Review of: "Systematically Challenging Three Prevailing Notions About Entropy and Life"

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Review of “Systematically Challenging Three Prevailing Notions About Entropy and Life”

The authors need to be careful to specify whether they are referring to the change in entropy in general, i.e., $\Delta S = Q/T$ in Joules/Kelvin, or the specific entropy change, i.e., ΔS = (Q per mass)/T in Joules/(gram or molar mass)-K.

Kinetic energy includes translational and rotational motions as well as vibrational motions.

Vibrational states are quantized, not disordered.

The distribution of energy quanta among quantized translational, vibrational, and rotational states is given by the Boltzmann distribution.

The sentence, “Since disorder …. measure of disorder.” makes no sense and adds nothing to the argument; the sentence can be deleted.

Equations 3 and 4 were first proven in H. Dennis Tolley, Brian F. Woodfield, Lee D. Hansen, Counting microstates via heat capacity and implications for the third law, *J. Chem. Thermodynamics, Vol. 171, August 2022,* Article Number 106807

The following statements need to be corrected or deleted.

“5. Heat dissipation from human bodies on cold days can reduce their entropy and cause disorder in their bodies, so entropy cannot represent disorder in humans.” Because humans are homeotherms, their body temperature is constant; any heat loss is compensated by heat production from the respiratory combustion of glucose. Thus, the mass decreases, but the specific entropy doesn’t change, and no disorder is created.

“7. Drinking water can restore order in a thirsty man, which simultaneously increases the man's entropy because entropy is an additive quantity [18][19][20]. This fact also suggests that entropy cannot represent disorder in humans.” Drinking water doesn’t “restore order” or change the specific entropy.

The argument against Schrödinger’s assumption that order is the reciprocal of disorder is dealt with in much more detail in Lee D. Hansen, Marko Popovic, H. Dennis Tolley, Brian Woodfield, Laws of evolution parallel the laws of thermodynamics, *J. Chem. Thermodynamics*, *Vol. 124*, 2018, pp. 141-148.

The sentence, “Additionally, during the developmental process from a fertilized egg into a prenatal baby of a human, its

entropy increases by millions of times because entropy is an additive property, and the increased entropy is from the food consumed by the baby's mother." confuses general entropy, which increases as mass increases, with specific entropy that doesn't increase. As shown by Battley, Thermochim. Acta 326 (1999) 7-15, the specific entropy of organic matter only depends on the elemental composition.

As a complication not mentioned in the paper, the matter in living organisms is organized, not ordered.

The concept of a "positional entropy" to describe disorder is further developed in a series of papers by Tolley et al. in three recent publications in Pure and Applied Chemistry. Since these papers are germane to the topic of this paper, they should be cited.

In summary, the paper is based on valid objections to current commonly held views of entropy, particularly as applied to the matter and processes in living organisms. However, the arguments in the paper are not well-developed, and key references