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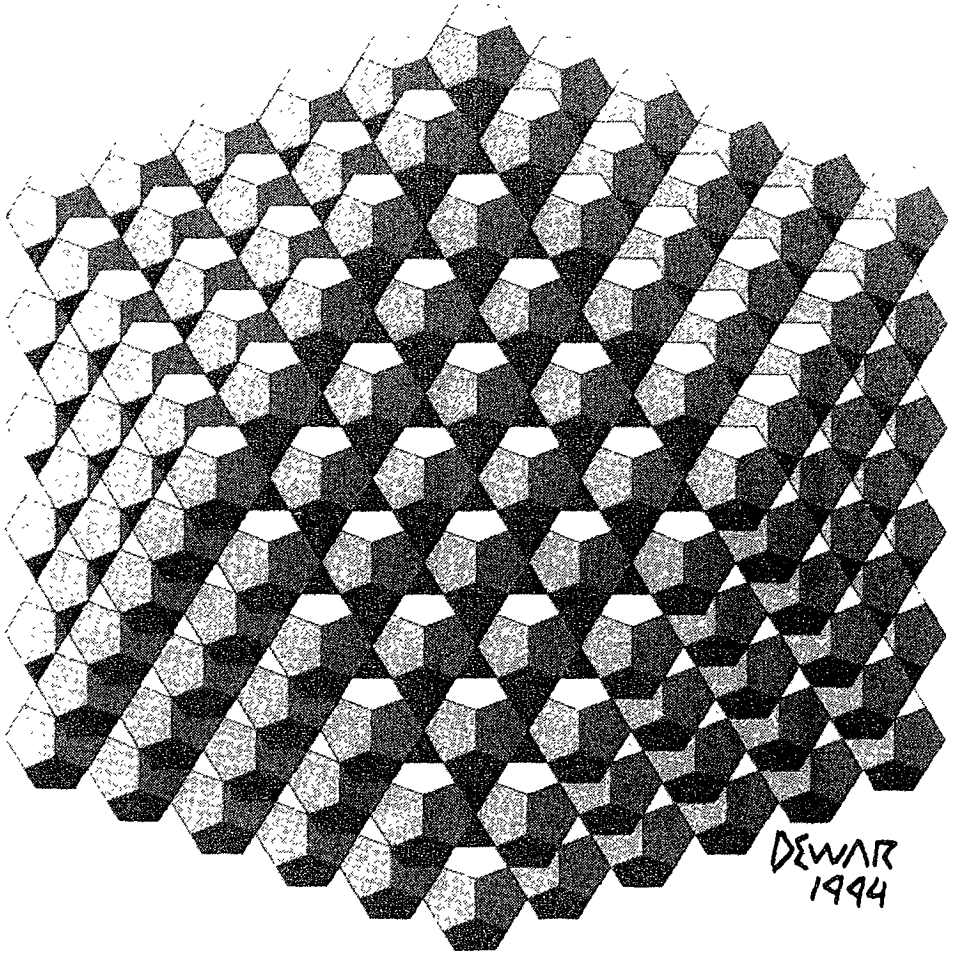

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HIGHEST SYMMETRIES AND BIOLOGICAL ALGORHITHMS

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From ancient time many naturalists (Aristotel was in their number) paid a great attention to the fact of wide realization in biological bodies of a special type of structure: multiblock chains and nets with regular repetition of a motive unit on the base of symmetrical rules. Flowers, mollusc's shells, lumbar spines and many others supramolecular biological objects have such algorithmical order.

The general rule of these structures is that the preceeding motive unit is transferred into the succeding one by a certain fixed transformation "g"; in other words, the neigbouring motive units S_k are mutually conjugated by an iterative algorithm:

$$S_{k+1} = g*S_k \qquad (1)$$

Consequently, by reapplying the generating "g" transformation "m" times to a motive unit S_k, a component S_{k+m} is obtained. For brevity, such configurations are referred to as cyclomerisms.

Classical biomorphology (see wonderful works of W.D'Arcy Thompson [1917], H.Weyl [1952], A.V.Shubnikov [1960], et al) investigated only those biological cyclomerisms which have generating transformation "g" from the similarity transformation group (the last consists of rotational, translational, mirror and scale transformations only). It is well-known thesis that this tansformation group is a base for Euclidean geometry according to the famous Erlangen programm declarated by F.Klein [1872]. Other (or Non-Euclidean) geometries - such as Lobatchevskij geometry, Möbius geometry and many others - have corresponding (non-similarity) groups of transformations in their bases.

If generating transformation "g" from (1) is belonged to one of such non-Euclidean transformations group, manifolds of corresponding multiblock structures have specifical figures and are distinguished from those which were investigated by classical biomorphology.

The author of this report devoted many years for investigation of such Non-Euclidean cyclomerisms in supramolecular biological objects. He brought to light that these Non-Euclidean types of cyclomerisms are realized widely in selforganization of living matter on all levels and all branches of biological evolution (like as Euclidean types which are particular, special cases of Non-Euclidean ones, from the geometrical viewpoint).

Many important questions of living matter are connecting with the principle of symmetrical (in extended and strict mathematical sense) repetitions in constructures, kinematic movements, sensitivities and other manifestations of living bodies. Thus, a development of many sciences about living nature will be accompanied with investigations of these basic phenomena of biological selforganization.

The more you investigate constructires and functions of supramolecular biological objects from the highest symmetries viewpoint, the more concrete examples of cyclomer multiblock structures you discover in living nature. Their existence provoke to create a new mathematical branches, for example, a certain "non-Euclidean fractals theory", where the fractal principle of repetition is connected not only with the similarity transformations group but with more wide transformations groups, first of all, Möbius or conformal-geometrical transformations group (which is known under name of local-similarity transformations group also).

The report consists of new examples of analysis and modelling of biological phenomena from highest symmetries and cyclomerism positions. Connections between cyclomer biology and cyclomer arts (that is arts using cyclomer rules in their compositions) are discussed.

References

Weyl H. [1952], Symmetry, Princeton, Princeton University Press.

Petukhov S.V. [1989], Highest symmetries and iterative algorithms in self organization of living matter. Cyclomer biology and cyclomer arts. In: "Symmetry: Culture and Science", (Ed. G.Darvas & D.Nagy), v.1, n.3, 1990.