the general science journal

ON THE PROBLEM OF "HEAT DEATH"

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As is known, in 1865 physicist Rudolf Clausius formulated the theorem of "heat death" of the Universe. The theorem is based on the second law of classical thermodynamics and reads as follows: the universe as an isolated thermodynamic system tends to the equilibrium state – to the state of "heat death". There is a set of attempts to theoretically refute the theorem since the theorem contradicts human experience. But, in my opinion, the degree of validity of the refutations is no higher than than degree of validity of the theorem because the Universe does not represent a thermodynamic system and statistical concepts (for example, concepts of temperature and entropy) are inapplicable to a description of the Universe. The problem of existence, orderliness, and stability of the Universe is not reduced to a thermodynamics problem. Since the problem of existence, orderliness, and stability of the Universe is of great scientific interest, it is important to analyze correctly the problem of "heat death" in the simple case of the isolated macroscopic system "ideal gas of molecules + surroundings". If the analysis of an old problem on the basis of a new point of view leads to development in science, then the purpose of the present comment is to analyze the problem of "heat death" on the basis of the cybernetic approach and to formulate the problem of existence, orderliness and stability of the Universe.

Correct analysis of the isolated macroscopic system "ideal gas of molecules + surroundings" is based on the following propositions (premises):

(1) "surroundings" is a controlling system; "ideal gas of molecules" is a controllable subsystem;

(2) controlling heat influence of the "surroundings" on the "subsystem" can be a heat or a non-heat one;

(3) if the "subsystem" is in an equilibrium state, then controlling heat influence on the "subsystem" does not take out "subsystem" from the state of heat equilibrium (i.e. state of "heat death", state of lowest degree of orderliness). (For example, equilibrium energy distribution of a molecule is described by the Gibbs' distribution, and, consequently, the concepts "temperature" and "entropy" exist. In other words, the concepts "temperature" and "entropy" are consequences of the concept "Gibbs' distribution");

(4) if the "subsystem" is in an equilibrium state, then controlling non-heat influence (for example, influence by laser radiation) on the "subsystem" upsets the heat equilibrium in the "subsystem": The "subsystem" transits into a non-equilibrium state (i.e. state of higher degree of orderliness). The non-equilibrium state of the "subsystem" is not described by Gibbs' distribution, and, consequently, the concepts "temperature" and "entropy" do not exist;

(5) if controlling heat influence on "subsystem" is broken off, then a relaxation process leads the "subsystem" to the equilibrium state (i.e. state of "heat death", state of the lowest orderliness) during a relaxation time.

The following statements are deduced from these basic propositions (premises):

(a) controlling non-heat influence is the cause of a non-equilibrium state for the "subsystem";

(b) relaxation process - stochastic process - in the uncontrollable non-equilibrium "subsystem" leads only to a unique result: the formation (!) of the equilibrium state (state of

"heat death", state of lowest degree of orderliness), i.e. to the formation (!) of temperature and of entropy. (In other words, there is no temperature and entropy (positive or negative) in the non-equilibrium "subsystem");

(c) irreversibility of a uncontrollable non-equilibrium state of the "subsystem" is the consequence of the relaxation process (i.e. "process of death" of non-equilibrium state) in the "subsystem".

The above statements permit correct formulation of the problem of existence, orderliness and stability of the Universe as follows [1-10]. What is the essence of the Universe? Are the existence, orderliness and stability of the Universe a result of control? How is the Universe controlled? Reality is deeper and is more substantial than it seems to physicists!

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