PRODUCER-USER RELATIONSHIPS BETWEEN LIVING CELLS AS A BASIS OF NATURAL CONTROL SYSTEMS SELF-ORGANIZATION

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To explain the essence of different specific homeostatic and functional control systems in high complexity life forms, traditionally physiologists use theoretic models based on goal concept. Another concept of the life origin and evolutionary complication based on principle of self-organization needs not any goals and their creators. This alternative concept is able to interpret the most of regulator processes in multi-celled organisms using specific producer-user (PU) type of relationships. This type is characteristic within every conglomerates of different specialization cells where the metabolic rate of one specialization cell depends on metabolites of another specialization of cells. So, all the internal and / or external conditions that able simulate or suppress metabolism of one cell, potentially able modify metabolic activity of another specialization cells that all together are forming one chain of PU. Principle differences between natural and known artificial control systems are connected with two characteristics of living cells: 1. Each living cell has a property to self-adapt its rate of biosynthesis in accordance with the increased rate of its structural-energetic losses; 2. Each living cell is functioning discretely.

The first property, known as a mechanism of cellular adaptation (MCA), was evolutionary saved as an effective mechanism functioning against environmental damageable influences. MCA is based on genetically fixed property of cell to produce during its early developmental phase essentially more sub-structures than they are necessary to cover cellular needs under mean biosynthesis rate. Usually, about 2/3 of these sub-structures still passive until external factors compel the cell react with a rate causing stable negative balance between the rates of biosynthesis and substrates losses. In this case, MCA of different types of cells each with their own adaptation potential and time constant will activate the rate of biosynthesis, transforming these passive units into their active state. Step by step the cell comes more powerful able to produce much more metabolites.

The second property of cell mentioned above could create specific problems. After every reaction, the cell needs some time to recover. This fundamental property of living cell is a key to understand why all our organs and other structures consist of cell populations instead of structures based on single cells only. Although the simple regulator contour consisting of PU-elements theoretically is able to provide functions of both positive and negative feed-back channels, such regulator structure could support only discrete reactions of multi-celled living organism to exogenous challenges. Therefore, such a hypothetical organism would have very low chances to be saved along evolution. Another constructive strategy based on use of cell populations on every functional links of the each control chain practically provides the host organism by continuous reactions to random, not predictable environmental challenges. This opportunity is based both on quantity (increases the power of summary reaction) of functionally relevant cells and on their functional heterogeneity. The last factor, mostly caused by random character of environmental variables, creates a basis for asynchronous reaction of cells even in case of rectangle exogenous influence.

The proposed view of systemic relationships in multi-celled organisms allowed us to interpret internal mechanism of wide spread biological nonlinearity. The nonlinear dependence between multi-celled organs is determined by cells parallel but asynchronous activity. In case external influence has high intensity able involve almost all cells of one population, nevertheless their different activation thresholds, such population cannot keep its long term maximal activity because of problems with chemicals income. Therefore, every time after generalization of organ's reaction obligatory will come the phase of its disability.

Mathematical models created using these basic organizational principles allow one to systemic analyze and to quantitative describe human organism adaptation to different environmental changes including gravitational, thermal, barometric, oxygen and others.