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Ancestor of the new archetypal biology: Goethe's dynamic typology as a model for contemporary evolutionary developmental biology

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ABSTRACT

As understood historically, typological thinking has no place in evolutionary biology since its conceptual framework is viewed as incompatible with population thinking. In this article, I propose that what I describe as dynamic typological thinking has been confused with, and has been overshadowed by, a static form of typological thinking. This conflation results from an inability to grasp dynamic typological thinking due to the overlooked requirement to engage our cognitive activity in an unfamiliar way. Thus, analytical thinking alone is unsuited to comprehend the nature of dynamic typological thinking. Over 200 years ago, J. W. von Goethe, in his *Metamorphosis of Plants* (1790) and other writings, introduced a dynamic form of typological thinking that has been traditionally misunderstood and misrepresented. I describe in detail Goethe's phenomenological methodology and its contemporary value in understanding morphological patterns in living organisms. Furthermore, contrary to the implications of static typological thinking, dynamic typological thinking is perfectly compatible with evolutionary dynamics and, if rightly understood, can contribute significantly to the still emerging field of evolutionary developmental biology (evo–devo).

Form is a moving, a becoming, a passing thing. The doctrine of forms is the doctrine of transformation. The doctrine of metamorphosis is the key to all signs of nature.

J. W. von Goethe (quoted in Richards, 2002, p. 454)

1. Introduction

There are few concepts identified by evolutionary biologists that have received more criticism than typological thinking and essentialism. As Mayr (e.g., 1963, 1982, 1991, 1997) never tired of pointing out (see also Chung, 2003), Darwin (1859) addressed these notions and hoped to put them to rest by proposing that only populations of variable individuals evolve, so-called population thinking. Typological thinking was viewed as incompatible with this evolutionary principle and thus had no place in evolutionary causality (see Amundson, 2005 for in-depth critique of this position). Indeed, it has become anathema to even allude to typological explanations in one's research program, notwithstanding recent conceptual explorations in evolutionary developmental biology that are more accommodating (e.g., Amundson, 1998, 2005; Hall, 1996; Jenner, 2008; Lewens, 2009a).

In this paper I hope to show that, first, historically a *static* mode of typology has overshadowed a *dynamic* mode of typology. Consequently, a straw man has been erected and perennially attacked, but this caricature bears little semblance to the dynamic typology proposed herein. Secondly, I will attempt to demonstrate how the dynamic typological thinking implicit in Goethe's research approach is perfectly compatible with a notion of evolutionary change and, *if rightly understood*, not only stands as a forerunner to modern evolutionary developmental biology (evo–devo) but also speaks to current questions regarding the nature of evolutionary dynamics. In fact, recent insights in evolutionary developmental biology, including genetic regulatory networks, developmental constraints, analysis of theoretical morphospace, developmental trade-offs, and recursive properties of morphological evolution,

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reaffirm a notion of dynamic typology. However, to grasp dynamic typological thinking, it is necessary to engage our cognitive activity in an uncustomary way, and this is the very reason why this way of seeing has been historically distorted: our practice of analytical thinking falls short of what is necessary to apprehend the dynamic thinking implicit in Goethe's way of understanding nature. Accordingly, I will explore in detail the subtleties of Goethe's methodology to show how it is not just an historical curiosity but has contemporary relevance for how we formulate questions regarding understanding morphological evolution. In this vein, I concur with Richards (2002, p. 408) "that Goethe's understanding of scientific procedure marked him not simply a good scientist for the time, but a good scientist for all time."

2. The dynamic nature of the archetype

Central to typological thinking is the notion of "archetype." Descriptions of archetypes and their relationship to physical entities date back to Plato's *Republic* and other writings. His oft-quoted allegory of the shadows on the cave wall, ultimately mistaken for the full reality, identifies the relationship of, for example, actual organisms and the informing "Ideas" that give them shape. According to this interpretation, there exists an archetype, or *eidos*, of Cat, for instance, and all actual cats are but mere imperfect shadows, or approximations, of this nonphysical entity. These archetypes have been taken to be "perfect," whatever that may mean (it's rarely defined), constraining, and static, that is, unchanging and unchangeable. (Such interpretations, in fact, may stem from *mis*interpretations of Plato. Bortoft (2012, p. 82), for example, cites H-G Gadamer, the Plato scholar: "Plato was no Platonist.") Accordingly, such notions cannot support organic transformation on an evolutionary timescale and lead to views of species fixism. If the archetype is a nonphysical entity—not of this earth—how can it be influenced by earthly processes? And if it exists in a state of eternal perfection, how, and why, would it change? Why are living organisms so variable and thus only imperfect expressions of their respective presumed archetype?

To illustrate how this static interpretation has influenced biology, we need look no further than to the pre-Darwinian era, for example to Richard Owen's search for the archetypal vertebrate. Owen was determined to discover the "essence" of the vertebrate body plan, the unifying principle, or Unity of Type, common to all living vertebrate forms (Amundson, 2005; Gould, 2002; Owen, 2007[1849]; Richards, 1992, 2002; Rupke, 1993). Accordingly, he distilled what he believed to be the key ingredients, the common denominators, of vertebrate architecture and constructed a blueprint of basic, repeating skeletal features (Fig. 1). Owen, therefore, abstracted elements of the vertebrate body plan and juxtaposed them in a generalized configuration; accordingly, his was a "reductive theory" (Richards, 2002, p. 302). Clearly, Owen's schema looked like no actual vertebrate, living or extinct, although it had a vague resemblance to a fish skeleton. In 1859, with the publication of *Origin of Species*, Darwin supplanted Owen's hypothetical archetype with the presumed actual ancestral vertebrate—the "unknown progenitor"—which gave rise to all subsequent vertebrates through descent with modification (Amundson, 1998; Brady, 1987). Consequently, Owen's influence was demoted, and along with him the *Naturphilosophie* movement of which he was a part, and apparently the problem of the vertebrate archetype, and archetypes in general, was resolved.

Earlier, in 18th century Germany, however, a previous attempt was made to ascertain the nature of the archetype, but this time not only animals but geologic formations, meteorological phenomena, and especially plants provided the focus (Amrine, Zucker, & Wheeler, 1987). J. W. von Goethe's (1749–1832) original research on morphology—a term he coined (Nyhart, 1995)—sought to grasp the unity disclosed through the diversity of a given class of phenomena through "disciplined and cultivated perception" (Steigerwald, 2002, p. 293). Regarding plants, after many years of detailed botanical observations, culminating in his celebrated Italian journey, Goethe some years later claimed to have experienced what he called the *Urpflanze*, the archetypal plant, the basic transformative element of which he termed "leaf" (Richards, 2002; Tantillo, 2002). Unlike Owen, Goethe did not attempt to express his archetype in a visual schema except for a few hastily scribbled lines he once showed to his philosopher friend Friedrich Schiller during an animated conversation. Oddly enough, only subsequent self-proclaimed interpreters of Goethe have taken liberty to illustrate his archetypal plant; as discussed below, these efforts were, and continue to be, based on a misguided notion of Goethe's archetype.

According to philosopher of science Brady (1987), after 1859 Goethe's notion of the archetype suffered the same ignominious fate as Owen's. But was this justified? A superficial analysis would nod in agreement, but, as Brady points out, this is based on a misreading of Goethe. In contrast to Owen's abstract schema, Goethe's notion of the archetype does not necessarily imply an ancestral form (nor does it deny one) and, more importantly, requires a dynamic mode of cognition to be apprehended. Unlike a static blueprint that serves as a distilled generalization and representation

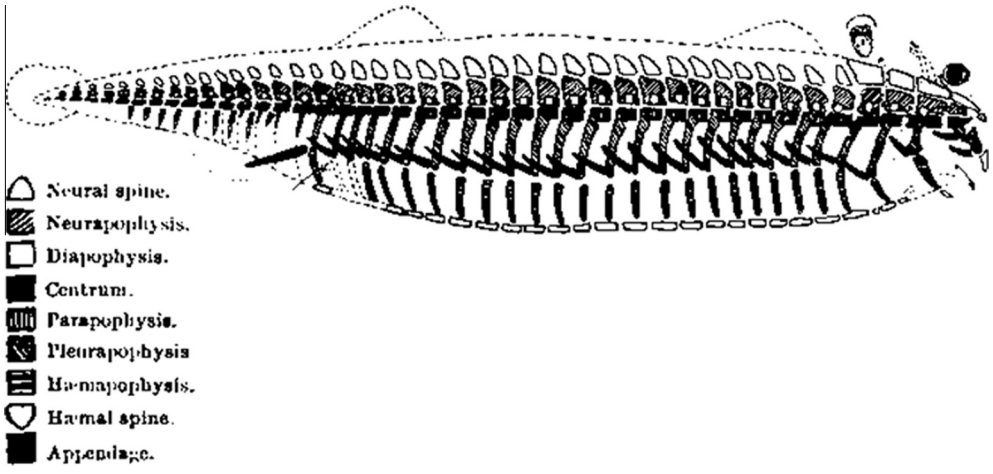

Fig. 1. Richard Owen's "archetypal" vertebrate (1848); reproduced in Owen (2007).