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Ecology: Science or philately? An interdisciplinary analysis of sustainability by exploring if it is possible to get more and more information by reducing collateral environmental damages

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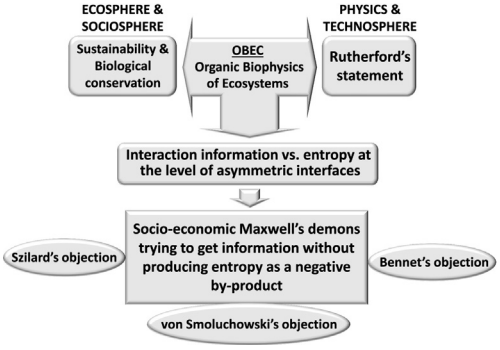
HIGHLIGHTS

- Biological conservation and transient sustainability mean civilization crisis.
- The current mainstream of ecosystem ecology has neglected its foundations in physics.
- Stationarity in open systems = equilibrium in closed ones, sealing the gap between ecology & physics.
- A new understanding is reached analyzing human beings as ecological Maxwell's demons.
- The unique long term solution combines conservation & interplanetary expansion.

GRAPHICAL ABSTRACT



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ABSTRACT

We herein explore the connections between the current condition of ecology concerning to sustainable development and the statement of Rutherford regarding the importance of physics to understand sustainability and biological conservation. The recent emergence of organic biophysics of ecosystems (OBEC) may constitute a feasible alternative to fill the gap between conventional ecological thinking and physics, especially thermodynamics. However, our comprehension of sustainability and biological conservation is influenced by the interactions between information and entropy, because we tend to exclude parts of the biosphere as well as their relationships among them. We explore the use of a holistic analysis of sustainability and biological conservation using physics, and also establish a parallelism between Maxwell's demons and human beings. Lastly, the ecological meaning of the hypothetical feasibility of Maxwell's demon at the anthroposphere scale is analyzed starting from the objections of von Smoluchowski, Szilard and Bennet.

1. Introduction

1.1. Outlining a Kafkaesque situation

The word "ecology", as many other related terms, has become an essential part of our daily language. But it is misunderstood in too many

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instances, mainly because ecological problems are seen as "external issues" (i.e., issues from wildlife) in regard to our quotidian life within the complex human anthills in which modern cities have become. Some scientists, such as some physicists, chemists or mathematicians, regard ecology a 'soft science', mainly because it has too many theoretical concepts unbacked by empirical data that could be suitably ordered by an all-encompassing and reproducible theoretical framework. In comparison, other disciplines like geology, physics, and biochemistry are very rich in data, at the same time that they are supported by a small number of very solid theories.

However, despite the above-mentioned situation, many economic, cultural, political, and quotidian facts are inextricably connected with the ecological backstage of civilization. For example, some oil entrepreneurs stubbornly deny the possibility of a collapse of our planet's natural resources. Contrastingly, scientists are generally convinced that a major global climate change is at the gates. Meanwhile, they go to their jobs driving a car moved thanks to the activity of oil entrepreneurs. Demographers are worried by imminent massive movements of environmental emigrants looking for better living conditions. Correspondingly, astrobiologists are thinking about the terraforming of Mars and Venus since these planets could be, in the long-term, good alternative destinations to address those concerns of Earth's demographers. But a massive effort of interplanetary migration based on our current technology would imply an overwhelming consumption of additional energy, by increasing the risk of a catastrophic global warming. Finally, politicians are trying to please all these actors so as to attract the greatest amount of votes.

In addition, neoliberal economists hold that value has a marginal nature that derives from our subjective vision of reality (a very interesting tautology according to which those things with a high demand and value—price—are valuable precisely because we demand them, and we demand them because they have a high value or price, and so on…). According to this mainstream economic approach, misery, poverty and natural resources depletion largely results from a high level of overpopulation which, therefore, must be reduced (Meadows et al., 1972; Turner, 2008). But, on the other face of the coin, overpopulation is "wonderful" from the economic point of view, because it provides an oversupply of manpower which reduces costs, increasing in such a way the profits of big enterprises (e.g.: the well-known massive migration of enterprises to countries of Asia, Africa and Latin America). However, this oversupply of manpower imposes an increasing pressure on the exploitation of natural resources. Consequently, there is a complex combination of depletion of natural resources, overpopulation and poverty that is pushing people to migrate toward those developed countries in which big enterprises have their headquarters. Obviously, this massive migration is menacing the wellbeing of developed countries themselves. In the large scale, it is a sort of social fulfillment of Newton's third law: for every action, there is an equal and opposite reaction. Alternatively, from the point of view of cybernetics, it is an astonishing eco-socio-economic vicious cycle on a planetary scale.

This previous simplistic sketch represents a paradigmatic example of an irrational combination of goals and potential solutions, always with the word "ecology" in mouth. Actually, nobody can be blamed, but every one of us. Plainly speaking, civilization itself is "the problem". The effects of many decisions in society are unforeseeable in the long run. Humans are, in this sense, very similar to moles: they go digging the tunnel and fixing the damages in its walls at the same time: Henry Ford did not know anything about the global environmental impact of cars; Paul Hermann Müller in 1939 did not have enough data about the increment of the fragility of hawk eggs exposed to DDT; and Thomas Midgley did not have any knowledge about the destructive effects of CFCs on the ozone layer. In this very moment, we are conceiving some odd "technological wonder", with likely unforeseeable catastrophic effects in the future. Hence, we are the problem and, as far as we are concerned, at least a big part of the solution.

A general interdisciplinary agreement is an essential requirement in this issue because, following the viewpoint of O'Neill and Kahn (2000), the conventional ecological paradigm isolates human activity in a box labeled as "disturbances", whereas the orthodox economic paradigm isolates ecosystems into another box labeled as "externalities". But both abstractions are mutually destructive when human activity reaches the global dimension of the latter half of the twentieth century. Under these circumstances of huge socio-economic growth there is not remaining space to any alternative tangible "box", since everything, nature and society, is enclosed into the same ecosphere container. The internal borders of this container are more and more blurred over time. Everybody with a minimum culture about thermodynamics clearly knows that the functioning of any complex system depends on a given set of gradients; and gradients, in turn, depend on the existence of clear active borders or asymmetric interfaces which sustain a selective exchange of energy and substance (Margalef, 1991).

Taking into account the above-sketched landscape, the main concern is not to study the problem in itself but its deepest interdisciplinary origin (far beyond its particular epistemological borders) as the only way to find a reliable potential explanation (as in medicine the cure depends on an exact diagnostic). Good will and scientific hyperspecialization are not enough in this field. A reliable scientific theoretical framework is the only possible way to assimilate this joke in poor taste to ourselves. In fact, it is only when presidents receive scientific advice that they have the opportunity to hear something beyond the dominant comments of their political or military government advisors. Therefore, ecology has an important role to play in this game. Is ecology at the height of this challenge? This depends on the rationality and passionless accuracy of ecologists.

1.2. Outlining the goals of our theoretical debate

The well-known statement from E. Rutherford ("*All science is either physics or stamp collecting*"; Birks, 1963) is surely quite hyperbolic. However, it is also true that large branches of chemistry, as well as geology, biology and social sciences are framed within the preceding physical context of universe evolution. Given that "*ex nihilo nihil fit*" (nothing comes from nothing), then we should accept that Rutherford was right, at least at a very general level.

We herein explore the analytical link between the current condition of ecology in regard to development sustainability and the above-mentioned statement of E. Rutherford. Sustainability seems to have a so low probability of a rapid solution that it is almost including ecology in the same denomination of "dismal science" that economics has flaunted with sad pride for decades (Carlyle, 1849). So, one of the main goals of this debate is to simplify our point of view about a very complex topic (the interdisciplinary meaning of sustainability concept) by reducing it to its simplest and most essential understanding: the unavoidable effects of the relationship between information and entropy due to the universally pervasive influence of second law of thermodynamics (i.e.: "*the entropy of an isolated system always increases or, in the limit—reversible processes—, it remains constant*"; Aguilar, 2001).

Starting from the above-mentioned simplification, we analyze the whole of current environmental problems as a result from a single fact: the physically predictable failure of man as Maxwell's demon, as well as the important role of this recurrent failure as the main incentive in favor of civilization development. Finally, this article explores the dichotomous role of biological evolution in regard to the survival of biosphere in the large scale, as well as the only possible solution to the environmental crisis in the long run. This solution assumes that, from the above-mentioned dichotomy, we need to fight as strongly as possible in favor of the alternative that includes the survival of our species as the most convenient option from the natural as well as from the cultural point of view.