Review of: "Conceptual Differentiation of Heat: The Entropic Promise of a Post-Pyrocene World"

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This paper is fundamental and sets the record straight in the field of thermodynamics. However, like any article on the science of thermodynamics, it is written in highly technical language with acronyms that are often completely hermetic. The uninitiated will therefore find it difficult to see what exactly we are talking about and, above all, may think that all this is a matter of detail and therefore secondary. In fact, this would be a serious mistake, and so I'm going to take the liberty of translating into the vernacular what this paper is about.

During the nineteenth century, the scientific approach placed the notion of energy, a Greek term originally meaning "force in action," at the centre of our understanding of how the observable world works. But at the same time, energy was endowed with a much less noble offshoot called "entropy." This term is a learned derivative of the Greek entropê, meaning "the action of turning over," hence "the action of transforming, change." The problem was that we ended up with two very distinct concepts for a single observable nature. In order to restore a degree of unity, the hybrid concept of "free energy" was forged, a clever mix of energy and entropy driven by a third concept: temperature. It was this unified approach that would give birth to the science of thermodynamics, a word derived from the Greek verb θερμαίνω (thermaínô, to heat, warm) and the adjective δύναμικός (dúnamikós, powerful, efficient, strong). Thermodynamics was thus endowed with two principles, the first proclaiming the conservation of total energy (work plus heat), and the second, the inevitable and irreversible growth of entropy pushing the world towards ever greater disorder. In so doing, the emphasis was clearly placed on the fact that, in order to do everyday things, we needed force and therefore energy in the form of heat. So it was possible to create new things using energy. But these new things were immediately condemned to wear out irrevocably until they became unusable. And that's where the notion of entropy came in, which was very often perceived as something negative and destructive, as opposed to creative energy, which had a much more positive connotation. It was all a question of balance between processes that generated order through the free energy available and processes that generated disorder through the irreversible growth of entropy. Then, in the twentieth century, there was the development of the thermodynamics of irreversible processes, which looked at the states and processes in non-equilibrium systems. Surprisingly, it was the variable entropy that came to the fore, with the notion of energy becoming a simple agent of transformation, useful of course, but not fundamental, since it is always conserved no matter what happens. Then came the development of cybernetics, which revealed that entropy was a materialised form of a very fundamental and powerful concept: information, a word derived from the Latin informare, meaning "to shape, to form; to represent, to describe." Hence, in the twenty-first century, an obvious split in science between energy scientists, heirs to nineteenth-century energy thinking, and computer scientists, heirs to twentieth-century entropy/informatics thinking.

With this crucial context in mind, the present paper takes a clear stand in asserting that the entropy aspect is more fundamental than the energy aspect in terms of understanding the natural world, and, above all, that the notion of 'free' energy, seeking to reconcile the energy goat with the entropy cabbage, is not the right solution. Since free energy is both energy and entropy, why emphasise the word energy to the detriment of the word entropy? The question arises, and the paper explains why it is better to emphasise the entropy variable, unlike in most articles or books on thermodynamics, where it is the energy variable that is emphasised. Personally, I share the author's view that it is necessary and essential, in 2024, to stop associating the notion of entropy with something negative and destructive. For it is information and its twin sister entropy that govern the future of an ecosystem, not its energy content. The idea is simple to understand. Energy is everywhere and can never vary one iota. So all you have to do is use it in the form you need, making sure you give it back in another form as soon as something new appears. And, for this novelty to appear and develop, it must be provided with a sufficient flow of entropy given the desired internal complexity.

I highly recommend reading this contribution, which explains in more technical language what I have just summarised.