APPLICATION OF FRACTAL GEOMETRY TO THE THEORY OF SYNERGETICS

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Background. The deterministic picture of the world that had prevailed throughout the existence of classical scientific knowledge led to many unsolvable questions and paradoxes. As a result of the crisis of the classical model of world vision, new disciplines appeared during the twentieth century: synergetics and fractal geometry. It is not surprising that the theories that were being developed at the same period began to form convergence on a number of issues. That created new prospects for the joint application of these scientific disciplines.

Aim. To identify and substantiate the similarity of approaches of synergetics and fractal geometry as far as the functioning of systems are concerned; to express the principles of synergetics through the use of modern mathematical apparatus and to confirm the interrelation of disciplines within the framework of post-non-classical science.

Methods. It has been shown that the basic concept of synergetics — a dissipative structure with a high hierarchy at micro-levels — is a dynamic fractal [1], self-similar elements of which form within the limit a chaotic figure existing on a fractal set.

As a practical application of such a description of the systems' behavior, the problem of population distribution over the area of the earth's surface (models of urbanization) has been considered. At the same time, the foundations of synergetics have been used, the corresponding elements of calculations have been provided with fractal dimension [1, 2]. That allowed solving the main paradoxes associated with the unevenness of urbanization and population surges across the territory.

Results. When correlating the basic concepts and problems of synergetics and fractal geometry, the convergence of these disciplines as for the hierarchical behavior of systems has been revealed. Making a synergetic attempt to describe the functioning of systems, the generality of such a description for systems of different nature and, in some cases (in the process of open interaction), the possibility of the influence of systems of different nature on each other is emphasized. In turn, fractal geometry provides such a description with a radically new factor — fractional dimension.

When studying the issue of urbanization from mathematical and philosophical perspectives, the dependence was obtained that determines the distribution of population on the continents, the growth of cities and the peculiarities of their development. Urbanization is proposed to be considered as an open system with basic small processes of development leading to diversity at the macro level.

Conclusions. Both theories — synergetics and fractal geometry — are distinguished by the universality of applying their basic provisions to issues of a wide range of sciences, while revealing general laws and ways of functioning of systems and their groups.

The complementarity of the basic concept of synergetics with the theories expressed by Mandelbrot in his works on fractal geometry is obvious. The hierarchical architecture of systems with their ordering at the micro level and the variety of forms and chaos at the macro level is nothing more than a mechanism described in fractal theory as natural fractals.

Keywords: synergetics; fractal geometry; attractor; dissipative structure; fractal.

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