

“Entropy, Externality and Human Evolution” to “Radiator Theory of Brain”: a Very Short Review

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Abstract:

This review of the paper “Entropy, externality and human evolution” by G. Iurato and A.Yu. Khrennikov, for the Journal of Neuroscience and Neurological Surgery, is aimed to highlight the main neuroscience and paleo-neurology implications of the theoretical research conducted in such a work, above all in relation to the so-called Radiator Theory of evolution of the brain.

Keywords: entropy; neuroscience; endocrinological

Introduction

In the paper entitled “Entropy, externality and human evolution”, by Giuseppe Iurato and Andrei Yu. Khrennikov, and published in *Bio Systems* 191-92 (2020) 104130, the authors have mainly considered the possible applications of non-equilibrium thermodynamics to biological systems, with a particular attention to human being evolution, and making appeal also to socio-humanities, like anthropology, sociology, cliodynamics. From this interdisciplinary discussion, some other possible consequences, from the neuroscience side, have been drawn from either the ontogenetic and the phylogenetic standpoint.

To be precise, considering formally human nervous system as a dynamical system, hence subject to thermodynamical roles and laws, it has been inferred possible ways through which climate changes, as well as meteorological variations, more or less may influence the normal and regular functioning of some basic biological components of central nervous system, above all mid-brain structures, with a particular attention to hypothalamus. So, the paper argues on the possible relations between chief mid-brain structures of human brain and neuroendocrinological system, as influenced by climate changes and meteorological variations from the thermodynamical standpoint.

The hypothalamus is a fundamental mid-brain structure which regulates the biochemical bases of human psyche, so it is a central component of psychosomatic system [1]. It may be considered as a particular dynamical system from the formal viewpoint, whose main vital function is that said to be *homeostasis*, a crucial neurovegetative function; hypothalamus, with pituitary and endocrinological glands, gives rise to neuroendocrinological

system but, at the same time, rules basic motivational and emotive functions as well as stress responses [2-10].

So, the paper considers, on the basis of what non-equilibrium thermodynamics says about the rapid variation of initial or boundary physical conditions (as occur in climate changes and meteorological variations), the neuroendocrine system (and the hypothalamus for first) as a dynamical system ruled by non-equilibrium thermodynamics, hence undergoing its rules and laws, from which then to infer possible explanations of certain neurological phenomenology, like meteoropathy. At the same time, in the paper has also been mentioned the possible relationships between human evolution and some chief notions of non-equilibrium thermodynamics, like entropy and the breaking of time symmetry, so pointing out their occurrence during the crucial bifurcation from primitive societies to civilized ones, which has besides given rise to the transition from a cyclic time to a linear one, typical of the modern societies.

On the one hand, if one looks at the neurobiological bases of time perception, then we observe that even invertebrates have a time perception which may also be quantified per intervals, so if we refer to the so-called triune brain evolution model of Paul D. Maclean, along the biological line of evolution of living beings, one may argue on what possible changes have occurred along the human brain evolution from the rhombencephalic structures (typical of invertebrates), to mesencephalic ones (typical of mammals), until up prosencephalic components, above all their telencephalic parts, typical of human beings, so we may infer that only these latter have conferred a more *symbolic* (or qualitative) meaning to time, besides its typical quantitative nature (which is a feature present, along the biological evolution line, from invertebrates to mammals), with the crucial passage from nature to culture,

so the above mentioned passage from the cyclic time to the linear one, with its enriched variety of meanings (culture), may be put into correlation with the rising of the neocortex structures.

On the other hand, having also made reference to certain thermodynamical properties of complex dynamical systems to possibly explain human evolution is in agreement with some past hypotheses on the brain evolution based on the so-called *radiator theory* of brain due to the works of Dean Falk [11] and Konrad Fialkowski [12, 13] where is put forward the main hypothesis according to which brain evolution of primitives might have been due to evolutionary adaptation responses to increased heat stresses and consequent temperature regulation which, in turn, entailed a rewiring of blood vessels net of human brain during its phylogenetic evolution.

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