

MOLECULAR STRUCTURES AND SPATIAL THINKING IN ARCHITECTURE

N.I. Yusifova

*Azerbaijan National Museum of History, Azerbaijan National Academy of Sciences, Baku, Azerbaijan
 narisrafil@mail.ru*

Abstract- The expression of substances and their conversion by means of model conceptions on the level of micro-sphere is the peculiarity of chemical thinking. One obvious methods of such expression is a demonstration of a series of properties of a molecule in the form of its graphic image. These graphics are forms which create plane and volumetric conceptions reminding geometrical figures. Such forms promote the representation of architectural models and designs having a molecular structure with scientific elucidations.

Keywords: Molecular Structure, Cyclohexan, Spatial and Chemical Thinking, Volumetric Conceptions.

I. INTRODUCTION

All perfect architectural edifices as all living forms of the nature have their own law of creation of the form and their structural form. Stone annals of all architectural forms reflecting nowadays the whole scientific portrayal of the epoch since the antiquity are obvious examples of that the professions of an engineer and an architect were created on the basis of the scientific of all scientific spheres and are the places of blending of scientific accomplishments as well [1].

As the human being is a part of the nature, the fruit of his mind should reflect the universe, material reality. In this case the result of intellectual work of the man finds its material manifestation of creative thinking is the repetition of the nature. But creative thinking also reveals new peculiarities, qualities and all of it is natural according to inner laws.

From this point of view the notion of chemical structure should unite in itself the principle of resemblance in various spheres and geometrical structure. In this case geometrical structure creates the opportunity of searching the unity in the sphere of architectural creation and stereochemical structure [2].

We come across term "stereo-chemistry" in the special section of chemistry, the term "stereometre" in a special section of geometry. The word "stereo" in the structure of both words shows their likeness and indicates the volumetric object in the space.

Modern stereo chemical synthesis is developing in a very complicated and original way. Of course, the

investigation of spatial structure of organic substances, creation of new structures as well as the study and the synthesis of rotaxan and nodulous molecules which don't have chemical ties and exist both in animate and in animate world are main problems in modern chemistry.

Some of them are connected with investigations of natural models (oil, living organism etc.) and others with the creation of new models. The latter demands the synthesis of stereochemical structures according to the known "project", that's to say "gathering" of new molecules with any spatial structure. For example, as in building firstly the calculation is carried out, then to draw up a draft and at last to bring them together. From this point view the synthesis polyhedrons reminding geometrical figures are of great interest.

As long ago, in 1869 German scientist Albert Zadenburg affirmed that molecules of Benzene have a structure of prism. But then six-term monocyclic structure with the length of sides in 1,42 Å was accepted for Benzene [3].

Later in 1964 Belgian scientists pointed out the possibility of the synthesis of organic combination preserving the structure of a prism and called it prism according to Ladenburg's statements. The American chemists Ayton and Cory synthesized the new substance - Cuban, having the structure of a cube (Figure 1).

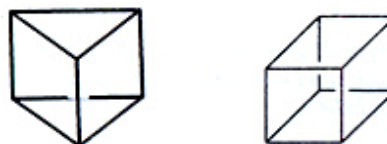


Figure 1. Prism and cubic structures

It should be noted that at present, the chemists continue synthesizing more original models and molecules from the point of view of stereochemical architecture. Adamantine, twisting, congressing, cubing, prism, aster, furler and other polyhedrons are the result of the last achievements in the sphere stereochemical synthesis. They are hydro-carbonic compounds which have the volumetric polyhedral structure reminding geometrical figures [4].

II. CYCLOHEXAN

The resemblance between adamantine and uncut diamond is in the molecule of the first one. It makes up a fragment of the cell of the diamond. In its spatial structure there is observed "the chair" of conformation of three molecules of a cyclohexan. As is obvious from the name molecule of cyclohexan is made up of circular compound of single tie of six carbons and according graphic appearance has structure of a hexagon.

As in "the chair" of conformation the molecule of cyclohexan each carbon atom is connected with others at an angle of $109^{\circ} 28'$, all carbon atoms are placed not on the same surface, but on two parallel surfaces. In this case the angle between ties is not tight. As a result there is made up a net of carbons like a rostrum.

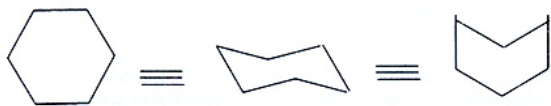


Figure 2. The cyclohexan molecule conformation

It should be noted that this conformation is not the only form. So for example as result of partial conversion of carbon atoms the other conformation is made up in the space. In the science it is called as "boat", "twist" etc.

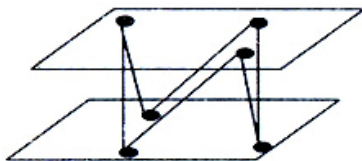


Figure 3. The cyclohexan molecule with "twist" conformation

Here it is necessary to point out the general process of penetration of mathematical methods into other spheres of knowledge, interrelation of mathematics, exactly descriptive geometry with other sciences that is the sphere of stereochemistry. This process of penetration is manifested in various forms. Descriptive geometry in simple speech is understood as spatial geometry, and stereochemistry as spatial chemistry [5].

Descriptive geometry from the point of view of its strict logical structure of theories can penetrate into other sciences as a specimen for them. One of methods of interrelation of descriptive geometry with other sciences is that it gives various spheres of science a ready mathematical apparatus for solving their precise tasks. And this apparatus can have structure from three-measured till multi-measured spatial construction depending [6].

For comprehension and investigation of spatial forms of material world, each who is engaged in these questions must have spatial thinking. On the whole, the principle of structuring the form, demanding the independence of thinking of the people according to its content promotes the development of logical and spatial thinking. Besides, the task of construction develops the researcher's design abilities and graphic conceptions. It is known that the molecule of cyclohexane can exist in several stable

conformations; they are called "chair", "boat", "twist" and indicated by corresponding graphic pictures.

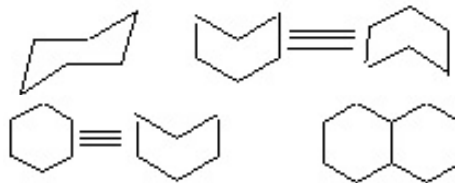


Figure 4. Combination of cyclohexan molecule with "boat" conformation

It should be noted that six-carbon molecule of cyclohexane reminds the graphic picture of a boat in profile and "a boat" conformation makes it possible to create humorous designs in molecular ornaments. On the basis of such graphic pictures it is possible to create stable to earthquakes, as well as constructively perfect brick decor. Portrayals of bricks of various purposes with "boat" conformation are indicated in the picture stated below [7].



Figure 5. Brick decor of cyclohexan molecule with "boat" conformation

As it is seen from combinations of forms with "boat" conformation it is possible to create a new group of ornaments not having any analogues.

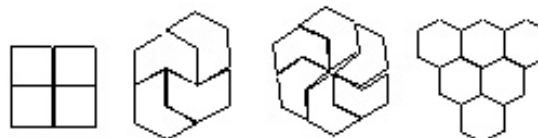


Figure 6. The cyclohexan molecule ornaments with no any analogues

When four bricks of square form combining in one point creates four-cell square molecular ornaments, in case with bricks with "boat" conformation, 3 or 6 elements can be united in one point. Such a combination corresponds to the form of cyclohexane compound by the way of 11 kinds of the packet (6_3).

Such brick decors can be rather acceptable in the erection of buildings with more original designs and humorous molecular ornaments, as well as in the creation of blocks stable to earthquakes. Besides the configuration of cyclohexane molecule with "boat" motif provides more firm combination of brick blocks between them.

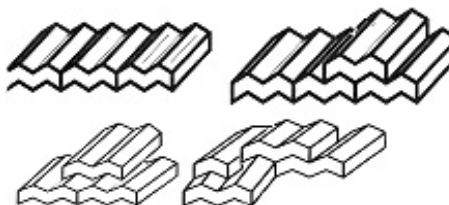


Figure 7. The blocks stable to earthquakes with a motif of "boat" conformation of cyclohexan molecule

III. ORNAMENTS

Our observations show that in all monuments created by Ajami Nakhchivani, there prevail geometrical ornaments. Ajami has also risen to the highest level geometrical ornaments as art motifs on Kufi tombstones and other spheres.

These tombstones rich in ornamental elements and merging with each other can be called more complicated and refined molecular ornaments. So as to prove our thought it is possible to study the structure of ornaments on the surface of the tomb Kharragan from the point of view of molecular ornament [8].

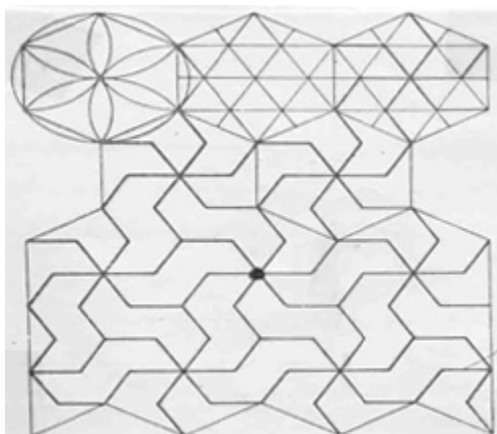


Figure 8. The fragment from geometrical discovery on the surface of the tombstone Kharragan

As it is seen these ornaments are created of natural combination of the hexagon drawn inside the circle and consists of the combination of separate particles stated below.

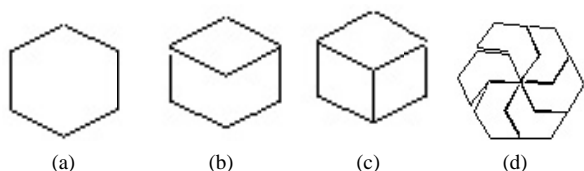


Figure 9. Ornaments created by cyclohexan molecules
 (a). Graphical structure of cyclohexan molecule
 (b). "boat" conformation of cyclohexan molecule
 (c). Cube-graphical structure of cubic molecule
 (d). Combination of the six cyclohexan molecules

It should be noted that the investigation of ornament fragments on the surface of the tomb Yusif Ibn Kuseyr presented in Figure 10 arouses great interest of specialists. For example, lineal perspective structure of one of ornament fragments on the surface of monument and perspective construction of the hexagon making up this ornament [9].

The architect used such a division of patterns very skillfully when writing the word "Ali" which is repeated for 6 times above the entrance of the court of Shirvanshahs Palace. The master using the laws of symmetry at the same time completely provided the parallelism of sides of geometrical ornament with the sides of the hexagon surrounding it.

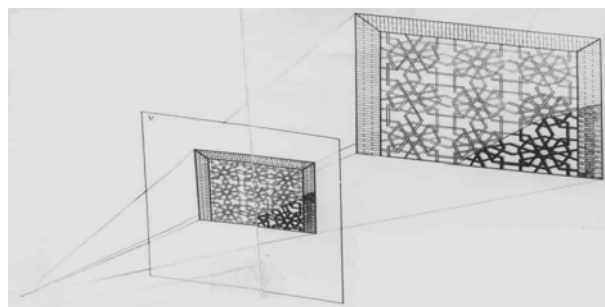


Figure 10. Perspective construction of ornament fragments on the surface of the tomb Yusif Ibn Kuseyir

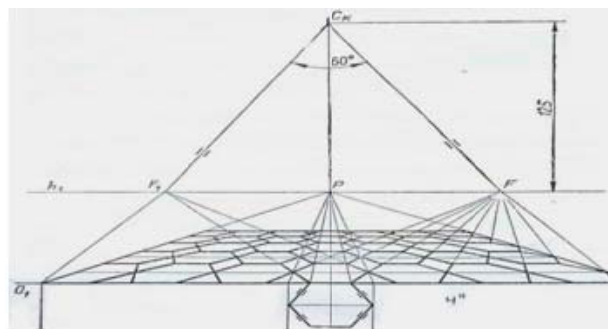


Figure 11. The construction of the perspective of geometrical making up of ornament of Figure 10

IV. CONCLUSIONS

All fragments of instructions in the direction of the sides of hexagon are equal. The diameter of the thickness is same with a type and frame. As the human being is a part of the nature, the fruit of his mind should reflect the universe, material reality. In this case the result of the human's intellectual work finds its reflection in the nature. The principle that material manifestation of creative thinking is the repetition of the nature becomes paramount. But creative thinking also reveals new peculiarities, qualities and all of it is natural according to inner laws.

From this point of view the notion of chemical structure uniting in itself the principle of resemblance in various spheres and geometrical structure makes it possible to search certain unity in the sphere of architectural creation and stereochemistry.

REFERENCES

- [1] M.S. Salahov, A.A. Efendiyev, A.M. Maharramov and R.S. Salahova, "Azerbaijan", Chemistry Journal, No. 2, pp. 78-83 (180), 2003.
- [2] K.M. Mammadzade, "Building Art of Azerbaijan", pp. 47-81 (210), Baku, 1973.
- [3] V.M. Papanov, "Stereochemistry", Chemistry Journal, pp. 47-81 (420), Moscow, Russia, 1976.
- [4] Y. Shill, "Catenans, Rotaxans and Nodes", pp. 1-212 (145), Mir Publication, Moscow, Russia, 1973.
- [5] N.I. Yusifova, "Conception of Unity of Science and Education", Gobustan Journal, No. 2, pp. 67-70 (192), Baku, Azerbaijan 2005.
- [6] M.S. Salahov, V.V. Baghmanov, N.I. Yusifova et al., "Chemistry School", pp. 80-85 (162), Baku, Azerbaijan, 2005.

[7] M.S. Salahov, V.M. Abbasov, N.I. Yusifova et al., "Cn Hydrocarbons, their Structure, Graphic Representations and Nomenclatures", Chemistry at School Journal, No. 1 (9), pp. 66 (175), Baku, Azerbaijan, 2005.

BIOGRAPHY



Nardane (Israfil qizi) Yusifova was born in Tovuz region of Azerbaijan Republic in October 3, 1959. In 1983, she graduated in the B.S. degree from Azerbaijan State Oil Academy, Baku, Azerbaijan. In 1995, she defended her M.S. dissertation called "The problem of restoration of the artistic images of the monuments on the surface of cylindrical surface". She

published more than 150 scientific articles and 2 textbooks including "Spatial Thinking". She is a doctorate in art field and completed her doctoral thesis called "Azerbaijan decorative application of geometric ornaments of art and their spatial structure". Her field of interests are molecular ornaments of geometry and their nomenclature, and difficult subjects in the arts by providing a kind of emphasizes. At present, she is working in Azerbaijan National Museum of History (Baku, Azerbaijan). She is a scientific worker of department of "Scientific and organization of exhibitions" and a member of the Azerbaijan Union of Architects and Creative Teachers.