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Are There Three More Laws of Thermodynamics?

Processes or changes can be classified into two groups – feasible and infeasible, depending on whether or not the process under consideration obeys the First Law of thermodynamics (FLT) (see Step 1 in Figure 1 below) [P. Atkins, Four Laws that Drive the Universe, Oxford University Press, Oxford, 2007]. FLT states that the energy and matter (or mattergy) of the Universe are conserved. Feasible processes can be divided into two classes – spontaneous and non-spontaneous. Spontaneous processes increase, and non-spontaneous processes decrease, the entropy of the Universe (see Step 2). Spontaneous processes divide themselves into organized processes exhibiting patterns and random processes showing no recognizable patterns, depending on whether or not physical information (I_P)(e.g., the universal constants) plays a visible role in the process under consideration (see Step 3). Organized processes can be divided into self-organized (e.g., Belousov-Zhabotinsky reaction) and other-organized processes (e.g., Bernard convection cells), depending on whether the organization is driven by chemical reactions (encoding chemical information, I_C) occurring inside or outside the thermodynamic system under consideration (see Step 4). Finally, self-organizing processes can be divided into biotic (i.e., living) and abiotic (i.e., non-living) processes, depending on whether or not the processes under consideration are parts of (or associated with) self-reproducing systems controlled by biological information, I_B (see Step 5).

The first two laws of thermodynamics are related to free energy (or energy, more conveniently), while the last three 'suggested' laws concern informations defined at the three distinct levels of physics (P), chemistry (C), and biology (B), designated as I_P, I_C and I_B, respectively. This seems consistent with the information-energy complementarity principle formulated in the early 1990's [Ji, S. (2002). The Bhopalator: An Information/Energy Dual Model of the Living Cell (II), Fundamenta Informaticae 49(1-3), 147-165]. The contents of the suggested laws can be stated as follows: 4th = "Not all spontaneous processes are random"; 5th = "Not all organized processes are driven by external forces"; 6th = "It is impossible to self-reproduce without biological information".

1 (E; 1st law)
[Processes] ----------------> [Feasible vs.

2 (S; 2nd law)
Infeasible] ----------------> [Spontaneous vs.

3 (I_P; 4th law)
Non-Spontaneous]-----------------> [Organized vs.

4 (I_C; 5th law)
Random] ------------------> [Self-Organized vs.

5 (IB; 6th law ?)
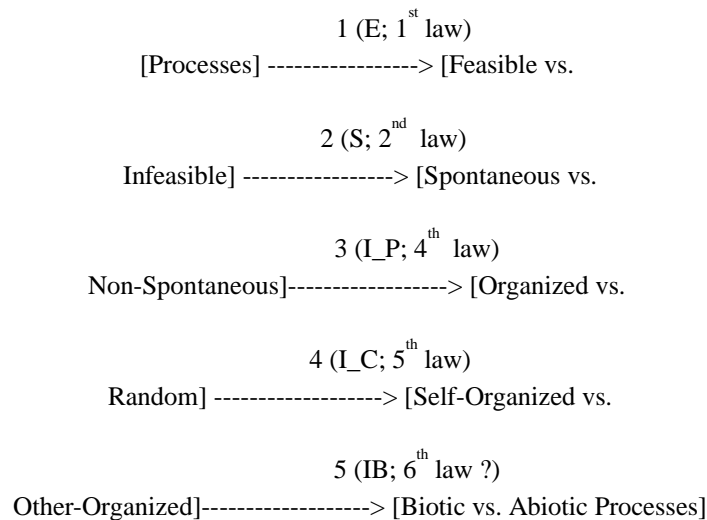Other-Organized]------------------> [Biotic vs. Abiotic Processes]

Figure 1. The five levels of bifurcations of natural processes. Each bifurcation is postulated to be associated with a fundamental concept (e.g., entropy) and a law (e.g., the second law of thermodynamics) as indicated in the parenthesis above an arrow (see the text for more details).