



# Does a Cadillac Engine Need a Biological and Phylogenetic Explanation?

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## Abstract

In this text we briefly explore whether ridiculing material objects like a 'Cadillac engine', a 'desk', 'gold bars in a vault' as reduction ad absurdum in 'dialectical duels' or as a metaphor for teaching evolution is really phylogenetically justified, or whether that evidence really needs an explanation in the evolutionary field. The key of reading is the combination of the definition of semaphoronthomorphy by Willi Hennig, the concept of Extended Phenotype introduced by Richard Dawkins and the memetic theory by Susan Blackmore. Once these theoretical elements are considered as a whole and in an integrated way, the logical system of Hennig still shows its all-encompassing explanatory power, a good opportunity to appreciate the great complexity and elegance of phylogeny and evolution.

In the perspective presented in this paper, spiders, whales, a desk, the Cadillac engine and the American flag on the Moon are considered in some way monophyletic, and then require a putative explanation even in the phylogenetic-evolutionary field.

## Keywords

Cladistics, Phylogeny, Memetic theory, Extended phenotype, Semaphoronthomorphy, Human evolution

## Introduction

"The aim of science [is] to find satisfactory explanations, of whatever strikes us as being in need of explanation" [1].

## Rationale

The recent lively discussion in phylogenetics about the concept of homology in relation to symplesiomorphies, synapomorphies and homoplasy represented an opportunity to address some latent issues left unresolved for a long time and allows formulation of new questions and new interesting reasoning peripheral to the main issue.

Platnick [2] recently questioned the interpretation by Nixon and Carpenter [3] according to which a symplesiomorphy must also be considered a homology, the symplesiomorphous parts are also homologues, and thus also a symplesiomorphy is evidence that must be explained. In opposing this interpretation, Platnick [2] gave the example of the phylogeny of spiders and of character absence/presence of spinnerets stating that: "What, then, is the plesiomorphic state of these characters? Presumably, the plesiomorphic state is merely the absence of these features. It is true that scorpions, opilionids, and other arachnids have those plesiomorphic states. Is the absence of spinnerets in scorpions

and opilionids a homology, and does it therefore require explanation? It is also true that birds, mammals, strawberries and bacteria do not have spinnerets. Do they therefore also share a homology that requires explanation? In short, is the absence of spinnerets in non-spiders evidence, and if so, evidence of what? It would seem that at most it could be construed as negative evidence-evidence that scorpions, opilionids, birds, mammals, strawberries and bacteria are not spiders. Does that evidence require explanation? My desk also lacks spinnerets; does my desk therefore share a homology with scorpions, etc., that "must be explained?". The passage quoted clearly highlights that the choice of the example "my desk" is a *reductio ad absurdum*, as already mentioned by Brower and de Pinna [4], "an example of rhetorical hyperbole used to emphasize the absurdity of the alternative proposition". Farris [5] properly criticizes such examples, bringing attention to the fact that the basis of the phylogenetic method is the explanatory importance of common ancestry. Then it follows that it is totally useless to refer to a 'desk' in the construction of the particular character (considering both the original concept of homology by Owen and the transformational one of Hennig there is no topographical, ontogenetic or positional evidence or correspondence to apply the same phylogenetic character to spiders as well as a desk). A comprehensive treatment and substantive resolution of the debate whether in a phylogenetic framework a symplesiomorphy must also be

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considered as homology is outside the objectives of the present study. However, the use of anthropogenic objects or products of fantasy in such debates represents an opportunity to stress once again the truly holistic nature of the system conceived by Willi Hennig.

Rhetorical hyperboles of this kind, in fact, are not new in the literature on phylogeny and cladistics, considering that, in order to support a particular argument, a 'Cadillac engine' [6], 'gold bars in a vault', 'unicorns' and even 'angels' [4] have been recently mentioned. The question at this point is the following: do all these objects really represent absolute absurd reasoning in the phylogenetic field? Are we justified in ridiculing such objects in cladistics, within the framework of dialectical exchanges? The answer is absolutely not, and the reason, once again, can be found in the monumental and holistic approach to Phylogenetic Systematics by Hennig [7].

### The semaphoronthomorphy and the extended phenotype

In introducing the fundamental concept of semaphoronthomorphy Hennig [7] stated: "*The morphological characters of its spatial, three-dimensional body are not the only properties of a semaphoront. Rather these properties encompass the totality of its physiological, morphological, and psychological (ethological) characters. We will call the totality of all these characters simply the total form (or the holomorphy) of the semaphoront, which thus is to be regarded as a multidimensional construct*". The 'magic word' in the context that concerns the present contribution is 'ethological characters', to be connected to the concept of 'extended phenotype', as described and presented by Richard Dawkins [8], and to the concept of memes, as a second replicator beyond DNA in humans. The famous beaver dam and the resulting lake represent, according to that author, the extension of the phenotype of these animals (which is thus not limited for example to the skeletal structure of the beaver and other typical biological characters). The dam, as an external object generated by beavers, is directly related to evolutionary processes and differential reproductive and survival success: genes encode the construction of the dam-lake system, such a system ensures a subsequent differential reproductive and survival success, the genes manage to duplicate themselves in future generations and so forth. What about the extended phenotype in the context of humans?

### The giant brain and the emergence of a second replicator: memes

The modification of the outside world, both biotic and abiotic, through the extended phenotype reaches its unquestioned peak in a particular and unique kind of animal: humans. In his famous and fortunate "The Selfish Gene", Richard Dawkins states: "*Are there any good reasons for supposing our own species to be unique? I believe the answer is yes*" [9]. What makes man so different from the rest of the animal world? The answer is 'culture' or better memes (defined "unit of cultural transmission" or "unit of imitation"): the unique emergence in man of a second replicator in addition to the DNA, capable of very fast evolution, a concept initially identified by Dawkins in 1976 and then discussed and treated at length by Susan Blackmore in her seminal work "*The Meme Machine*" [10]. According to Blackmore [10], what really makes the genus *Homo* unique is the ability for real imitation, which she suggests is closely linked to the evolution of an oversized brain. The size of the brain has achieved exceptional dimensions in a period that can be considered short geologically speaking (about two and a half million years, the period between modern humans and the last australopithecines). Blackmore [10] convincingly explains the process of co-evolution between memes (the second replicator) and the 'big brain': 1) the emergence of imitation by evolution leads to the onset of a second replicator that can spread much faster than the first (DNA); 2) the copied abilities initially proved useful from a biological standpoint, and the best imitators have experienced a reproductive advantage ("breed with the best imitator"); 3) at this stage the most successful memes start to 'choose' which are the genes that maximized their spread; 4) now the second replicator has taken over, the genes are triggered by

memes and the process of co-evolution necessarily leads to a dramatic increase in brain size. An equally compelling logic is also applied to the onset of language [10].

In such a perspective, it is exactly the emergence of the second replicator that represents a genuine and real autapomorphy of the genus *Homo*, which allows them to consider the arrows of the Bushmen, a Shakespearean sonnet and the synchrotron in Grenoble as manifestations of a single and unique evolutionary process. Blackmore [10] stated that, although the transition from stone axes to fax machines was not absolutely inevitable, the degree of co-evolution between memes and genes achieved in *Homo* necessitated a shift from stone axes to something more complex and highly improbable. Such a process is considered inevitable. As pointed out by Cavalli-Sforza and Feldman [11] in addition to the vertical passage from father to son typical of genetic transmission, memetics as an evolutionary model of cultural information transfer can rely on the incredible power of the horizontal transmission such as between a child and another child, an adult and another adult, or between a child and an adult.

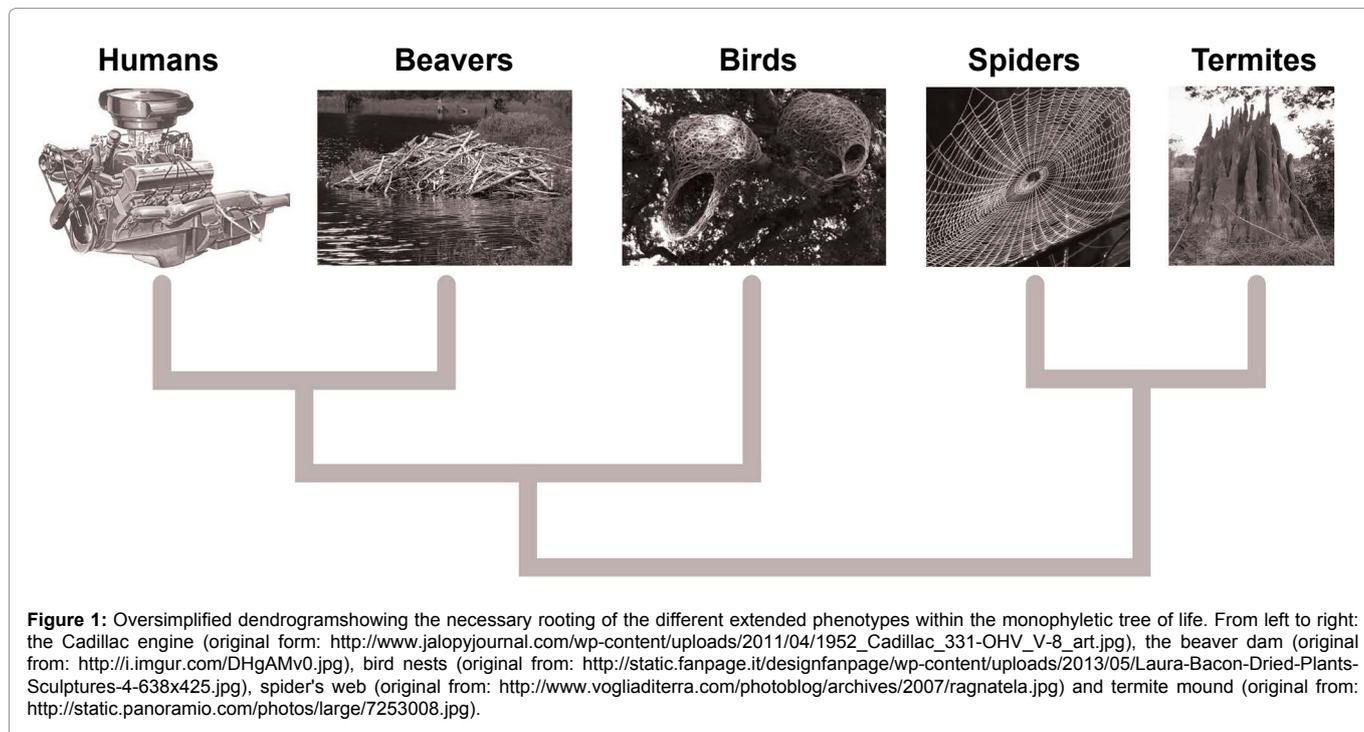
Once appeared, memes undergo a true evolution in the strict sense, being characterized by all the three conditions necessary to be considered as replicators [10]: 1) inheritance, with behavior copied in the general and in particular aspects; 2) variation, with possible errors, changes, additions and personal embellishments; 3) selection, i.e. not all behavior is emulated and copied with equal success. This form of inevitable cultural evolution, rooted in the initial phase to a strictly biological evolution (unique replicator) is the real reason for the so peculiar and sensational extended phenotype of humans.

### Discussion

In this distinct perspective, Platnick's desk, the Cadillac engine or the Saturn 5 rocket of the Apollo missions, represent -in all respects -part of the extended phenotype of *Homo sapiens* regarded as particularly evocative memes or memic complex (and therefore successful as replicators). With respect to the phylogenetic character in question and taking Hennig's statement into account, the gain of the large and critical brain mass of humans through the co-evolution of genes and memes (and the resulting ability to plan, build and develop technology-from stone axes to nuclear submarines) results in a distinct autapomorphy of *Homo*, with the apomorphic state of these 'ethological' characters being reached at a precise node of the monophyletic tree of life. As such, it requires an explanation in the scientific field. Certainly to find a USB memory stick in Paleozoic deposits would sound dramatically odd, and we would try to find a possible explanation for the phenomenon. In the same way, potentially advanced civilizations in other solar systems, were a second replicator is independently occurred, probably would ask questions and attempt to seek an explanation in case of sighting of the probe Voyager 1 launched in 1977 and currently well outside of the solar system.

However, logically we must not make the mistake of considering the rise of the different technologies or the various myths and legends (e.g., unicorns, witches, angels) as single unambiguous synapomorphies. In fact, many innovations such as the active production of food or the origin of writing have arisen multiple times in different forms and places and it is not said that all the populations of the world have now developed the idea of 'angels' or 'unicorns', supporting a polyphyletic rather than monophyletic origin. Nonetheless, the autapomorphy which lies at the base is the giant brain, the emergence of the second replicator and the co-evolution between memes and genes that inevitably leads to language, writing, and in the end to culture in a broad sense.

So, the American flag on the Moon as well as the Colosseum in Rome, are all evidence of an extreme ethological autapomorphy which identifies, in this case, the monophyletic clade *Homo*. In the purely hypothetical case of the arrival of an alien spaceship (and considering life monophyletic at the scale of planet Earth), the alien rocket and the Saturn 5 from the Mission Apollo would be clearly homoplastic



in the ethological field (i.e. shared advanced technological status, not due to a common ancestry, but explainable by the separate origin and developments in different parts of the universe without previous cultural transmission between the two).

Obviously, with this contribution we do not support that “extreme” ethological characters of *Homo* should actually be used as characters in phylogenetic reconstructions. As mentioned above, myths, legends, technologies, or similar tools often emerged several times in the history of *Homo*, resulting in pervasive homoplasy, which would make them mostly inapplicable or misleading for cladistic purposes. In contrast, the goal of this text is simply to demonstrate that such elements can be explained in abiological and phylogenetic framework.

In fact, all this reasoning, which might merely seem to represent a ‘word game’ or rhetorical exercise, indeed helps to see once again how the explanatory power of Hennig’s work is actually monumental, and how it can explain, in such an elegant way, the most disparate aspects of the phylogenetic history of life on Earth (Figure 1).

## Concluding Remarks

In conclusion, going back to the original question as to whether even the ‘gold bars in a vault’, the ‘angels’ and ‘unicorns’ may have a phylogenetic explanation, and if they can be explained by common ancestry the answer is definitely yes. Even ‘unicorns’ found a phylogenetic and biological significance as extended phenotype: the emergence of fantasy objects, which do not exist in reality, products of the imagination of a massive brain generated by the co-evolution between memes and genes. It follows that also ‘angels’ and ‘unicorns’ are ethological evidences of a human autapomorphy: the emergence of the second replicator. The astonishing conclusion is that bacteria, whales, spiders, a desk, the Cadillac engine and a sonnet by Shakespeare or Dante Alighieri are in fact in some way monophyletic. However, one must keep in mind that the last three represent an extended phenotype of a particular clade (humans) and not organs to be related within the concept of homology.

Once the superb elegance of the system contemplated by Hennig is understood, wisdom (or simply common sense) forms the basis for not putting these different categories of life manifestations or evidence in the same ‘transformation series’, i.e. in the same character for phylogenetic analysis. Scholars and educators in the

field of evolutionary biology could use these material objects, the result of the emergence of a second replicator, to communicate the extreme complexity and beauty of the phylogenetic system, rather than as a ridiculizing weapon in dialectical duels.

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## Competing Interests

The authors declare that they have no competing interests.

## Authors’ Contributions

Both authors, MR and JF, shared all responsibilities related to research and drafting of this manuscript. All authors read and approved the final manuscript.

## References

1. Popper KR (2000) Realism and the Aim of Science from the Postscript to the Logic of Scientific Discovery. Taylor & Francis Group, Routledge, London and New York.
2. Platnick NI (2013) Less on homology. *Cladistics* 29: 10-12.
3. Nixon KC, Carpenter JM (2012) On homology. *Cladistics* 28: 160-169.
4. Brower AZ, de Pinna MCC (2014) About nothing. *Cladistics* 30: 330-336.
5. Farris JS (2014) Homology and misdirection. *Cladistics* 30: 555-561.
6. Platnick NI, Humphries CJ, Nelson G, Williams DW (1996) Is Farris optimization perfect?: three-taxon statements and multiple branching. *Cladistics* 12: 243-252.
7. Hennig W (1966) *Phylogenetic Systematics*. Urbana (IL): University of Illinois Press.
8. Dawkins R (1982) *The Extended Phenotype: The Gene as the Unit of Selection*. Oxford: Freeman.
9. Dawkins R (2006) *The Selfish Gene*. Oxford: Oxford University Press.
10. Blackmore S (1999) *The Meme Machine*. Oxford: Oxford University Press.
11. Cavalli-Sforza LL, Feldman MW (1981) *Cultural Transmission and Evolution. A Quantitative Approach*. Princeton (NJ): Princeton University Press.