Review of: "A Law for Irreversible Thermodynamics? Synergy Increases Free Energy by Decreasing Entropy"

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I find this work interesting because it is stimulating questions in a field which is not often treated. However I think that the author underestimates the benefit of rigorous existing theoretical constructions, by choosing neither to define the concepts he is using, like «free energy», nor to define what system and what transformation he is considering in each example. I understand that the author may want to take distance from existing theory, focusing on experimental aspects, but at the same time he is using theoretical concepts to suggest some unification. I think that taking more care into defining things can bring better clarity in the studied examples, and simplify the statements.

The example of the cannon is a good illustration. If the author is vague about which system, which process, which time are concerned, it seems to me that an extra precision can be quite enlightening here. Indeed, there are actually two processes, the process made by living beings - building the cannon, and the process of firing itself, which is just a spontaneaous process in the sense of classical thermodynamics. The consequence of the first process - building the cannon - is to reduce the number of degrees of freedom of the second process - firing. The reduction of the number of degrees of freedom has both consequences on the entropy and the energy. The entropy is reduced because it somehow quantifies the number of degrees of freedom of the system. On the other hand, since the total energy is constant, the energy per degree of freedom increases mechanically.

Furtherly, it seems to me that formulating the different examples of the authors in terms of degrees of freedom makes the point clearer. For instance division of work decreases number of degrees of freedom for each worker, who then have simpler things to do. Also, what the author choses to measure in the column «work» actually looks more like some «increase of energy per degree of freedom». Hence «efficiency in energy consumption» is quite related to energy per degree of freedom, whereas efficiency is quite distinct from the concept of work.

It is not so obvious for the texts or the music, but in these cases the system is not well defined. Thus, being static, a text cannot be considered as a thermodynamical system, however, reading a text is some kind of thermodynamical process. But then the system is the reader, not the text. So one might say that a good text reduces the number of degrees of freedom - the number of its possible interpretations - accessible to the reader who is reading.

Also the abstract is not very precise. For instance, the first sentence states «Classical thermodynamics focused on reversible processes in closed systems», but irreversible processes have always been considered by physicists, since the second law itself deals with them. On the other hand, the thing that was traditionnally not considered was «far from

equilibrium processes», as the whole classical thermodynamics construction relies on the existence of «equilibrium states».