. Escher's creativity?

Crystallographers are scientists who study how solid matters are formed from atoms and molecules. Their aim is to establish correlation between their internal structure and their properties. From the 12th year of the 20th century onwards, crystallographers began to discover the structure of crystals by using X-rays. Atoms and molecules dispose themselves in crystals as M. Escher illustrated. For comparison, see Fig. 1.

This is the projection of the structure of an organic compound. Unlike the pictures M. Escher painted, the atom groups or molecules forming crystal are periodically arranged in three-dimensional space. Inside the crystals, atoms and molecules arrange themselves at the maximum tight as the components of

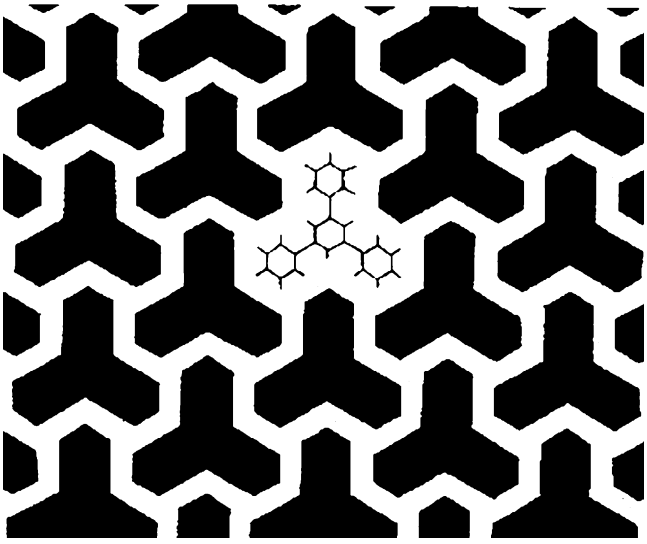

Fig. 1. Crystal structure of 1,3,5-triphenylbenzene.