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The evolutionary origins of teemosis and its implications for neoDarwinian theory

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KEYWORDS

Cambrian, Evolution, Emotions, Environment, Innate behaviour, Natural selection, Precambrian, Instinct, Teemosis, Teems, Transduction, Vendian.

ABSTRACT

Determining the origins of the teemosis evolutionary process has implications for the reinterpretation of the fossil record and the natural history of earth . Here it is argued that teemosis first emerged at the Vendian-Cambrian boundary - 543 mya. This suggests the preceding 3.2 billion years of Precambrian evolution were moderated exclusively by the Darwinian process of natural selection. A review of the Precambrian fossil record suggests natural selection was incapable of promulgating morphological complexity, biological diversity or complex inheritable instincts. This challenges the belief that given enough time, natural selection could, and did, achieve the biodiversity and complexity ubiquitous in nature. It is argued that for the last 543 million years, biotic complexification,

speciation, biodiversity and complex innate behaviour have been the consequence of teemosis and NS functioning in symbiotic concert.

INTRODUCTION

Since the publication of *The Origins of Species*¹ over 140 years ago, the prevailing biological paradigm has been that evolution has been moderated by a single evolutionary process - natural selection, gradualistically promulgating complex morphological and behavioural forms, speciation and biodiversity. This single evolution theory predicts that evolution is incremental and gradualistic and the fossil record will reveal linking intermediate forms. While phyletic gradualism as predicted by Darwinian theory is evident in the fossil record,^{2, 3, 4, 5, 6, 7, 8, 9, 10, 11} taphonomic evidence additionally reveals attenuated periods of morphological stasis, interspersed by the abrupt appearance of new species^{12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22} - patterns at variance with Darwinian theory.

Having postulated that evolution on earth has been moderated by two distinct evolutionary processes²³ an attempt is now made to chronologically date the origins of the teemosis evolutionary process and to speculate whether the two evolutions hypothesis can resolve inconsistencies in NeoDarwinian theory, and in particular, anomalies in the palaeontological record.

Dating the evolutionary origins of teemosis

Major adaptations are generally preceded by pre-adaptations,²⁴ and teemosis is no exception. As a major adaptive evolutionary process, the evolution of teemosis was dependent on at least ten pre-adaptations – components that needed to independently evolve before they could be fused by NS into a functional new evolutionary process. As

teemosis could not function until all ten of these pre-adaptations had emerged, we may determine the origins of teemosis by dating the most recent pre-adaptation.

The pre-adaptations (components) of teemosis and their approximate chronological origins include:

Eukaryotic DNA and the nucleated cell. Eukaryotic DNA emerged from ancestral prokaryotic cells around 1.6 - 2.1 billion years ago.^{25, 26, 27} Unlike prokaryotic DNA, eukaryotic DNA contains large amounts of ncDNA and introns which teemosis uses to encode teems. Noncoding genomic sequences are spliced out prior to protein synthesis.

This is not to suggest however that eukaryotic DNA emerged specifically to moderate teemic functionality. It is more likely to have originally emerged because it fulfilled unrelated adaptive functions, almost certainly related to multicellularity. For example, introns have been implicated in chromosomal organization, gene expression and other regulatory functions in multicellular eukaryotes.^{28, 29, 30, 31, 32, 33}

Hypermutable of microsatellites and other ncDNA elements. Bacterial prokaryotes utilise hypermutational noncoding microsatellites, what Moxon et al (1994)³⁴ call 'contingency genes' to enable bacterium to adapt to new environmental conditions. This functional hypermutability of microsatellites may represent a prokaryotic solution to environment-genome interaction, a solution which NS conserved and utilised in eukaryotic teemosis. Hypermutable of microsatellites dates to the origins of eukaryotic DNA.

The emergence of the CNS - the emotion producing organ of teemosis. The evolution of the CNS from nerve cell networks, originally to effect organismal mobility, is indicated by 'trace fossils,' (notably *Trichophycus pedum*) reliably dated to the end of the Vendian, 650 to 544 mya.^{35, 36, 37, 38}

Neurons, (sensory, motor and interneurons,) and their concomitant synaptic, dendritic systems. Essential to the emergence of the CNS and therefore established prior to the Vendian Metazoan radiation.

Hormones, Neurotransmitters, Neuropeptides, Enzymes, Ion channels, and other electro-chemical compounds. Similarly, indispensable to CNS function and therefore extant by the Vendian-Cambrian boundary.

Mobile multicellular animals. Coordination between individual cells facilitated the emergence of the mobility and the metazoans. Although multicellular seaweeds were extant 1 billions years ago, mobile multicellular animals are abundantly evident in the Metazoan radiation that occurred between 565 - 543 mya.^{39, 40}

Habituation – (learning to ignore a stimulus): a genome resident innate behaviour evident in primordial organisms like the flatworm, Planarian (*Dugesia dorotocephala*) and other species extant during the late Vendian and early Cambrian.

Rudimentary sensory modalities and chemoreceptors – the fossil records indicates sensory modalities first appeared in the Vendian, notably in *Branchiostoma*. Eyes in the form of simple eyecups were present by the lower Cambrian.^{41, 42}

Proto-cerebral modules; embryonic neural tubes, insulating myelin sheaths, etc, antecedents of the reptilian brain and the amygdaloid complex, almost certainly extant in Vendian jawless fish of the class *Agnatha*. Although not indispensable to encoding teems, proto-cerebral modules facilitated teemic monitoring and activation, and additionally were instrumental in the adaptive complexification of the teemosis process.

Thus, all the constituent preadaptations of the teemosis evolutionary process were sporadically and independently manifest by approximately 550 mya. This is no

coincidence. Over the next 5-10 million years, organismal motility, enabled by the CNS, contributed to the rapid geological dispersal of pre-adaptive characters. Once the pre-adaptive constituent characters were independently assembled and widely dispersed, it is conjectured natural selection rapidly fused the disparate characters to form the rudiments of the teemosis process, which in turn, achieved rapid vagility. Accordingly, this suggests the teemosis evolutionary process was adaptively functional and widely dispersed by 543 mya.

This rapid global radiation may be attributed to several coincidental factors. Teemosis created, for the first time, stable, systematic instincts, including epigamic, agonistic, parental, copulatory, proceptive and allelomimetic behaviours, predation, territoriality, escape strategies, nutrient identification and preference, etc. that provided a singular selective advantage in variable ecological contexts and importantly, provided a means by which the organism's current environment could be factorial in the creation of new innate behaviours.

Secondly, the inefficient nature of the Darwinian mutational process, the absence of predation, and the homogeneous aquatic environment ensured that by and large, Precambrian taxa evolved in parallel – almost as a single entity. The hypothesis - that analogous ecological, evolutionary and selective conditions precipitated a uniform global 'steady-state' phyla-wide evolution throughout the Precambrian is supported by palaeontological data that reveals the Ediacaran biota appeared virtually simultaneously around the world throughout the Vendian - discovered so far, on all continents except Antarctica. The steady-state scenario predicts that the dispersal of the eukaryotes, oxygen metabolism, multicellularity, noncoding genes, the emergence of the CNS, motility, rudimentary sensory modalities and other teemic pre-adaptations emerged contemporaneously in disparate geological and ecological niches, providing the 'critical mass' that allowed teemosis to simultaneously emerge and rapidly radiate.

Testing the hypothesis - teemosis invents systematic predation

The hypothesis - that teemosis emerged dramatically at the base of the Cambrian, 543 mya. Can be easily tested because it makes certain predictions that should be observable in the fossil record. For example, if as has been asserted, teemosis is the only means by which complex new instincts are created and promulgated, the fossil record of the early Cambrian should reveal evidence of the sudden, unprecedented appearance of complex innate behaviour.

One example of such complex, environment specific behaviour, demonstrably reliant on innate capacity, is predation. Accordingly, the hypothesis predicts that systematic predation first emerged abruptly at the basal Cambrian. This prediction is supported by a considerable body of palaeontological evidence, as indicated by trace fossils, coprolites, taphonomic patterns and phylogenetic affinities,⁴³ which reliably dates the emergence of systematic predation to the basal Cambrian,^{44, 45, 46, 47} While this stratigraphic data supports the prediction, one possible example of predatory boring does exist below the Cambrian, (Bengtson and Yue, 1992)⁴⁸ but is not taken to be representative of widespread predation.⁴⁹ Significantly, while the sudden appearance of widespread systematic predation after 3.2 billion years of Darwinian evolution is problematical for prevailing evolutionary and palaeontological paradigms, it is wholly consistent with teem theory and the abrupt advent of a new mechanism of behavioural evolution.

Testing the hypothesis - the impact of teemosis on organic evolution

It is posited that the rapid dispersal of teemosis among lower Cambrian animal phyla generated ecological competition for the first time, and established natural selection proper as an important evolutionary factor for the first time. Competition to acquire the teemosis process, we may suppose, rapidly created a divide between teemic

and Darwinian taxa. As teems provided a singular selective advantage compared to existing Darwinian instincts, (notably reflex actions, kineses and tropisms, plus simple gene based behaviours precipitated by hormones, peptides etc,) it may be inferred that nonteemic species, including most of the Ediacarian assemblage, that could not make the transition to teemosis (because they lacked a CNS, sensory organs, or both,) either faced extinction or adapted to nonteemic ecological niches.

This prediction is confirmed by biostratigraphy that shows the majority of Ediacaran taxa abruptly disappeared at the lower Cambrian.^{50, 51, 52, 53, 54}

Although various theories have been proposed to explain this near extinction, no consensus currently exists for their sudden demise. Teem theory supports the view (Morris 1998) that while some Ediacaran medusoids possessed a CNS to effect free-swimming and burrowing motility, the majority of circular Ediacaran fossils are probably the bulbous anchors of soft coral and sea-pen like cnidarians.⁵⁵ Lacking a CNS and sensory organs, these taxa never became teemic and were grazed to extinction by teemic benthic feeders.

Among the new teemic animal taxa, selective pressures, including those generated by predation, rapidly ameliorated the adaptive functionality of the teemosis process. Characteristics utilised by teemosis, in particular the CNS, sensory organs and electrochemical messaging systems, underwent rapid morphological complexification. We may speculate that teemosis was so adaptive that the transition from an exclusive Darwinian biota to a predominantly teemic biota occurred within five million years, and possibly as few as one million years.

As teemic transduction utilises sensory organs, the hypothesis predicts that teemosis drove the evolution of more efficient visual, aural, tactile and olfactory

receptors. Again, this rapid complexification of sensory receptors should in theory be evident in the fossil record, and this is evidentially demonstrated in the abrupt appearance of fully functional holochroal and abathochroal eyes of trilobites (*trilobita*.) The abrupt emergence of functional compound eyes in trilobites has been dated by Clarkson (1975) and Zhang et. al (1990) to precisely 543 mya – the basal Cambrian.^{56, 57}

The appearance of a compound eye in such a primitive arthropod has remained problematical for paleontology, as indeed, has the sudden appearance of 15,000 described species of trilobites. By contrast, teem theory holds that trilobites were among the first fully teemic species, demonstrating highly adapted sensory receptors and a library of complex teem-based predatory, defensive and sexual behaviours that facilitated their adaptation and dispersal into a diverse range of aquatic environments.

In conclusion, evidence supports the hypothesis that all the core teemic pre-adaptations were assembled by the basal Cambrian. The emergence of widespread teemosis by 543 mya is supported by the abrupt appearance of systematic predation, functional sensory receptors, the rapid proliferation of teemic species such as trilobita, and the mass extinction of nonteemic metazoan taxa.

The implications of the origins hypothesis

The hypothesis – that systematic teemosis emerged at the Vendian-Cambrian boundary divides natural history into two major new epochs; preteemic and teemic. The Precambrian was coincidentally exclusively mediated by Darwinian evolution while the lower Cambrian to the present has been mediated by both the NS and teemosis evolutionary processes.

This hypothesis makes two significant predictions. Firstly, that the fossil record of the Precambrian – a period of exclusive Darwinian evolution lasting 3.2 billion years,

will predominantly demonstrate phyletic gradualism consistent with Darwin's original theory.

Secondly, from the basal Cambrian to the present, a period spanning 543 million years, organic evolution has been the consequence of NS and teemosis functioning in symbiotic concert, and may therefore be expected to demonstrate a differential fossil record, indicative of the singular contribution of teemosis to organic evolution.

If correct, and the Precambrian taphonomy is an accurate chronicle of natural selection's exclusive tenure as the sole evolutionary process on earth, it provides a convenient methodology to isolate NS and reevaluate its effectiveness as a evolutionary process.

What then does the fossil record tell us about natural selection? A review of the palaeontological record of the 3.2 billion year tenure of exclusive Darwinian evolutionary activity reveals phyletic gradualism, bradytelic and sporadic evolution, interspersed with "long-term morphological stasis now recognized as one of the most striking aspects of the fossil record." (Williamson, 1981.)⁵⁸ While it is widely accepted that evolution tends towards increased complexity^{59, 60} and diversity,⁶¹ paradoxically, after more than three billion years, life on Earth was still "a world of microscopic forms, rarely achieving a size greater than a millimetre or a complexity beyond two or three cell types." (Carroll 2001.)^{62, 63}

The ineffectiveness of Precambrian NS meant that three billion years of Darwinian evolution, (representing 87% of geologic time,) produced bacteria, protozoa, algae and cnidarians, but anomalously failed to manifest skeletal assemblages, jaws, the reptilian brain, efficient sensory organs, terrestrial organisms, predation, interspecies communications, or complex inheritable instincts. The only tenable conclusion that may

be extrapolated from this cursory review of the Precambrian fossil record is that singly, random mutations and natural selection proper cannot, and did not, achieve complexity, biotic diversity or complex instinctual behaviour, a conjecture that challenges the putative belief that given enough time, NS could, and did, achieve the biodiversity and complexity ubiquitously evident in nature.

This radical conclusion supports Darwin's original understanding of natural selection as a gradualistic and incremental evolutionary process, but challenges the prevailing orthodoxy that random mutations promulgated the complexity ubiquitously evident throughout the Phanerozoic. If correct, this requires a significant reevaluation of natural selection as a functional evolutionary process.

Four ecological factors are proposed that contributed to the pervasive virtual stagnancy of Darwinian evolution throughout the Precambrian and that limited the effectiveness of NS as an evolutionary process.

Firstly, there exists a theoretical limit to the complexity, diversity and novelty that any random based evolutionary process can achieve, beyond which it stalls. Simple morphological traits that only require a small number of mutational alleles to function or modify, such as size and occasionally colour, will be the most common objects of evolutionary modification facilitated by the Darwinian process, notwithstanding that even the colour of *Drosophila*'s eye is moderated by 13 different genes.⁶⁴ However, more complex physicalities, necessitating multiple mutations impacting on perhaps thousands of base pairs in innumerable genes on multiple chromosomes, in precise and complex sequential arrays, will be progressively rarer.

Secondly, without a systematic method of creating and inheriting essential behaviours like sexual reproduction, nutrient procurement, defence, territoriality etc.

survival was too precarious to sustain the behavioural expansion required for a more complex biosphere.

The author does not impute that Darwinian evolution was unable to utilise random mutations to effect stable genome based innate behaviours: after all, life had been maintained for 3.2 billion years and this would have necessitated at least some form of stable, innate behaviour. However, the hypothesis, that on their own, random mutations cannot achieve complexity or biotic diversity predicts that Precambrian Darwinian instincts must, of necessity, have been extremely simple biologically, and been achievable by the random reconfiguration of minimal genetic material.

Accordingly, Precambrian (preteemic) Darwinian instincts are comprised exclusively of simple behaviours consisting of hormone derived behaviours and reflex actions, including habituation, tropisms, kineses, taxis, and other basic conditioned responses. Consistent with this hypothesis, these automatic stimulus-response behaviours are genome based, rapid, reliable, adaptive, do not require functional brains, and are genetically simple enough to be promulgated by random mutations. Significantly, among the few behavioural genes so far identified have been those coding for simple reflex actions, such as egg laying in the sea slug, *Aplysia*⁶⁵ and feeding behaviour in the worm (*C. elegans*)⁶⁶

Clearly, throughout the Precambrian, primitive Darwinian instincts contributed to the adaptive landscape by conferring on multicellular organisms in simple aquatic environments rudimentary inheritable behaviour, including the hormones, neurotransmitters, enzymes, neuropeptides and other physical systems that supported these behaviours. However, the author is of the opinion, based on the complexity, diversity and environmental interactivity of teemic instincts, and their ubiquitous prevalence in higher taxa, that Darwinian instincts and reflex behaviours were too

rudimentary, inflexible and lacking in ecological interactivity to singularly support the behavioural repertoires required to sustain phyletic expansion through the lower Phanerozoic, and in particular, transitions to higher animal taxa in terrestrial environments.

The third point is an extension of the second. The inability of NS to evolve mechanisms by which complex, environment directed inheritable behaviours could be promulgated ensured that adaptive instincts such as nonrandomised mate selection, territoriality, progeny nurture and predation did not arise in any systematic widespread context. Proof that systematic predation failed to emerge during the 3.2 billion year reign of NS is provided by taphonomic evidence, including the Ediacaran assemblage, that consistently reveals defenceless, soft bodied organisms, devoid of body armour or agonistic weaponry. Without predation and the 'food chain,' competition between individuals is greatly reduced, and intraspecific and interspecific competition, as we know from Darwin, is an essential element of NS.

Finally, the ancestral Precambrian environment was exclusively aquatic, and imposed a limiting and unvarying context that muted the NS process and meant that by and large, most species evolved analogous traits and behaviours to deal with a comparable ecological niche.

Collectively, these shortcomings proscribe a theoretical 'Darwinian zenith' of complexity and diversity that Precambrian biology could achieve *vis-à-vis* before plateauing out. Having argued that simple hormonally induced behaviours, plus tropisms, habituation, taxis, kineses and other reflex actions represent the zenith of NS's attempt to create innate behaviour, we may now reason that this morphological zenith can be identified in the fossil record and dated to between 600 and 545 mya. It was here, in the late Vendian Period, that the random Darwinian evolutionary process attained its

modest pinnacle of morphological effectiveness, exemplified by the 30 different genera comprising the Ediacaran Fauna.^{67, 68, 69, 70, 71} a disparate assemblage of multicellular, soft bodied organisms of uncertain affinities, or (like *Tribrachidium*,) unassignable to any extant phylum.

As the Edicarians reveal no evidence of systematic predation or other complex inheritable behaviour, they appear to represent the upper limits of the random mutational matrix. Unsupported by appropriate innate behaviour, the Edicarian assemblage achieved a biotic plateau beyond which it could not progress. Unless a new evolutionary process emerged capable of generating heritable instincts, environment-genome interactivity, morphological complexity and diversity, this ‘failed evolutionary experiment’⁷² was destined to remain an accretion of aquatic cnidarians, annelid worms and primitive arthropods.

The late Precambrian Darwinian zenith appears to have coincidentally and independently accumulated a number of disparate biological systems and traits, each individualistically adaptive and unrelated, which selective pressures assembled into the new teemosis evolutionary process via a process of ‘ratcheting.’ The evolution of the eukaryotic nucleated cell from ancestral prokaryotic cells, the transition from unicellularity to multicellularity, and the advent of the CNS and its contiguous sensory receptors were significant evolutionary milestones that presaged the emergence of teemosis. In effect, the history of life on earth may be attributed to the fact that just as NS reached the extent of its effectiveness, it evolved a new evolutionary process that could create life forms and behaviours far more complex and environment-specific than anything random mutations could achieve alone.

Conclusion

Dating the evolutionary origins of teemosis to the basal Cambrian warrants a reinterpretation of the Precambrian and Phanerozoic eons of geological time as seminal divisions of teemic time. In this context, the first 3.2 billion years of life on earth, a period corresponding to the Precambrian, is characterised by 'Darwinian evolution' which is consistent with the modern synthesis' gradualistic and incremental theory of evolution by means of natural selection. By comparison, the Phanerozoic displays more complex and diverse evolutionary activity that corresponds to the advent of teemosis and 'teemic evolution.'

In light of these hypotheses, it may be useful to re-examine organic evolution from 543 mya to the present to determine the contribution of teemosis-NS to organic evolution. In the next paper, (on this web site), it is argued that teemosis in conjunction with NS made a significant contribution to the complexity and diversity of organic evolution throughout the Phanerozoic.

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