

## Typology Reconsidered: Two Doctrines on the History of Evolutionary Biology

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**Abstract.** Recent historiography of 19th century biology supports the revision of two traditional doctrines about the history of biology. First, the most important and widespread biological debate around the time of Darwin was not evolution versus creation, but biological functionalism versus structuralism. Second, the “idealist” and “typological” structuralist theories of the time were not particularly anti-evolutionary. Typological theories provided argumentation and evidence that was crucial to the refutation of Natural Theological creationism. The contrast between functionalist and structuralist approaches to biology continues today, and the historical misunderstanding of 19th century typological biology may be one of its effects. This historical case can shed light on current controversies regarding the relevance of developmental biology to evolution.

**Key words:** typology, essentialism, idealism, adaptationism, morphology, Richard Owen

### 1. Two historical schemata

According to popular conceptions, biological debates in the 19th century revolved around a single crucial question: Had existing species evolved from common ancestors or had they been individually created by a divine intelligence? Just as the Copernican Revolution comprised the drama of 17th-century science, the Darwinian Revolution of evolution over creationism was the story of the 19th century. Our modern perspective on this history is influenced by developments in modern biology, of course. With the Modern Synthesis of the 1930s and 1940s biology became in many ways more fully “Darwinian” than it had ever been in the 19th century, at least in the sense that Darwin’s mechanism of natural selection came more and more to dominate biological thought (Mayr and Provine 1980; Bowler 1988). The neoDarwinism of Synthesis biology was well established by the mid-1950s, in time for the 1959 Centennial of the publication of the *Origin of Species*. Non-biologists were slow to recognize the strength of this new validation of Darwinian thought, and philosophers especially seemed moored in

the past (Mayr 1980, p. 3; Mayr 1982, p. 551). But after the Centennial, philosophers began to awake to modern neoDarwinism. Philosophical discussions of biology began to center on the Darwinian Revolution, and took evolution-versus-creation as a central organizing schema.

The evolution-versus-creation debate is a theme within the *Origin of Species* itself. The rhetorical opponent chosen by Darwin was what we now call a special creationist, an advocate of the separate divine creation of each distinct species. Darwin treated the issue of species origins as a relatively simple dichotomy; divine creation and gradual transmutation were the only alternatives discussed. He later acknowledged that many of his contemporaries were neither creationist nor evolutionist, believing (for example) in some unknown but natural cause of species origins. But Darwin's dichotomy was an effective expository device, well suited to highlight the virtues of his theory. In the public mind special creation probably was the only well-understood alternative to evolution anyhow. The dichotomy continues to shape our understanding of debates in biology, and especially in the history of biology. I will refer to this dichotomy as the Evolution/Creation (E/C) Schema.

A different dichotomy has been offered as a better representation of the true state of the debate in 19th-century biology. Dov Ospovat urged that the division between creationist and evolutionist distorts the debates of the period (Ospovat 1978; 1981). A classification that more truly depicts the actual issues and alliances would contrast 19th-century teleologists with morphologists. Teleologists regarded adaptation and the fit of the organism to its environment as the single deepest fact of biology. Morphologists rejected the centrality of adaptation, and regarded commonalities of structure as deeper indications of biological reality. This distinction reflects the dichotomy laid out in E.S. Russell's *Form and Function* (1916). Russell described the history of biology as a series of episodes in a long debate between advocates of the biological centrality of form and those of function, biological structuralists versus functionalists. The drama of 19th-century biology takes on new aspects from this Russell/Ospovat (R/O) Schema. In particular, the relevance of the study of anatomy and morphology can be seen in a new light. In this paper I will discuss the historical interpretation of a heterogeneous group of biologists termed transcendental anatomists. I will consider two interpretations of the transcendentalists' scientific work. One takes the perspective of the Evolution/Creation Schema, and has been expressed by several prominent philosophers, scientists, and historians writing between 1959 and about 1980. The second takes the Russell/Ospovat Schema, with scholarly support from a group of more recent historians of science. I will argue that the interpretation associated with the E/C Schema contains a systematic underappreciation of

the role of morphology and transcendental anatomy in 19th-century biology, especially among philosophers. In conclusion, I will suggest that the R/O alternative provides a valuable perspective not only on the 19th century, but on post-Synthesis biology as well. Certain modern evolutionary debates appear as relics of outmoded styles of thought when seen from the E/C perspective, but fit very coherently into the R/O Schema.

For present purposes the category *transcendental anatomist* will be broadly drawn. These biologists, sometimes also labeled idealistic morphologists or philosophical anatomists, are the morphologists of the R/O Schema. The terms “transcendental” and “idealist” carry ominous metaphysical connotations to the modern ear. For the moment I ask that they be accepted merely as labels; in Section 5 I will try to explain their significance. Major transcendentalist figures include Johann von Goethe, Etienne Geoffroy St.-Hilaire, Louis Agassiz, and Richard Owen. Each advocated the primacy of structure or form over function, of the Unity of Type over the Conditions of Existence. Transcendentalists include (notoriously) the *Naturphilosophs*, and in the present paper such continental embryologists such as Karl Ernst von Baer. The R/O teleologists include Cuvier and the British Natural Theologians, followers of William Paley. Many important distinctions among these biologists will be overlooked in this discussion. Continental anatomists (except Cuvier) will be taken as transcendentalists, and the differences between Cuvier and the British Paleyans will be ignored. ‘Teleology’ will refer to the Platonic, external version of the British Natural Theologians, not the Aristotelian, imminent teleology of many continental biologists. Admittedly this modern oversimplification of the concept of teleology is a distortion of historical facts (see Lenoir 1982, Rupke 1994, Nyhart 1995, and Depew and Weber 1995 for these and other distinctions herein blurred). My excuse for this caricaturization is that I wish to discuss our modern view of these episodes, and to most modern thinkers teleology is Paleyan. A coarse application of the R/O Schema is a fine enough tool for our purpose.

## 2. The modern image of transcendental anatomy

It is customary to attribute the pre-Darwinian resistance to evolution to a cluster of philosophical ideas. Ernst Mayr made the classic statement of this tradition (1959a). In contrasting Darwinian population thinking with typological thinking, he identified the latter with Plato’s *eidōs*. Platonic idealism was said to have dominated the thinking of most of the great philosophers of the 17th through 19th centuries. “Any attachment to metaphysical idealism, any commitment to an unchanging *eidōs*, precludes belief in descent with modification” (Mayr 1964. p. xx [sic]). Under the influence of Karl

Popper the notion of essentialism was associated with biological typology and idealism by Mayr and others (Hull 1965; Ghiselin 1969). The three inter-related concepts of essentialism, idealism, and typology came to define the philosophical core of anti-evolutionism, with only occasional doubts about its adequacy (Sober 1980; Gould 1983).

This trio of concepts certainly does provide a stark contrast with neo-Darwinian population thinking. The trio is intended to account not only for the rejection of population thinking, but also of non-Darwinian evolutionary concepts. The historical reality of the second kind of influence is harder to document, however. Did no one deny both transmutation and essentialism, and affirm the contingent permanence of species? Was it truly impossible to accept both typology and transmutation? A tempting response is that evolution entails anti-essentialism by definition. This move must be avoided if essentialism is taken to be an explanation rather than a mere redescription of anti-evolutionism. To find the real historical relations among these concepts it is necessary to examine the historical science itself. Modern intuitions about the linkage of typology to anti-evolutionism (for example) are unreliable guides to history.

Transcendental anatomists as a group were not the center of attention when the trio of metaphysical doctrines was first described. Apart from Mayr's study of Louis Agassiz (Mayr 1959b), there was very little recognition of distinctly transcendentalist biology within philosophical or methodological discussion; the writings of historians on transcendentalism were mostly unnoticed.<sup>1</sup> Darwin's opponents were seen to be Natural Theological creationists, followers of William Paley. Transcendentalists were all but invisible until the late 1970s. Nevertheless the trio of doctrines seems preadapted, so to speak, to the transcendentalists. As transcendentalists came to scholars' attention, the doctrines fit them nicely. Platonic idealism is openly endorsed by some transcendentalists. The principle of Unity of Type, the transcendentalist alternative to the functionalist Conditions of Existence, sounds like a paradigm case of typological thinking. By means of the trio of doctrines, the transcendentalists slid nicely into place within the E/C Schema of 19th-century biology. Transcendentalism was simply seen a variant of Natural Theological creationism, unusually forthright about its typological commitments, and wielding a modified version of the Argument from Design.

After Agassiz, Richard Owen was the first transcendentalist to be recognized in recent times. In 1848 Owen presented the Vertebrate Archetype as the vertebrate expression of Unity of Type, and in 1849 described the Archetype as a sort of Platonic Idea, said to have existed in the mind of God prior to the gradual introductions of actual Vertebrate species on the earth. This seemingly-unequivocal "God's mind idealism" has been taken as grounds to

describe Owen's idealism as a subtype of the Argument from Design. Peter Bowler (1977; 1984) treats it in this way, with Owen its prime proponent and Darwin oblivious to the movement. Michael Ruse (1979) gives more attention to Owen's Unity of Type ideas, and considerable respect to their significance for evolution. Ruse also seems to have been the first to notice an ambiguity on Owen's part regarding the Platonic aspect of biology; the importance of this observation will become apparent. Nevertheless, Ruse too positions transcendentalism within Natural Theology, as a non-utilitarian variant of the creationist Argument from Design.

The implications of tarring the transcendentalists with the brush of Natural Theology will be discussed below. But the commentators of this period developed a second and more refined critique, directed at a feature of transcendentalism that was not shared with the Natural Theologians. It addressed the transcendentalist concept of common plan or Unity of Type. This concept, the primary *differentium* between transcendentalists and Natural Theologians, is said to be explanatorily vacuous. David Hull expressed this criticism of transcendentalist explanations in terms of common plans.

As long as one believed in God, and these plans could be interpreted literally as thoughts in the mind of the creator, then such explanations had some explanatory force, but if reference to God is left out of the explanatory picture, then all that is left are the plans. Rather than being explanations, the existence of such 'plans' calls for explanation (Hull 1973, p. 75).

A "God's mind" version of transcendentalism, with types reified as divine ideas, is on these grounds the only possible genuinely explanatory theory. So transcendentalism is either creationist or it is vacuous.

In discussing transcendentalism, several authors refer to a particular passage from the Morphology section of the *Origin* in which Darwin points out that Unity of Type cannot be accounted for by traditional Paleyan accounts of adaptation. The passage is worth quoting in full.

Nothing can be more hopeless than to attempt to explain this similarity of pattern in members of the same class, by utility or by the doctrine of final causes. The hopelessness of the attempt has been expressly admitted by Owen in his most interesting work on the 'Nature of Limbs.' On the ordinary view of the independent creation of each being, we can only say that so it is; – that it has pleased the Creator to construct all the animals and plants in each great class on a uniform plan [; but this is not a scientific explanation] (Darwin 1859, p. 435; bracketed passage added in later editions; Darwin 1872, p. 383).

Bowler finds it "curious" that Darwin credited Owen in this passage "without mentioning that [Darwin's] theory made equal nonsense out of Owen's

own explanation” (Bowler 1977, p. 37). The “nonsense” refers to Owen’s Platonism. The strongest praise Bowler can muster is that Owen’s work “was not just idealist moonshine” because the work included Owen’s definition of homology (Bowler 1984, p. 125). Mayr condemns transcendentalism in similar terms, quoting the same passage from the *Origin*.

The idealistic morphologists were completely at a loss to explain the unity of plan and, more particularly, why structures rigidly retained their pattern of connections no matter how the structures were modified by functional needs. As Darwin rightly said ‘Nothing can be more hopeless than to attempt to explain the similarity of pattern in members of the same class, by utility or by the doctrine of final causes.’ (Mayr 1982, p. 464)

The vacuity of transcendentalist theory expressed in the first sentence is a common theme; Unity of Type could not itself be explained, and so was vacuous. But the reasoning offered in the second sentence is a *non sequitur*, and can only be a lapse on Mayr’s part. In this passage Darwin was not attacking transcendentalism, but rather the pious adaptationism of Natural Theology. Indeed Darwin credited Owen on the point, as Bowler somewhat perplexedly acknowledged. If the transcendentalists are guilty of vacuity, it is surely not because of an over-reliance on utility and final causes; these were precisely what they were arguing *against*.<sup>2</sup>

In an important 1983 paper, Hull distinguished between 19th-century idealism and creationism, breaking with the tradition of classifying transcendentalism as a subtype of Natural Theology. Like Ruse’s 1979 careful attention to Owen, this was a step towards a truer view of transcendentalist biology. Evolutionism, creationism, and idealism were now seen by Hull as the contending doctrines, with “reverent silence” a fourth option (Hull 1983, p. 63). Idealists are here described in two ways. Only some of them were essentialist anti-transmutationists (e.g. Agassiz and Dana). But all were advocates of a position that was “not a scientific explanation.” This expression was taken from the clause at the end Darwin’s Morphology section quoted above, inserted in later editions of the *Origin*. It appeared as a section heading in Hull’s paper. Transcendentalist biology was beginning to be distinguished from creationist Natural Theology, but it remained empty of scientific content.

### 3. Transcendentalism as natural theology

The treatment of transcendental anatomy as a subtype of Natural Theology will be discussed in this section, and the claim of vacuity in the following section. The traditional treatment depicts transcendental biologists as Natural Theologians who were metaphysical essentialists, idealists, and/or

typologists. Natural Theology entails a direct evidential connection between scientific and theological concerns, and in the early 19th century it entailed the denial of transmutationism. Is this a generally accurate description? Did transcendental anatomy involve the conjunction of 1) belief in a personal God, 2) metaphysical idealism, and 3) denial of a naturalistic cause for species origins?

As a group, transcendental anatomists were far too heterogeneous in theology, metaphysics, and biology to be captured by such a neat characterization. Let us consider our sample of transcendentalists to illustrate the heterogeneity: Goethe, Geoffroy, Owen, and Agassiz. We have a patchwork of commitments. In religion, Agassiz and Owen were theists, Goethe is probably best seen as a pantheist, and Geoffroy an agnostic. In metaphysics Agassiz was an idealist in the “God’s mind” sense. Owen is reputed to have similar views; these will be considered presently. Goethe can be read as a Kantian idealist, though not a “God’s mind” idealist like Agassiz, and Geoffroy appears to have been a materialist. On the issue of species origins, Agassiz believed in special creation for reasons tied to his version of idealism. But none of the other three was an unequivocal creationist. Goethe’s position remains unclear on species origins, and it is now widely recognized that both Geoffroy and Owen accepted naturalistic origins of species, possibly by transmutation. This is a very mixed bag.

One illustration of the conceptual tangle before us: Materialism is, by philosophical delineation, a logical contrary to idealism. The fact that a materialist (Geoffroy) is considered a practitioner of “idealistic” morphology illustrates that something is awry in the labeling scheme for this scientific tradition. This problem of nomenclature does not arise from the naming conventions of the present paper, but is a product of the eclecticism of the group of biologists being discussed.

The interactions between advocates of British Natural Theology and of transcendental anatomy were nothing short of acrimonious. Consistent with the Russell/Ospovat schema, the intellectual and social alignment was teleology (Natural Theology) *versus* morphology (transcendental anatomy). Many recent historians discuss this tension, but Adrian Desmond (1989) especially documents the strife between the two schools in the 1830s and 1840s. British advocates of transcendental anatomy included a number of Edinburgh-trained biologists together with political radicals opposed to the Oxbridge aristocratic domination of the medical profession. Natural Theology was allied with political and religious conservatism. Most of its advocates considered the non-teleological Continental forms of biology as reprehensible on scientific, social, and religious grounds. Transcendental anatomists seemed to view nature as capable of self-organization, rather than the contrived product of

a supernatural Designer. A few Natural Theologians did take morphology seriously. Only Peter Mark Roget's *Bridgewater Treatise* (1834) did so (and very cautiously) prior to Owen's Archetype writings of the late 1840s. Afterwards James McCosh (1851) and a few others picked up and elaborated on Owen's theologically friendly version of transcendentalism. But the far more usual attitude was expressed by Adam Sedgwick, who complained about Geoffroy and his "dark school . . . his cold and irrational materialism" (Clark and Hughes 1890, p. 86). Natural Theologians including William Whewell, Sedgwick, Charles Bell, and Lord Henry Brougham recognized the challenge of the continental "lovers of system" and soundly disparaged them in print. These passages were usually coupled with praise of Cuvier, and his sound functionalism. Transcendentalists were *not* Natural Theologians, at least not in the minds of Natural Theologians.

The modern view of transcendental anatomy as Natural Theology may have been influenced by the relative accessibility of the writings of two transcendentalists, Agassiz and Owen. Agassiz was certainly a strict creationist and a transcendentalist. But he had little institutional affiliation with British Natural Theologians, and he was quite unhappy with the moral and the functionalist aspects of Bridgewater biology (Rupke 1994, p. 144). It is possible that Mayr's early study (1959b) of Agassiz encouraged at least the association of transcendentalism with creationism in modern minds. Richard Owen is the most well-known of the British transcendental anatomists in the modern day, both because of his stature and because of T.H. Huxley's vigorous and ceaseless attacks on him. Owen's writings of 1848 and 1849, together with his institutional and intellectual affiliations, provide the most direct legitimation for the stereotype of the transcendental anatomist as Natural Theologian. Is this view consistent with recent historiography?

Nicolaas Rupke's biography is by far the most thorough study of Richard Owen, though valuable perspectives can be found in many recent works (Rupke 1994, Sloan 1992, R. Richards 1992, Desmond 1982 and 1989, E. Richards 1987, Rehbock 1985, and indeed Ruse 1979). Owen had been a favorite of the Oxbridge establishment, the domain of the *Bridgewater Treatise* authors and the dons of British Natural Theology, from his earliest scientific work. His early work followed the functionalist tradition of Cuvier, but he retained interests in German morphology. He was on the side of the conservatives during the 1830s disputes. In the 1840s he began to lean towards morphological and embryological topics, and away from the functionalism that had ingratiated him with Oxbridge. This change may be interpreted in various ways: as a matter of Owen's individual intellectual development, as his recognition of the increasing force of morphological arguments raised by Geoffroyans and the Edinburgh school, or as a ploy in a class-conscious

political struggle (Desmond 1989). What matters to the present context is that he came out of the closet with his transcendentalism between 1846 and 1849. He proposed the Vertebrate Archetype, invoked Platonic idealism, bluntly denied the adequacy of Paleyan teleological biology, but affirmed that teleology and morphology could be happy bedfellows in an enlightened and pious biology. Especially given his affinities with Oxbridge, Owen has been taken as the Platonic ideal of the Platonic idealist Natural Theologian.

It would be possible to maintain my criticism of the stereotype of the transcendentalist as Natural Theologian and simply admit Owen as the exception. He is, after all, a unique case. No earlier British transcendentalist had Owen's Paleyan Oxbridge connections, nor showed any yearnings in that direction. But in fact the stereotype gives a distorted image even of Owen, the ideal idealist.

Owen presented himself as a great conciliator working out a middle path between Cuvierian functionalism and Geoffroyian structuralism. This self-description fits with the image of transcendentalist Natural Theology. It has been accepted by most historians prior to Rupke (1994), who disagrees. "The reality behind the facade of Owen's self-presentation showed no synthesis, but two largely segregated bodies of work. . . . Moreover, whenever the two approaches came together, 'form' was used as the primary context of explanation, and 'function' merely as an incidental one" (p. 163). In order to insinuate the Unity of Type into a Natural Theological context, Owen tried to "redefine teleology itself" (ibid.). One such ploy was an explication of the expression 'made in vain' in the sense of 'without purpose', an attribute that teleologists considered to apply to no actual biological trait. True to his structuralism, Owen did not claim a utilitarian basis for Unity of Type. Rather he made the semantic suggestion that "such structure does not exist 'in vain' if its truer comprehension lead rational and responsible beings to a better conception of their own origin and Creator" (Owen 1849, p. 85). Now, one must judge for oneself whether this was a serious interpretation of teleology or merely a pious facade. William Whewell, even while approving of Owen's Platonism, would not put up with this sophisticated slight-of-hand with the concept of teleology. "Final Causes *for us* are contrivances of which *we see* the end; and nothing is added to the evidence of [purposive] Design by the perception of a unity of plan which in no way tends to promote the design" (Whewell 1863, vol. 2, p. 643 emphasis in original). One of my students summarized this passage from Owen as the view that "Unity of Type is God's way of fishing for compliments."

A much more serious point is made in the final paragraph of Owen's book, in a passage that Darwin and others either neglected or misread. "To what natural laws or secondary causes the orderly succession and progression of

such organic phenomena may have been committed we as yet are ignorant” (Owen 1849, p. 86). Owen here alludes to new species as arising from some as-yet-unknown but natural causes. (Secondly causes are natural ones, God being *primum mobile*.) Rupke has determined that Owen never referred in print to a divine origin of species after 1841 and made regular if obscure references to naturalistic species origins thereafter (Rupke 1994, p. 211). The misreading of Owen’s naturalism regarding species origins enabled Darwin to introduce the Evolution/Creation Schema in the *Origin*, where he labeled Owen a creationist like Sedgwick and Agassiz (Darwin 1859, p. 310). It is a sign of the persistence of the E/C Schema that many of its recent proponents have continued to identify transcendentalists like Owen as creationists and/or Natural Theologians. When Owen complained of this characterization, Darwin responded that Owen’s difficult style of writing had been impossible to interpret. In the “Historical Sketch” added to later editions of the *Origin*, Darwin acknowledged Owen’s naturalistic passages in a way that sarcastically dramatized their abstruseness (Darwin 1872, p. xvii). Not everyone had missed Owen’s point, however. Rupke shows that many others had recognized his naturalism, including some of his disapproving Oxbridge patrons, the evolution-sympathetic Baden Powell, and at least one newspaper reviewer who complained of the impiety of such a theory (Rupke 1994, p. 241).

Owen’s 1849 endorsement of “God’s mind idealism” is the primary source for the modern labeling of transcendentalism as Natural Theology. But as Ruse pointed out, Owen between 1848 and 1849 appeared to be confused about exactly which biological facts revealed the Platonic ideas in God’s mind (Ruse 1979, p. 123). In 1848 Owen discussed two distinct biological forces, corresponding to the contrast between form and function (the R/O Schema). Structural conformance to the Vertebrate Archetype, the simplest possible vertebral form, was governed by the first force. Adaptation and diversity was governed by the second. The first, structural force was described as a “polarizing force.” It was presumed to be a quasi-material force like that involved in crystallization or magnetism (Rupke 1994, pp. 172 ff.). The simplest vertebrates, closest to the Archetype, were most closely governed by the polarizing force; very low animals sometimes show simple crystalline geometric forms. The adaptive force, on the other hand, was described as Platonic in nature: “The platonic *idea* or specific organizing principle or force would seem to be in antagonism with the general polarizing force, and to subdue and mould it in subserviency to the exigencies of the resulting specific form” (Owen 1848, p. 172). So the 1848 Archetype has a quasi-material cause, with adaptation and diversity governed by Platonic ideas.

In 1849 Owen did an about-face. Without explanation he declared that the Archetype, instead of the adaptive force, constituted the Platonic idea; it is

“. . . that essential character of a part which belongs to it in its relation to a predetermined pattern, answering to the ‘idea’ of the Archetypal World in the Platonic cosmogony, which archetype or primal pattern is the basis supporting all of the modifications . . .” (Owen 1849, p. 2). He is almost silent about the adaptive force. He repeatedly points out how teleology and final causation are unable to explain Unity of Type (in a series of arguments well-used by Darwin in the *Origin*). The polarizing force, formerly enforcing the Archetype, is nowhere to be seen. It has been supplanted by a revised Platonism. Except by Ruse and Rupke, Owen’s Platonic reversal has been unnoticed by historians and philosophers. The 1849 Platonic Archetype has usually been taken as the deepest indication of Owen’s intent, and as unequivocal evidence of the religious motivation of Owen’s transcendentalism.

Why Owen’s reversal? Rupke has uncovered a smoking gun. The Oxbridge establishment was incensed with Owen’s 1848 introduction of the materialist notion of polarity as a factor in biology. William Conybeare conveyed the dissatisfaction to Owen in a letter discussing Owen’s 1848 work. The polarizing force was deemed unsatisfactory, and in its place a revised Platonic idea was suggested. Besides the theological benefits, Conybeare considered this to accord better with Plato’s original intention. “[Plato] meant the archetype forms of things, as they existed in the creative mind, and by their participation in which the innumerable individual existences of actual nature possessed a true specific unity” (quoted in Rupke 1994, p. 202). And so, to “placate the powerful Oxbridge faction among Owen’s supporters,” Owen’s Platonic adaptive force gave way to a Platonic Unity of Type (Rupke 1994, p. 204).

It is easy to see the benefits to Natural Theology of Owen’s flip-flop. Natural Theology had no need for a second supernatural explanation for adaptation and species diversity. The Argument from Design already served that function. Owen’s Platonization of the adaptation-producing principle had been theologically redundant. God’s mind was already in charge of adaptation; Plato was not needed. Unity of Type, on the other hand, had for years been a thorn in the side of adaptationist Natural Theology on grounds of its apparent *lack of need* for theological underpinnings. If Owen could be convinced to Platonize the Unity of Type, Natural Theologians would have a way to give a theological blessing to the obviously progressive ideas of transcendental anatomy while still insisting on supernatural supervision over all aspects of biology. Owen went along with it.

In the 1857 Third Edition of his *History of the Inductive Sciences* Whewell reprinted without modification the skeptical examination of transcendental anatomy from his 1837 First Edition. But he appended an “Addition” favorably reporting on Owen’s 1849 Archetype ideas. Perhaps morphology was not so bad after all. As quoted above, Whewell made quick work of Owen’s revi-

sionist teleology. But he approved of Owen's revised Platonism, the notion that "... the Archetype of the Animal Structure being of the nature of an *Idea*, implies a mind in which this Idea existed; and that thus Homology itself points the way to the Divine Mind" (Whewell 1863, p. 644). Owen's watered-down teleology didn't pass muster with a true teleologist. But the Platonized Archetype, Conybeare's amendment, was gratefully accepted.

Let us reconsider the stereotype of the transcendentalist as Natural Theologian. Owen has been considered the prime example of that kind of idealism, and he may have inspired the notion in the first place. But when we see that the first (1848) version of his Vertebrate Archetype attributes Unity of Type to a quasi-material cause, and we recognize that the Platonic Archetype was most likely an appeasement to Oxbridge complaints, the Paleyan theological motivation for Owen's transcendentalism disappears. Owen's interests in transcendentalism developed at a time when he wasn't even conscious of "God's-mind idealism" as a possible reading of Unity of Type – a Natural Theologian had to point it out to him around 1848. Rupke considers the Platonization of the Archetype as Owen's attempt to "hide its pantheist birthmarks" (Rupke 1994, p. 203). To be sure, Owen's discussions of species origins were obscure and couched in pious rhetoric, and he was highly sensitive to the religious scruples of his Natural Theologist patrons. He would later pay dearly for these scruples at the hands of the Darwinians. But his transcendentalism was in no way a byproduct of Paleyan piety.

Prior to the 18th century, Natural Theology as an empirical source of religious knowledge used *either* purposive (mostly biological) or merely pattern-like (mostly astronomical) phenomena as premises for theological conclusions. The differences between the two cases seemed to be unnoticed. After Newton's successes, and for the first time, the Argument from Pattern exemplified by astronomy became semantically distinguished from the Argument from Purpose exemplified by biology; "astrotheology" was distinguished from "physicotheology". Astrotheology almost immediately fell into neglect and the biologically-informed physicotheology became the core of Natural Theology (Gillespie 1987, Amundson 1996). Once the patterns of astronomy were well understood it was difficult to prove that brute material causes could not have given rise to them. The modern, purposive version of the Argument from Design dates from this event. From John Ray and Robert Boyle through Paley and Whewell, Purpose is recognized as stronger evidence than Pattern. Even in his acceptance of Owen's results, Whewell devalued the Platonized Archetype in words much like Paley's devaluation of astrotheology. Paley favored biology over astronomy, which was "*not* the best medium through which to prove the agency of an intelligent Creator" (Paley 1831, p. 517). Whewell considered Owen's Platonism "a view quite

different from that which is described by speaking of ‘Final Causes,’ and one much more difficult to present in a lucid manner to ordinary minds” (Whewell *op. cit.*).

My purpose in subjecting Owen to such a close examination is to defend the historical significance of the Russell/Ospovat Schema. Even in the person of Richard Owen, transcendentalism was not a specialty within the practice of Natural Theology. Natural Theology itself was on the teleological side of the Russell/Ospovat Schema from the beginning of the 19th century onwards. As a matter of the history of religious thought, the attempts to classify transcendentalism as a species of Natural Theology may be relatively harmless. Once transcendental anatomy became acknowledged as a biological field, it was indeed whitewashed by Owen and made a grudging footnote to British Natural Theology. But as a matter of the history of *science*, such subtyping of Natural Theology is unhelpful. It belies the intellectual origins of transcendentalism, which was not at all a product of Natural Theological thinking. The tendency to see it as such may arise from an attachment to the E/C Schema, assuming that if transcendental anatomy was not an evolutionary movement it must have been a creationist one. In fact transcendentalists were arrayed on all sides of the question of origins. Transcendental anatomy cannot be categorized within the Evolution/Creation dichotomy. It is a style of biology distinct from and at odds with the teleology of Natural Theology, but transcendentalism *per se* takes no stand on organic origins. Doctrines on religious and metaphysical issues (such as the existence of a personal God or materialism vs. idealism), like questions of organic origins, are non-diagnostic of the movement. Teleology vs. morphology is the proper diagnostic tool.

#### 4. The vacuity thesis

“If we suppose that the ancient progenitor, the archetype as it may be called, of all mammals, had its limbs constructed on the existing general pattern . . .” (Darwin 1849, p. 435).

Darwin’s transformation of Owen’s archetype into an ancestor is among his most elegant achievements. It neatly arranges many of the primary results of transcendental anatomy as support for descent with modification. The vacuity thesis describes Darwin’s transcendental predecessors in a fashion that highlights their shortcomings in comparison to Darwin’s successes. Seen from a certain perspective, the transcendentalists failed but Darwin succeeded in explaining a striking set of biological phenomena. From this perspective, Darwin achieved not merely a success but a devastation; he “made nonsense of” transcendental views of the matter.

By the vacuity thesis I mean the judgment that transcendentalist biology of this period was effective irrelevant to the development of evolutionary theory *because* transcendentalists could give no explanation of Unity of Type. To assess this view we must consider the status in the mid-19th-century of the broadly transcendentalist biological program. Were the scientific results of transcendentalism so empty that *on their face* they are worthy only of antiquarian attention? Or were they, like Kepler's results in the 17th century, scientifically important but soon to be reinterpreted?

First, did Darwin himself consider transcendentalist theories to be vacuous, as Hull and Mayr intimate? Darwin certainly did consider his theory *better* than the transcendentalist views known to him, but that doesn't imply the vacuity of the less satisfactory theory. Some passages from the *Origin* can be interpreted as vacuity claims. "It is so easy to hide our ignorance under such expressions as the 'plan of creation,' 'unity of design,' &c., and to think that we give an explanation when we only restate a fact" (Darwin 1859, p. 482). But we must keep in mind that in 1859 Darwin considered Owen (for example) to be a special creationist. So it is unclear in this context whether Darwin is condemning transcendentalism itself or merely the creationist use of transcendentalist concepts. The latter seems likely, since Darwin elsewhere described Unity of Type as one of the two "great laws" of organic form (*ibid.*, p. 206). To illustrate Darwin's belief in the vacuity of transcendentalism, Hull referred to the quotation from Darwin's Morphology section given above. He reported that Darwin "conclud[ed] his discussion of Owen with 'but this is not a scientific explanation'" (Hull 1983, p. 71). If we keep in mind the distinction between transcendentalism and creationism, we can see that the phrase quoted from Darwin does not dismiss Owen's transcendentalism. By the time Darwin added "not a scientific idea" to the *Origin* he had already acknowledged that Owen was no special creationist. The quoted passage does *not* condemn Owen, but rather special creationism, described by Darwin as "the ordinary view of the independent creation of each being."

Hull and Mayr, in different ways, interpreted the same passage as showing that Darwin considered transcendentalism to be vacuous. In fact Darwin was criticizing only special creationism. Where Darwin *does* distinguish transcendentalism from creationism, he *does not* label transcendentalism (but rather creationism) as unscientific. Far from rejecting Unity of Type, Darwin endorsed Owen's own transcendentalist rejection of Natural Theological adaptationism. Only by conflating transcendentalism with creationism is it possible to cite Darwin as believing transcendentalist biology to be vacuous.

Just how contentful or controversial were the transcendentalist claims in the 1840s and 1850s? Was Unity of Type merely a restatement of obvious truisms about organic kinds? Hull suggests this is so: "None of the scientists

under discussion doubted that the regularities referred to by unity of type existed. They differed with regard to their physical or causal explanation” (Hull 1983, p. 71). Bowler reports quite the contrary about Natural Theologian Charles Bell’s Bridgewater Treatise *On the Hand* (1833), said to contain “an explicit denial that there is any underlying unity in organic nature that could serve as alternative [transcendentalist] evidence of design” (Bowler 1977, p. 33). Was there or was there not a consensus on the reality of Unity of Type? This question is better phrased: Was the concept of Unity of Type considered to carry significant explanatory force? The answer was No according to most Oxbridge scientists, including Bell, Whewell, and Sedgwick. This does not mean that biological types could not be discerned. They could be, but their identification was of no real scientific value. The situation was similar in the Cuvier/Geoffroy debate. Cuvier admitted that (many of) Geoffroy’s types existed, but denied Geoffroy’s structuralist morphological explanations of them. For Cuvier and the Natural Theologians, all types were functional types, explainable by the similar functional needs of the organisms (Appel 1987). Because all animal traits are explained by the functions they serve, nothing was left over for transcendental morphological theories to explain.

Bell’s 1833 and Owen’s 1849 books are each studies of the vertebrate limb written by Oxbridge-favored biologists. The theoretical contrast between the books is enormous. Bell and Owen, like Cuvier and Geoffroy, instantiate the elements of the R/O Schema. Like Cuvier, Bell denied not the existence of types, but only their significance. He recognized similarities between corresponding parts of different species, including some of the parts that transcendentalists used to trace homologies. Bell spoke of the “great plan of creation” (compare Darwin above) which plan allows us to recognize extinct organisms as members of existing types (Bell 1833, p. 23). Nevertheless, for Bell this unity did not call for explanation, nor was it itself invoked to explain any other phenomena. There are some real similarities, but they are merely artifacts of adaptation. Bell was well aware and very distrustful of the work of the continental morphologists. Those “modern works on Natural History” carry the wrong message. “It is supposed that the same elementary parts belong to all animals, and that the varieties of structure are attributable to the transposition and moulding of these elementary parts. I find it utterly impossible to follow up this system to the extent which its abettors would persuade us to be practicable. I object to it as a means of engaging us in very trifling pursuits – and of diverting the mind from the truth” (ibid., pp. 39–40). Adaptation explained all that needed explaining.

Bell was well read in continental biology, and could critique the latest transcendental hypotheses. He rejected the recently-proposed homological correspondence between mammalian inner ear ossicles and the jaw bones

of lower animals, pointing out that “the sense of hearing is enjoyed in an exquisite degree in birds” (Bell 1833, p. 139). Because there was no adaptive deficit, there was no point in identifying ear bones in one species with jaw bones in a different species. To Bell, function was all that mattered. Patterns of structural relationships were either reducible to functional similarities, or they were unworthy of attention.

So Hull and Bowler are each partially correct about the Oxbridge adaptationist stance on biological types. Anatomical types were acknowledged to exist, but they were not acknowledged to have any real structural significance, that is, any significance over and above function itself. This was the true schism between transcendentalist and Natural Theological thinkers – not whether Types exist, but whether they reflect a reality independent of adaptation. The reality of non-adaptive Types was the rift zone of the R/O Schema.

Bowler’s report on Bell quoted above carries a further presupposition – that it was “alternative evidence of design,” what Bowler calls “the idealist version of the argument from design” that Bell was rejecting. As I read the historical record, the idealistic version of the Argument from Design is primarily an artifact of 20th century thought. It was never a significant issue in the 19th century, and was certainly not on Bell’s mind in 1833. He was rejecting transcendentalist *biology*, not transcendentalist theology. Bell and his colleagues regarded transcendentalism as a materialist threat, not a theological alternative.<sup>3</sup>

Where does this leave the vacuity thesis? Did Unity of Type lack explanatory value in the absence of a “God’s Mind” reification of the Plan? The relations among evolutionism, special creationism, and transcendentalism are best perceived from the perspective of 19th century scientific methodology. As it happens, we have two good sources on the topic in Ruse (1979, pp. 56 ff.) and Hull (1983, pp. 70 ff.). Each author reports the cautious inductivism of the period. True causal laws, such as Newton had discovered, were considered exceedingly difficult to obtain, and speculative overeagerness was a dangerous scientific vice. Phenomenal or “geometrical” laws were more readily available, and a sober scientist would direct his attention towards these (Hopkins 1860). Kepler’s planetary laws exemplified geometrical laws, and Newton’s gravitation a causal law. Causal laws are deeper in the sense that they can account for geometrical laws. Evolution and special creation are each intended as causal laws. This is why special creation made such a neat contrast with evolution for the purposes of the *Origin*. In Mayr’s terminology each expresses “ultimate causation” in that it refers to causal (as opposed to geometrical) laws that operated in the remote past. Should transcendentalist

Unity of Type be considered to be an ultimate/causal law or a geometrical law?

Transcendentalists generally did not treat Unity of Type itself as a causal law. Owen in 1849 mentioned the unknown secondary laws by which species were introduced. Species that came into existence by these laws *exhibited* Unity of Type, but were not created by it. Geoffroy claimed that his laws of affinities were inferred directly from the phenomena, and did not express remote causation (Geoffroy 1930). Although his Types were surely not as inductively inferred as he claimed, Geoffroy's Unity of Type was a geometrical law that expressed a pattern in the phenomena, not an ultimate cause of the phenomena. Some transcendentalists (Agassiz and momentarily Owen) went "ultimate" with reference to God's Mind, but most simply didn't comment on the ultimate cause of the phenomena of Type. Some undoubtedly believed that Unity of Type would eventually be found to have a naturalistic explanation. Though few openly proclaimed transmutation as an ultimate cause of homology, fewer still followed Agassiz in attributing it directly to God with no secondary intermediary causes.

This is not to say that transcendentalist concepts were completely phenomenal. Owen considered his principle of 'irrelative repetition,' for example, to partially account for organisms' conformance to their Type (compare Sloane 1992, p. 72). (Irrelative repetition applies most directly to serially homologous body parts such as segments and vertebrae.) Von Baer's embryological principle that heterogeneous structures arise and diverge gradually out of homogeneous structures similarly describes a causally active process. These intermediate-level laws or principles hypothesized causal processes, not just geometric patterns. But they did not advert to ultimate causes. A creationist might think of these as "secondary causes," a neoDarwinian as "proximate causes."<sup>4</sup> The causal nature of these processes aligns transcendentalism with modern developmental biology, as will be discussed below. The important point is that they were not at the metatheoretical level of ultimacy at which creationism and evolutionism contrast. The question of the ultimate cause of the facts expressed by von Baer's principle could be given either a creationist or an evolutionary answer – or no answer at all.

Hull points out that because of the inductive methodology of the period "scientists felt perfectly justified in remaining silent on those issues for which they lacked sufficient data" (Hull 1983, p. 63). Most transcendentalists remained silent about the ultimate causes of species origins. It is a mistake to read this caution as a belief in the causal ultimacy of Archetypes and polarities themselves. Transcendentalist laws such as Unity of Type and embryological divergence are best seen as geometrical laws, at least with respect to species origins. So interpreted, their vacuity is far from obvious. Transcendentalists

usually treated their laws as atemporal and abstract (ideal), rather than as products of specific historical processes. But the reluctance to *assert* historical, temporal, ultimate causation should not be misread as a commitment to divine ultimate causation.<sup>5</sup>

The claims that transcendentalist biology was vacuous and that idealists were “completely at a loss” to explain Unity of Type fail to acknowledge one crucial point: The transcendentalists were the ones to call attention to Unity of Type in the first place! Prior to their elucidation of Unity of Type *there was nothing to explain*. Once the Unity was established to the satisfaction of the biological community (after even Whewell was forced to acknowledge its reality) Darwin’s archetype-to-ancestor flourish was enabled. A causal explanation could be offered for the geometrical law. No one pronounces Kepler or Mendeleev unscientific because the planetary laws and the periodic table contain no references to ultimate causation. The transcendentalists deserve at least equal respect. At a bare minimum, the transcendentalists played Kepler to Darwin’s Newton.

Transcendental morphologists had, above all else, demonstrated the richness of the patterns connecting organic forms at every scale. There were surely excesses in the school; Geoffroy’s vertebrate/mollusc homologies and the *Naturphilosophs’* Vertebral Theory of the skull did not pan out. Nevertheless, the branching patterns of embryological development, their relation to taxonomic patterns, and to some extent the association of both of these with the fossil record were primarily achievements of transcendentalist morphologists. Darwin showed no caution or embarrassment about using these results in the *Origin*. They play crucial roles in what Ospovat calls Part II of the *Origin*, Darwin’s argument for the fact of descent with modification.

## 5. Structuralist biology as the study of form

To this point I have used the term transcendentalist as a convenient label for a group of biologists. I will now propose an interpretation consistent with the above discussion. Organic adaptation was regarded by British biologists (and many others before and since) to be an easily observable fact of the natural world. It required a minimum of hypothetical or speculative reasoning to discern. The continental biologists who purported to discover “higher” types and relations in the organic realm were seen as speculative in part because they abandoned the safe generalizations of observed adaptation. To be sure, many continental biologists were speculative from anyone’s perspective. The *Naturphilosophs* are everyone’s favorite case. Lynn Nyhart reports that beginning in the 1820s and 1830s “*Naturphilosophie* became a code word meaning speculation and was regularly used as a convenient label of derogation”

(Nyhart 1995, p. 44). This happened on the continent as well as in Britain, and the tradition continues today: “. . . influential though *Naturphilosophie* may have been, it was ultimately pretty ridiculous nonsense, with all of its silly notions about polarities and archetypes and so forth” (Ruse 1993, p. 384). Many of the biologists here discussed as transcendentalist were equally critical of *Naturphilosophie* for its speculative excesses, though perhaps not for Ruse’s reasons. Nevertheless they shared with it a theoretical orientation that distinguished them from mainstream British functionalist biology.

The primary theoretical goal for this large and heterogeneous group was *the explanation of biological Form*. The various theoretical ideas that grew out of this approach were not uniformly speculative and otherworldly. They offered explanations, partial explanations, and hypotheses that reported unities among portions of the organic kingdom that it were not based on the empirically respectable observations of adaptation favored within the British tradition. The continental biologists favored structural explanations, the British favored functional explanations. Functional facts seemed concrete and empirical to the British, and in comparison the continental structuralist theories (positing hypothetically-inferred unities) seemed transcendental. The anomaly of Geoffroy as a materialist-idealist is resolved in this way. His “idealism” is merely his commitment to a biological reality beyond the empirically given observations of adaptation.

Nyhart (1995) shows that the study of Form, or morphology (a term introduced by Goethe), was a mainstream of biological investigation in the 19th century. Encompassing both theoretically oriented comparative anatomy and embryology, its development incorporated quite smoothly what we now identify as the Darwinian Revolution. Much of what now seems archaic about late 19th century evolutionary biology results from the strength of the morphological, embryological, structuralist tradition at that time, a tradition that was not incorporated within the Modern Synthesis. The E/C Schema, which fits nicely within the Synthesis, strongly distinguished the morphologists who did from those who did not accept descent with modification. It does not acknowledge the continuity of the morphological approach. For example, interpretations of the patterns of Meckel-Serres recapitulation and von Baerian views of development were to a large extent unchanged by the *Origin* – evolution was merely the means by which one or the other embryological pattern had come about.

On the other hand, is it imaginable that the *Origin* could have been written *in the absence of* the results of transcendental biology? What if there had been no Archetype for Darwin to transform into an ancestor? No concept of homology? Suppose the embryological debates in Darwin’s day had still been preformationism versus epigenesis, and the embryological basis of the

Meckel-Serres/von Baer debates had not yet been discovered. What would the *Origin* have looked like? Darwin considered embryology “by far the strongest single class of facts in favor of change of forms,” and “the morphological or homological argument” a close second (quoted in Ospovat 1981, p. 165). Most of what was known about these fields in the 1840s and 1850s came from transcendentalist sources. These same sources were condemned as speculative nonsense by the truly creationist Natural Theologians. It is ironic that so many modern thinkers agree with the Paleyans on this issue.

For a more charitable understanding of the structuralist/transcendentalist style of thought it is important to avoid superimposing the E/C Schema of ultimate causes on the notions being discussed. The reminders of Ruse and Hull about the inductivist tenor of the time are important; *Naturphilosophie* was so widely criticized even by continental biologists because of its eagerness to abandon inductivist caution. One must refrain from writing “creationist” or “evolutionist” in the margins of this writing – these were not the topics. When biologists of this era are read without assuming creationism, a Gestalt shift can sometimes come about – they start to sound like evolutionists! Developmental biologist Brian Hall, in discussing the importance of ontogeny in von Baer’s understanding of biology, states that according to von Baer “there was no phylogeny apart from ontogeny” (Hall 1992, p. 50). The problem is that von Baer never endorsed transmutation, and when Darwin’s views became known von Baer considered them just as speculative as *Naturphilosophie* (Nyhart p. 21). What Hall means to say is that von Baer considered ontogeny as the only way to understand what we might call the “natural system” – the set of deep relationships underlying all life forms. We modern thinkers, Hall included, consider phylogeny to be the underlying reality of this natural system. Hall’s agreement with von Baer that ontogeny is a crucial part of understanding the natural system caused him to forget that von Baer was not committed to the phylogenetic nature of the system.

As diverse as their metaphysical, religious, and biological views were, the group here labeled as transcendentalists were in agreement that there *was* a “natural system” that unified distinct life forms, and that the structural patterns that can be discovered in embryology and comparative morphology gave clues to its nature. Types and subtypes were intrinsic features of this system, and not merely conveniences of classification. The parallels among embryology, systematics, and paleontology evidenced the robustness of the system. Many of the structuralist accounts can be seen as *generative* systems – one basic, simple form gives rise to a diverse range of outcomes, all of which are unified by traces of their origin in the simple form. This pattern fits von Baerian and Meckel-Serres embryology, as well as Owen’s Archetype theory and its predecessors, and in fact any system of homologies. Such a

system may or may not be coupled with the historical claim that the pattern is an effect of phylogeny. Prior to Darwin the generative systems were usually discussed as abstract and atemporal, but the geometry they entailed was suited to evolutionary interpretation. The transcendentalist Archetype was well in place, at the root of the tree, in time for Darwin to point to it and declare it an ancestor.

This is in contrast to the 19th-century functionalists and Natural Theologians. To them Types were epiphenomena, mere byproducts of similarities in adaptation. The world was an assemblage of marvelously designed, interacting parts, each species and each element an individual intelligent creation. The “plan” or “unity” of this creation was not to be seen in the purposeless patterns of organic Type, but in the adaptive intricacies with which each part of each organism fulfilled its purpose, and each organism of each created species fit its niche in the world. To the non-literalist Bridgewater generation of geologists including Buckland and Sedgwick, species were successive creations, each intelligently fitted to niches of the changing earthly environment. Unity of Type was an illusion; the only meaningful affinities were between a species and its place in the economy of the world. This ontological individualism with respect to species was a prime support of special creationism. Transcendentalist Unity of Type denies the ultimate individuality of species by asserting real affinities among groups and subgroups of species. This is why transcendentalism was so repugnant to Natural Theologians, and why the fruits of transcendentalism (the unifying, branching patterns of embryology and morphology) were so valued by Darwin.

It is a great irony that “typology” should have been identified as the philosophical grounding of special creationism. In transcendentalist vocabulary, species are not Types, but at best members or representatives of Types. True special creationists, like the Natural Theologians, denied the reality of Types. The transcendentalist principle of Unity of Type asserts the objective relatedness of some species with other species, and some kinds with other kinds. Without a belief in such a reality there would have been no grounds to hypothesize common ancestors for particular groups of species. Typology, or belief in the objective reality of organic Types, was a step away from creationism and towards evolution. Transcendentalism was not a form of creationism; typology is not an Argument from Design.

## **6. Conclusion: The Russell/Ospovat Scheme today**

The Russell/Ospovat Schema does not only apply to historical biology. Aspects of the contrast continue today. The views on transcendental biology that have been examined in this paper were developed in the intellectual con-

text of neoDarwinian, Modern Synthesis evolutionary biology. Adaptation and function are central to the modern view, while the structuralist biological fields that were cultivated by the transcendentalists are peripheral. Embryology, for example, has never been a significant part of Synthesis evolutionary theory (Hamburger 1980; Gilbert et al. 1996; Depew and Weber 1995, Ch. 15). During the past 15 years developmental biologists have begun to argue for the inclusion of structural and embryological approaches within evolutionary theory, some calling for a second Synthesis, this time to include embryology. The debate is sometimes termed ‘adaptation versus developmental constraint,’ but the evolutionary *relevance* of developmental biology (not just its constraints) is the issue. Many modern structuralists recognize their intellectual ancestors among the 19th-century transcendentalists. As in the 19th century, some modern structuralists emphasize abstract patterns (Goodwin 1982; Kaufmann 1993) while others stress the mechanics or genetics of embryological development (Wake et al. 1991; Gilbert et al. 1996). NeoDarwinian functionalists quite naturally see little value in these studies (Reeve and Sherman 1993; Wallace 1986). As in the 19th century, methodological differences play a strong role in the debates. The Russell/Ospovat Schema lives on.

Perspectives on the history of science are naturally influenced by current scientific understandings. The common image of 19th-century transcendentalism as an Argument from Design and as scientifically vacuous reflects the functionalist perspective of modern neoDarwinism. It underestimates structuralist influences on Darwin’s own ideas, and overestimates Darwin’s opposition to structuralist authors. It makes a bogeyman of historical biological structuralism, presenting it as the very antithesis of scientific evolutionary thought. Those concerned with the modern debates between functionalist and structuralist biology should be wary of historical presuppositions, such as the view that typology is a creationist enemy of evolutionary biology.

Some readers of an early version of this paper took it to be attributing a sort of hidden agenda to the authors of earlier writings on the transcendentalists. In fact I do believe that those writings were not “pure” history (if any writings ever are), and that 19th century science was being interpreted from a perspective which begged certain substantive questions regarding 20th century evolutionary biology. The writings on essentialism and typology served not only to explain preDarwinian creationist error, but also to associate that error with contemporary competitors to Modern Synthesis biology. Some readers suggested that I, too, interpret history in the context of modern debates. And so I do. Here is my agenda: Critically examine those aspects of current philosophical and historical understandings of biology which underlie the widespread opinion that developmental biology is irrelevant to the understanding of evolution (Amundson 1990, 1994, forthcoming). Among those

aspects are contemporary conceptions of typology and essentialism, and their application to 19th century biology. Like the earlier writers on transcendentalism and idealism whose works are here examined, I am attempting to do history in the service of a good cause (Hull 1996, personal communication).<sup>6</sup>

## Notes

<sup>1</sup> Examples are Lurie 1960, Gruber 1960, and Greene 1959. Evolutionary biologist A.J. Cain's (1964) very interesting and contentious discussion of Owen also had little impact on concepts of transcendentalism at the time. Unlike the writers discussed in the present paper, Cain believed that Darwin had *too much* respect for Owen!

<sup>2</sup> Darwin's report that Owen "expressly admitted" the inadequacy of teleology is a mild statement of the case. Owen's *Limb* book (1849) positively reveled in Paleyan teleology's shortcomings.

<sup>3</sup> Bowler considers the theories of Hugh Miller, William MacLeay, and Edward Forbes to be additional cases of the idealistic version of the Argument from Design (personal communication, 1996). I consider them to be rather pious interpretations of straightforward science. The view that evidence for God can be seen in *any* pattern in nature, whatever its details, comes very close to William Whewell's argument that any natural law requires a Lawgiver. This is not itself a version of the empiricist Argument from Design, because the empirical details of actual science do not matter to one's theology (Amundson 1996, pp. 21 ff.). The difference between Bowler and I may come down to how the category "Argument from Design" should be conceived.

<sup>4</sup> The concept of secondary causation played a similar role in broadly creationist science to that played by proximate causation in neoDarwinian biology. Most secondary/proximate processes are presumed to have had an ultimate (divine/evolutionary) source.

<sup>5</sup> Hull insightfully identifies Unity of Type as a geometrical law (Hull 1983, p. 71). My conclusions differ from his for two reasons. First, he considers Unity of Type not to have been a controversial notion at the time. I disagree, as has been discussed. Second, he considers Owen's idealism as not *itself* a geometrical matter, but rather a causal explanation of the geometrical laws of Unity of Type. In this way Owen's idealism is seen as a failed, or unscientific, attempt at ultimate causal explanation. I see it as a relatively successful quasi-geometrical account.

<sup>6</sup> A number of people have given me instructive, generous, and sometimes extremely detailed comments on an early version of this paper. I am grateful. Among them are Jeremy Ahouse, Peter Bowler, Scott Gilbert, M.J.S. Hodge, David Hull, Kevin Padian, Nikolaas Rupke, Elliot Sober, Polly Winsor, and an anonymous referee. It is surely needless to add that these individuals do not necessarily agree with the positions taken in the paper. Nevertheless, I wish to make sure that they're all off the hook.

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