

The Number and the Form in the animate nature

Joseph Shevelev, U.S.S.R.

The advent of body of living objects and the advent of its form is an integral and indivisible event: neither the body nor its form could arise separately. The integral description of this event modeling the advent of the "space of being" (the form) as well as the energetic process of becoming would give us the mathematical law of harmony. The vectorial geometry opens the clue to this problem.

In this report I shall speak about the growth at the elementary level, i.e. about the basis of formgiving. In May 1979, I noted that a straight-line segment divided in the ratio of the golden section $(\phi^0, \phi^{-1}, \phi^{-2})$ and a right-angled triangle of the geometric progression $(\phi^0, \phi^{1/2}, \phi^1)$ display the identical interrelation of their parts $(1, N, N^2)$ thus representing the same variable triangle. The interrelation between two variables (two sides of the triangle) is governed by a quadratic law, the third quantity remaining constant. It became obvious that a straight-line segment divided in the golden ratio is a contracted vectorial triangle. The vector in its twofold nature characterized by direction and quantity represents the movement in terms of both the space (the straight-line segment) and the energy (the force). The observation of other states of that vectorial triangle revealed the unknown symmetry group reproducing the forms of various objects of animate nature featuring the regeneration of individual being cycles. Examples are found in such diverse objects as the apple, the egg, the mollusc shells, the capsule (cranium) containing the brain of mammals. These symmetries are described by the equation $N^{\vec{n}} = N + 1$, where N and 1 are modules, with $n = \pm 2^{\pm 1}$. The coincidence of indicatrices with contours of the real natural forms is not a random effect. The growing point of an organism is coincidentally the centre of the geometrical construction or the centre of polarity. The cluster of the living matter which enables the process of formgiving is a geometric point, whereas the form of any living object is a bounding surface of the space of expansion attained at the moment by the growing point. The space is the body; the body is the space. The law of squares represents the essential polarity of the elementary event of growing: the k -fold change of the distance alters the surface of a sphere by a factor of k^2 .

The following vectors are assigned to the terms $N^2, N, 1$ of the above equation: the singular potency of the point of origin ($\vec{S}$), the

vector of the exterior force factor or the potency ($\vec{V}$) and the resultant vector ($\vec{R}$). We can see the dichotomic structure of forming.

1. Two kinds of symmetry are being generated: the rounded "female" forms are produced under the prevailing influence of S, the expressed vertical ("male") forms - where U prevails. 2. In S-symmetries, the resultant indicatrix R follows the program $\dot{S}$ (the mechanism of conservation); in U-symmetries, the indicatrices R describe the new forms (the mechanism of variability). 3. There are the plus-symmetries presenting the directly proportional casual relation, and the minus-symmetries for the inversely proportional relation. In the plus-symmetries, the value of expansion in orthogonal directions is determined by the golden number $\phi^{\pm 1} = 1,6180339$, whereas in minus-symmetries it is a function of the binary golden number constituted by a pair of numbers $\phi^{\pm 1} = 1,4655712...$ and $\phi^{\pm 1} = 1,7548777...$ appearing invariably together. The number $\phi^{1/2} = 1,2720199...$ outlines the space of the symmetry of similarities; it may be considered as a structure based upon the bond $\sqrt{5}$ or $\sqrt{2}$. The number $\sqrt{\phi}$ defines the angle of intermolecular bonds of water which serves as a base for the life and genetics. Moreover, it forms the helix of the Nautilus shell, its curved contour being defined by a set of fundamental constants: 2, ϕ , e, π ; it comprises the proportional relations of the equal-tempered musical scale as well as those of the historic architecture. In U,S-symmetries, the golden numbers ϕ , ϕ , ϕ are the radius vectors characteristic for values of expansion. The parameters of curves in their critical points reveal the numbers $\sqrt{1}$, $\sqrt{2}$, $\sqrt{5}$, $\sqrt{7}$. Of a special importance are the numerical values of expansion along the vertical. Their interrelation and relationships with vertical displacements of geometric centres of doublets and triplets in reference to the point of origin are expressed by numbers comprising a row of basic physical constants (e.g. spin, magnetic moment and rest mass of proton, neutron and electron). The above observations made by the author help to define and to model the concept of WHOLENESS.

The whole - as it pertains to biological structures - is a singular UNITY generating all its parts in succession from ONE base. Let us denominate this initial base as the number OMEGA ($\omega^{\pm 1}$). Then the wholeness at the elementary level is a succession of numbers making up the UNITY in the most simple and natural way. Assume that each subsequent number within the structure of the UNITY is the result of successive multiplication of the base ($\omega^{\pm 1}$) by itself. At the same time we assume thereby the self-regeneration (or replication)

of the initial number $\omega^{\pm 1}$:

$$\omega_n^0 = \omega^{\pm 1} + \omega^{\pm 2} + \omega^{\pm 3} + \dots + \omega^{\pm n}$$

We shall consider now, of all the unities $\omega^0 = 1$, one attaining the maximum extent when $n \rightarrow \infty$ and the maximum contraction when $n = 2$.

1. From the above equation, it follows when $n \rightarrow \infty$ that the base of wholeness, the number $\omega^{\pm 1}$, equals $2^{\pm 1}$ (the dichotomy).

2. When $n = 2$, the same equation shows that the base of wholeness is the number $\omega^{\pm 1} = \phi = 1,6180339\dots^{\pm 1}$ (the golden number).

Case 1 ($n \rightarrow \infty$): it is nothing but mathematic generalization of the growth manifesting itself as unlimited potency to seize the space under conditions of a finite and confined system (the UNITY).

Case 2 ($n = 2$): a complementary structure, dichotomic by its nature, is revealed.

Thus we learn from the algorithm of wholeness that the potency of growing, essentially, is the dichotomy ($\omega_{n \rightarrow \infty}^{\pm 1} = 2^{\pm 1}$), whereas the essence of any dichotomic structure is the golden section ($\omega_2^{\pm 1} = \phi^{\pm 1}$). In actuality, the plus-dichotomy ($1/2^{\pm 1}$) in the nature is division of a cell in half. It is the mechanism of building up the INDIVIDUAL living structures. The minus-dichotomy, on the contrary, represents the conjugation of two sexual cells (the male and the female ones) into ONE; it is the advent of life, the event responsible for the growth of life as the WHOLE both in its continuity and discreteness. As it is widely demonstrated today, the intricate structures are governed by bonds of the golden section.

The principle of the dichotomy suggests the second step of the investigation aiming at the algorithm of wholeness of the second generation structures. Let us establish it by adhering to the Hamilton's principle of least action. It inherits the substance of the algorithm of elementary structures and, coincidentally, opens the way to the diversity of forms of the animate nature: each subsequent number contained in the structure of UNITY is derived by multiplication of the foregoing one by itself in accordance with the given rule.

To obtain TWO extremely contracted unities of the second generation, it is necessary, firstly, to double the number of elements of the structure (now $n = 4$) and, secondly, to replicate the initial base $\omega^{\pm 1}$, the parts of the whole grouping around it. The algorithm of the wholeness constitutes the groups: (a) the binomial $\omega_2^0 = \omega^{\pm 1} + \omega^{\pm 3}$ where $\omega^{\pm 1} = 1,4655712\dots^{\pm 1} = \frac{1}{2}^{\pm 1}$, and (b) the trinomial $\omega_3^0 = \omega^{\pm 1} \pm \omega^{\pm 2} \pm \omega^{\pm 4}$ where $\omega^{\pm 1} = 1,7548777\dots^{\pm 1} = \frac{1}{2}^{\pm 1}$.

Such is the logical model of wholeness of biological structures coincident with the vectorial model of formgiving. It shows also that the binomials of plus- and minus symmetries, i.e. the numbers ϕ and $\bar{\phi}$, are interrelated by the number $\pi/3$. The energy and the space; the dichotomy and the golden section; the orthogonal and hexagonal crystal systems as opposed to the animate nature objects exhibiting the golden numbers in orthogonal and hexagonal sections only: they all are bound together, in such a manner making up the indivisible wholeness.

