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## **Emergent Minds**

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### RESUMEN

Uno de los grandes retos para Darwin y sus seguidores fue explicar cómo era posible que las funciones mentales emergieran a partir de los procesos mentales sin recurrir a causas sobrenaturales. El propósito de esta artículo es investigar el programa darwinista de una teoría materialista de la emergencia de la mente humana, estrictamente basada en principios evolutivos, y evaluar este programa a la luz de las perspectivas modernas sobre la superveniencia y la emergencia.

PALABRAS CLAVE: *darwinismo, emergencia, evolución, materialismo, mente, superveniencia.*

### ABSTRACT

One of the greatest challenges for Darwin and his followers was to explain how mental functions could emerge from brain processes without appeal to supernatural causes. The aim of this paper is to investigate the Darwinian programme of a materialistic theory of the emergence of the human mind, strictly along evolutionary principles; and to evaluate this programme in terms of modern views on supervenience and emergence.

KEYWORDS: *Darwinism, emergence, evolution, materialism, mind, supervenience.*

[...] in evolution a major anatomical change inevitably signals concomitant functional change [...].

[M. Donald (1993), p. 95]

### I. INTRODUCTION

With the publication of Darwin's *Origin of Species* (1859) the issue of the origin and nature of humanity acquired a new theoretical framework. Darwin's famous promise that light will be thrown on human origins was immediately taken up by a number of researchers who attempted to provide an

answer in terms of natural selection. Darwinians like E. Haeckel, Th. S. Huxley, Ch. Lyell, F. Rolle, E. Tyler and K. Vogt spelt out the lessons of applying natural selection to the appearance of humans on Earth. The major obstacle was not so much the human body as the human mind. It seemed difficult to see how the superiority of the human mind could have emerged through the forces of natural selection. The challenge, which these researchers took up, was to remain faithful to the materialistic framework, adopted in the *Origin of Species*, and to apply the approach to the question of the emergence of human minds. To achieve their aim, the Darwinians treated the human brain as a natural organ, the seat of the human mind. When Darwin finally published *The Descent of Man* (1871) he benefited from these earlier research efforts. The extent of the challenge can be better appreciated if we consider the position taken up by Alfred Wallace, who was the co-discoverer of the principle of natural selection. Wallace was willing to accept that the forces of natural selection had shaped the human body. But he could not bring himself to accepting that natural selection was also responsible for the emergence of the human mind. His reason was that the mental abilities of man far exceeded what would have been useful for his survival.

Natural selection could only have endowed savage man with a brain a few degrees superior to that of an ape, whereas he actually possesses one very little inferior to that of a philosopher [Wallace (1870), p. 202].

Wallace therefore concludes that a superior being must have guided the ‘development of man in a definite direction’ [Wallace (1870), p. 204]. Darwin and the Darwinians were unwilling to adopt such an explanatory dualism. They opted for a unified materialistic explanation of the human body *and* the human mind, which implied a renouncement of the notion of design. The aim of this paper is to investigate how Darwin and the Darwinians argued in favour of a materialistic theory of the emergence of the human mind and to evaluate their programme in terms of modern views on emergence and supervenience.

## II. MATERIALISM AND THE MIND

The materialism of the 19<sup>th</sup> century is well expressed in Jean Baptiste Lamarck, whose views on ‘use inheritance’ were rejected by Darwin in the *Origin of Species*. In his *Philosophie Zoologique*, Lamarck claimed that:

All the faculties without exception are purely physical [...]. Physical and moral have a common origin; ideas, thought, imagination are only natural phenomena [Lamarck (1809), Part II, Introduction].

But it was one thing to treat humans as descendants of anthropoid ancestors — a thesis, which the Darwinians illustrated in the image of branching evolution — but quite another to account for the superior mental and moral faculties of human beings. The materialist could not help themselves to supernatural causes. They attempted to explain the explanatory gap between body and mind from below. Huxley, for instance, speculated that ‘molecular change in the nervous system causes states of consciousness’ [Huxley (1874), p. 365]. This early speculation was made more precise by the employment of two principles, which enabled the Darwinians to sketch a materialist theory of the emergence of mental states.

The first step was to employ Darwin’s Principle of Correlation of Growth to account for the observable evolutionary growth of human brain capacity. Variations in human body structure – upright posture, the freeing of hands – resulted in physical changes elsewhere in the body: a larger brain, a vocal apparatus. The principle is supported by the view that the organisms must be viewed as functional wholes. Huxley writes:

All faculty depends on structure and as structure tends to vary, it is capable of being improved. [...] Variation in structure does not correspond to variation in function. The variation in function which follows the variation in structure is much greater than the latter [Huxley (1863), pp. 468-9; Darwin (1871), pp. 80-81].

Huxley thus argues for a non-linear relationship between structural changes and functional changes. Although he sees functions as expressions of ‘molecular arrangements’, he hints at the second step in the argument. This principle implies that small changes in body structure may lead to vast functional changes of the organism affected. The development of a larger brain in humans allows for the emergence of ‘unselected’ functions. A large brain may develop functions, which are not strictly needed for survival. According to Huxley a small change in molecular arrangements may lead to a vast, non-linear expansion of mental functions.

In his *Descent of Man* (1871), Darwin explains the emergence of higher mental and moral functions as a result of natural selection amongst human groups.

Judging from all we know of man and the lower animals, there has always been sufficient variability in their intellectual and moral faculties, for a steady advance through natural selection [Darwin (1871), pp. 168-9].

Darwin locates the roots of moral and social faculties in ‘social instincts’, which —with the increase of experience and reason in humans— are converted into cultural values. He argues that the cultivation of intellectual and moral capacities in one tribe — as against a neglect of such attributes in a rival tribe — will bestow an evolutionary advantage on the cooperative tribe.

We can see that, in the rudest state of society, the individuals who were the most sagacious, who invented and used the best weapons or traps, and who were best able to defend themselves, would rear the greatest number of offspring [Darwin (1871), p. 153].

These two principles gave the Darwinians a research programme by which they could hope to explain how the ‘brain could cause the mind’ or by which brain processes could ‘cause’ mental processes. The explanation had to remain tentative as long as they could not specify the ‘causal’ relationship between the brain and the mind. The Darwinians did not have at their disposal modern notions of emergence and embodied minds. But their efforts to construct a materialist theory of the mind, within an evolutionary context, paved the way for modern evolutionary, materialist approaches to the puzzle of mental phenomena.

### III. EMERGENCE

As we have seen, Huxley assumes the existence of a non-linear relationship between small changes in the ‘nervous system’ and the vast functional changes in the states of consciousness. It is typical of emergent properties that they constitute qualitatively novel phenomena, which are no longer reducible to the base from which they emerge. Here the base is constituted by the neural networks in the brain, which produce novel, higher-order mental functions. Mental processes are the emergent properties of interacting neural networks. The integration of neural networks and the links, which exist between areas of the human brain, means that mental functions tend to be distributed across the cortex, although, depending on the activity involved, certain brain areas will be more at work than others. Emergent properties tend to be higher-order properties of the whole system [Weinert (2009), ch. II.V].

The notion of emergence has led M. Bunge to the thesis of emergentist materialism, which is characterized by three tenets [Bunge (1977), p. 506]:

1. All mental states (events, processes) are states (events, processes) in the central nervous system of vertebrates (CNS).
2. These states, events and processes are emergent relative to those of the cellular components of the CNS.
3. The so-called psychophysical relations are interactions between different subsystems of the CNS or between them and other components of the organism. There is no one-to-one mapping between brain states and mental states.

Note in particular that every emergent property of a system can be explained in terms of properties of its components *and* the interactions between them. This set of philosophical hypotheses needs to be translated into empirical research and this has been done in a number of approaches. For instance, the neuroscientist G. Edelman aims at completing Darwin's programme [Edelman (1992); (2004)]. To complete the Darwinian programme Edelman develops a biological theory of consciousness.

The theory must show how the neural bases for consciousness could have arisen during evolution and how consciousness develops in certain animals [Edelman (2004), p. 3].

Such a task, however, requires a much greater knowledge of the 'molecular arrangements' of the brain than was available to Huxley and his contemporaries. But the key to such a materialist approach is still to find the 'neural correlates of consciousness' [Edelman (2004), p. 13]. Edelman proposes a global theory of the brain, called neural Darwinism or theory of neuronal group selection. It has three basic tenets [Edelman (2004), pp. 39-41]:

1. Developmental selection leads to a highly diverse set of circuits; 'the dynamic primary processes of development [...] lead to the formation of the neuroanatomy characteristic of a given species' [Edelman (1992), p. 83].
2. Experiential selection leads to changes in the connection strengths of synapses, favouring some pathways and weakening others, resulting from 'variations in environmental input during behaviour.'
3. 'Reentry – during development, large numbers of reciprocal connections are established both locally and over long distances. This provides a basis for signalling between mapped areas across such reciprocal fibres. Reentry is the ongoing recursive interchange of parallel signals among brains areas, which serves to coordinate the activities of different brain areas in space and time. Unlike feedback, reentry is not a sequential transmission of an error signal in a simple loop. Instead, it simultaneously involves many parallel reciprocal paths and has no prescribed error function attach to it.' [...] reentry is the central organizing principle that governs the spatiotemporal coordination among multiple selectional networks of the brain.'

The particularly Darwinian aspect arises when an evolutionary event occurs that connects 'previously evolved capacities with new structural and functional features that emerge as a result of natural selection' [Edelman (2004), p. 48].

Leaving aside the technical details of the brain structure, which are involved in observable physical and mental behaviour, the crux of the theory is still how ‘the brain can cause the mind.’ Edelman’s thesis is that the ‘phenomenal transform, C, is entailed by the neural activity, C’ [Edelman (2004), p. 78]. Although conscious states (C) accompany neural states (C’), it is the neural correlate C’ that is ‘causal of other neural events and certain bodily actions’ [Edelman (2004), p. 78]. If there is mental causation, if mental states can act on physical states, this causation must, on Edelman’s view, occur via the mechanisms embedded in neural activity, since the ‘world is causally closed’.

The consequences of this line of reasoning is that evolution selected C’ (underlain by the neural activities of the dynamic core) for the efficacy in planning conferred by its activity. At the same time, however, such C’ activity entailed corresponding C states. Indeed, there is no other way for an individual animal to directly experience the effects of C’ [Edelman (2004), pp. 79-80].

#### IV. COMPLETION OF THE DARWINIAN PROGRAMME INCOMPLETE

At this stage, however, we must admit that the completion of the Darwinian programme is still incomplete. For Edelman’s notion of ‘entailment’  $C' \rightarrow C$  leaves open the question of the physical correlate of entailment. Two much discussed candidates are ‘supervenience’ and ‘emergence’.

The notion of supervenience is often used in discussions of the philosophy of mind. [Kim (1993); (2000); Dennett (1992); Chalmers (1998)] If we want a materialist explanation of the mind, it is tempting to understand supervenience as a physical relation. Let us call such a relation *natural supervenience*.<sup>1</sup> It would mean that the physical facts and laws of our brain structures entail the mental facts. Natural supervenience requires a) a covariation of the properties of one domain, the physical base (the brain), with a supervenient domain (the mind) and b) the dependence of the supervenient domain (mental states) on the base domain (brain states). The base constrains the supervenient domain [Rueger (2000)]. That is, any change in the physical base engenders a change in the supervenient domain. There are many examples of supervenience in a physical sense. For instance, the magnetic field, surrounding a current-carrying wire, is supervenient on the flow of electrons (Oersted). Or the current, which is produced by a varying magnetic field, is supervenient on the magnetic field flux (Faraday). Magnetic fields and currents are lawlike, measurable yet supervenient phenomena. In a similar way, the mental is said to supervene on the physical. An asymmetric dependence exists between the mental and the physical in the sense that any variation in the physical base brings about a variation in the mental domain, but not vice versa. Changing the physical base will change the mental contents of any entity,

which has that base. But changing the contents does not change the base. Coincidence in the physical entails coincidence in the mental but a supervenient property may have alternative subvenient bases [Kim (1993), Essay 4]. If the mental supervenes on the physical, then it can be explained in physical terms alone. In other words, it is reducible, in explanatory terms, to the physical base.

Does the supervenience view correctly describe the Darwinian programme? One problem is that the above physics examples can rely on lawlike regularities in the physical world but it has not yet been established that psycho-physical laws exist between the mental and the physical realm. Furthermore, the Darwinian materialists are eager to grant a certain independence to the mind and its products. The Darwinians considered non-adaptive change in their explanation of intellectual and moral faculties. They treated organisms as integrated systems, which implies both that there is no direct mapping of single brain states to single mental states and that brain and mind capacities have been subject to evolution [Donald (1993)]. But supervenience has no evolutionary dimension. The Darwinian considerations also imply that the mental domain is not exhausted by conscious states. Consciousness, the world of subjective experiences, may be supervenient on brain states. The subjective feelings, which accompany sensations and perceptions, may be entirely dependent on the existence of brain states. Though it is true that consciousness — the subjective awareness of ourselves in the world — disappears with the death of the body, it does not follow that all manifestations of the conscious mind vanish with the disappearance of the base. The Darwinians were not concerned with ‘qualia’ but rather with what Popper would call ‘world 3’ products of mental activity. For instance, language, moral values and cultural achievements can survive the demise of individuals and societies. Ideas live on in other people’s minds, in books and computer memories. Ideas can take on a material existence in social and cultural institutions and channel social actions in particular directions. Some mental products may therefore not be sufficiently explained by supervenience and call for a different explanation. For a long time the mind led a rather ethereal existence in philosophy. Under the Cartesian influence, the mind was depicted as a separate entity, confined to its own realm. William James proposed to view the mind as a process, so that today we tend to think of the mind ‘as what brains do’ [Blackmore (2003), p. 13]. In addition to the view of mind as a process, recent developments have emphasized strongly that the mind is enmeshed with the world. This has led to the concept of *embodied minds* [Clark (1997); Edelman (1992)]. The embodied mind interacts with the environment and uses symbolic props — symbolic language, cultural institutions, and memory devices — to go about its problem-solving activities. The embodied mind also leaves publicly available documents, like mathematical theorems, physical equations and many other cultural products in the public sphere. The extended mind is not likely to be simply supervenient on brain states. Given

the Darwinian emphasis on correlated variation and the possibility of unselected mental functions, it is likely that they would have regarded the mental faculties as emergent properties. In fact, the school of British emergentism defended exactly such a position.<sup>2</sup>

Huxley has often been accused of having been an epiphenomenalist about mental properties; and in an early paper [Huxley (1874)] he describes humans as ‘conscious automata’. But it is also true that both Huxley and Darwin came to emphasize the emergent aspects of mental properties. Thus Darwin stresses the importance of intellectual and moral faculties in the progress of civilization:

Of the high importance of the intellectual faculties there can be no doubt, for man mainly owes to them his predominant position in the world [Darwin (1871), p. 153].

Darwin sees in the intellectual faculties an evolutionary advantage. We have indicated how these intellectual faculties could have arisen from the operation of two principles. What is of interest in the current context is that intellectual faculties produce cultural products, like moral values, which transcend their individual bearers. At first Darwin displays a strong tendency to attribute the spreading of civilized values to the operation of natural selection:

All that we know about savages [...] shew that from the remotest times successful tribes have supplanted other tribes. [...] At the present day civilised nations are everywhere supplanting barbarous nations [...]; and they succeed mainly, though not exclusively, through their arts, which are the products of the intellect. It is, therefore, highly probable that with mankind the intellectual faculties have been mainly and gradually perfected through natural selection [...] [Darwin (1871), p. 153; cf. Rosenberg (2005)].

But note that he later qualifies this statement with respect to ‘civilized nations’:

With civilised nations, as far as an advanced standard of morality, and an increased number of fairly good men are concerned, natural selection apparently effects but little; though the fundamental social instincts were originally thus gained [Darwin (1871), 163, cf. p. 80].

With this qualification Darwin finds himself in the company with T. S. Huxley who strongly emphasized that amongst human societies, natural selection had been replaced by cultural selection. Human values spread by cultural rather than natural selection. The development of civilization consists in the gradual deflection of the forces of natural selection. Huxley compares civilized life to a horticultural process, in which human gardeners modify their living conditions by deliberate choice.



Laws and morality are restraints on the ‘struggle for existence between men in society’ [Huxley (1894), p. 30].

Society, then, differs from nature in having a ‘definite moral object’ [Huxley (1888), p. 202].

What all this means for the thesis of emergence is that the cultural values are more than epiphenomenal, causally inefficacious qualia. The ideas present a social force; they are a vehicle of progress in the civilization process. They spread through a process of Lamarckian selection [Gould (2002), p. 953]. Huxley expressly rejects crude materialism — the view that the universe consists of matter and motion — and stipulates that ‘consciousness’ is a ‘third thing in the universe’ [Huxley (1886), p. 134]. Hence, ideas are objectively novel phenomena, whose spread is governed by cultural, rather than natural selection. As both Huxley and Darwin stressed, they have a massive impact on social life. The very influence of Darwinian ideas on 20<sup>th</sup> century thinking testifies to the existence of this process.

Thus we have to conclude that on the Darwinian view certain products of the intellectual faculties — cultural and scientific ideas and moral values — are emergent properties of our brain functions. They are qualitatively novel and are governed by Lamarckian selection. But ultimately, the Darwinian challenge remains unanswered to the present day. The liquidity of water is an emergent property of the interaction of different molecules, where this emergent can be understood by the operation of physical and chemical mechanisms working on the components. The Darwinian thesis of emergence has to explain how mental products, like novel ideas, may arise from the interaction of neural networks. The thesis entails the emergence of the immaterial from the material. As long as no physical correlate can be found, notions like supervenience and emergence remain useful analogies. But it is at this stage still unclear whether notions like cause, emergence, entailment or supervenience can provide a physical bridge to close the gap between the mental and the physical.

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## NOTES

<sup>1</sup> In his work Kim discusses several notions of supervenience — weak, strong, global. [Kim (1993)] The term ‘natural supervenience’ comes closest to his characterization of weak supervenience: A set F of properties is supervenient upon a set G of properties with respect to a domain D just in case any two things in D, which are indiscernible with respect to G are necessarily indiscernible with respect to F [Kim (1993), p. 175]. Note, however, that such definitions become only useful if the notion of ‘necessitation’ is further specified. See Humphreys [(1997), p. 339].

<sup>2</sup> Note that, as the essays in Bedau/Humphreys [(2008)] demonstrate, there is no agreed definition of the term emergence and no agreed position of materialist emergentism. In the present essay emergence is introduced in its most basic and agreed general terms, as for instance discussed in Humphreys [(1997, pp. 341-20)].

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