The Impact of German Romanticism on Biology in the Nineteenth Century

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All art should become science and all science art;
poetry and philosophy should be made one.

Friedrich Schlegel, *Kritische Fragmente,*115

Introduction

Many revolutionary proposals entered the biological disciplines during the late eighteenth and nineteenth centuries, theories that provided the foundations for today's science and gave structure to its various branches. Cell theory, evolutionary theory, and genetics achieved their modern form during this earlier time. The period also saw a variety of new, auxiliary hypotheses that supplied necessary supports for the more comprehensive theories. These included ideas in morphology, embryology, systematics, language, and behavior. These scientific developments forced a reconceptualization of nature and the place of human beings therein. The legacy for the twentieth and twenty-first centuries has been a materialization and mechanization of the most fundamental processes of life. From our current perspective, it's easy to look back and assume that the foundational ideas of our contemporary science must have had the same character as they now seem to manifest. I think a closer inspection of biological science of this earlier period will reveal a discipline whose philosophic assumptions are quite different from those of its present incarnation. This becomes especially vivid when we focus on the contributions of German Idealism and Romanticism to the biology of the earlier dispensation.[1]

Idealism and Romanticism might seem the very antithesis of the kind of empirical biology of the early period, especially the evolutionary theories of Charles Darwin, who, it is usually assumed, banished ideas of purpose and finality from nature, the kind of ideas cultivated by the Idealists and Romantics.[2] At best these philosophical movements must be thought stagnant and reeking tributaries of the main currents that led to the modern era in science. I will, however, argue that certain fundamental ideas flowing through the main channels of biological science originated from what seem from our present vantage to be tainted sources. These sources were both direct and indirect. It was, after all, Alexander von Humboldt, disciple of Goethe and friend of Schelling, who inspired Darwin to embark on his five-year voyage, and the young Englishman's conception of nature bore the mark of his German predecessor. In what follows, I will describe some of the major features of this Romantic contribution to the biology of the nineteenth century and also suggest how those same sources finally caused a bend in the stream, channeling it toward materialism and mechanism.

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[1] The argument of this essay is based on my *The Romantic Conception of Life: Science and Philosophy in the Age of Goethe* (Chicago: University of Chicago Press, 2002); and *The Tragic Sense of Life: Ernst Haeckel and the Struggle over Evolutionary Thought* (Chicago: University of Chicago Press, 2008).

[2] That Darwin eliminated teleological considerations from biology has become the orthodox assumption, as testified to by the likes of Stephen Jay Gould, Daniel Dennett, and a host of modern scholars. See for example, Stephen Jay Gould, *The Structure of Evolutionary Theory* (Cambridge: Harvard University Press, 2002), p. 122; and Daniel Dennett, *Darwin's Dangerous Idea* (New York: Simon and Schuster, 1995), p. 133.

Romanticism in German Biology

Romanticism and Idealism in Germany

The early German Romantics are canonically constituted by the group of individuals in the orbit of the poet and scientist Johann Wolfgang von Goethe, such individuals as the historians and literary figures the brothers Wilhelm and Friedrich Schlegel, the poet Friedrich von Hardenberg, known as Novalis, the philosopher Friedrich Schelling, the theologian Friedrich Schleiermacher, and the galvanizing spirit, Caroline Michalis Böhmer Schlegel Schelling, whose surname tracks only a portion of her romantic alliances. Philosophically they were idealists of one form or another, but were distinguished from other idealists of the period by their emphasis on poetry and aesthetic expression as another mode for understanding reality. In this approach they were especially influenced by Immanuel Kant, particularly the Kant of the Third Critique. One might also widen the circle just a bit to include Alexander von Humboldt, the scientist and adventurer, and Carl Gustav Carus, the anatomist and painter, both disciples of Goethe and decisive in spreading the ideals of the movement. I will trace out some of the multiple ways the conceptions of this group gave substantial form to the biology of the late eighteenth and nineteenth centuries, especially to evolutionary biology.

The Contribution of Kant

While virtually no one would be inclined to think of Kant as a Romantic, his critical idealism became foundational to the philosophical and scientific project of the Romantics. In the *Critique of Judgment,* Kant maintained that aesthetic judgment and the judgment characteristic of biological science, teleological judgment, had a similar structure. They were judgments of the purposive character of beautiful objects and of organic beings. Such judgments, according to Kant, consisted in attributing the existence of the object, whether an artistic product or a natural creature, to the *idea* of the whole object of interacting parts.[3] In aesthetic judgment, we attempt to discern the idea of the whole through the special feeling that arises from the free-play of imagination, as Kant termed it, when we keep measuring our reflections about an art object against the rational standards of understanding.[4] When the feeling reaches a certain pitch, we are ready to call an object beautiful, though without being able to specify the concepts or rules by which the artist was able to achieve this effect. If such concepts or rules were consciously specifiable, the connoisseur might simply apply them to a painting or sculpture to determine whether it was beautiful or not. As Kant put it, aesthetic judgment is a judgment of "Zweckmässigkeit ohne Zweck"—purposiveness without (conscious) purpose, that is, without explicit awareness of the ideas guiding the artist's hand.[5] On the productive side, talent in the fine arts, in Kant's estimation, stemmed from the unconscious nature of the artist who executed a work of art and was led only by aesthetic feeling—what Kant captured in the formula by which he described artistic genius: "the inborn mental trait (*ingenium*) by which nature gives the rule to art."[6] Artists may have at their disposal scientific principles concerning perspective and color-mixing and rules of thumb about representation of particular kinds of scenes; but they have no guide book they can consult for meta-rules by which to

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[3] Immanuel Kant, *Kritik der Urteilskraft*, in *Werke*, ed. Wilhelm Weischedel, 6 vols. (Wiesbaden: Insel Verlag, 1957), 5: 298-99 (A32, B32).
[4] Ibid., p. 324 (A67-68, B68-69).
[5] Ibid., p. 300 (A34-35, B34-35).
[6] Ibid., pp. 405-406 (A178-9, B181).

produce a beautiful object. Such rules can only lie deep within the nature of the talented artist.

In judgments about living creatures, according to Kant, we need to reduce, as much as possible, their structure and behavior to mechanistic law, since valid science can only exist in virtue of a system of laws by which the forms and functions of objects are explained. We ultimately discover, however, that the forms and functions of living creatures require more than a mechanistic account. There are features of life that escape reduction of the whole to its parts. Rather, we have to appeal to the structure of the whole organism to explain features of its parts, that is, we have to assume the parts are organized according to a plan or design of the whole:[7] the functioning of the vertebrate eye, for instance, can be partly explained by the mechanical process of refraction, that is, the bending of light rays as they pass through the various media of cornea, aqueous humor, lens, and vitreous humor on to the retina. But the Snell-Descartes law cannot explain why the various media are placed where they are in the eye. By exploring the whole structure of the eye we come to understand the purpose of the disposition of the parts, namely, to produce a coherent image on the retina. It's as if the design of the whole were the effective cause of the arrangement of the parts, as if, in Kant's terms, an *intellectus archetypus* had so constructed living creatures.[8]

[7] Ibid., pp. 483-88 (A285-91, B289-93).
[8] Ibid., p. 526 (A346-47), B350-51). Kant first introduced the conception of an *intellectus archetypus* in a letter to Marcus Herz, his former student. Such an intellect would in its very conceiving be creative of the object of its representation, while an *intellectus ectypus* had its representations produced by the object. Our intellect was neither completely creative nor completely receptive. See Kant to March Herz (21 February 1772), in *Briefwechsel von Immanuel Kant in drei Bänden*, ed. H.E. Fischer, 3 vols. (Munich: Georg Müller, 1912), 1: 119.

Of course, machines can have designs that require us to comprehend the whole to understand the various functions of the parts. But biological organisms display features that no machine—at least of Kant's time—could manifest. The organs of creatures grow and repair themselves, with each organ acting reciprocally as means and ends of the other organs; moreover, the whole creature can reproduces itself through generation.[9] These features not only require the assumption of a plan as their cause—an intelligence behind the plan—but the plan must be realized over time.

At one level, the case of art is no different: the execution of the art object, or its appreciation, requires the assumption of an intelligent, creative nature. The difference between the aesthetic judgment and the teleological judgment amounts to this: the aesthetic is a judgment of purposiveness without conscious awareness of the purpose guiding the intellect of the artist; the teleological is a judgment of purposiveness based on awareness of the purpose, that is, the design of the creature.

In the mid-1780s, Kant critically reviewed his one-time student Johann Gottfried Herder's *Ideen zur Philosophie der Geschichte der Menchenheit*, which was just appearing in several volumes. He found Herder's proto-evolutionary ideas "so monstrous that reason shudders before them."[10] Yet when the anthropologist and comparative anatomist Johan Friedrich Blumenbach advanced similar ideas, Kant found them not to be an affront to reason, but as he said admiringly, "a daring adventure of reason."[11] He simply thought the evidence did not support the theory that organisms over time underwent species transformation; moreover, if one were to suppose such a

[9] Ibid., p. 486 (A288-89, B292-93).
[10] Kant, *Rezension zu Hohann Gottfried Herder: Ideen zur Philosophie der Geschichte der Menschenheit,* in *Werke*, 6:781-806 (A17-22, 309-10, 153-56).
[11] Kant, *Kritik der Urteilskraft*, in *Werke*, 5: 539 (A365, B370).

alterations in the history of life, one would have to contend that the purposive character of life could not be derived from mechanism but stood as an original force to be comprehended only by the regulative, teleological judgment he described. There could, as he said, be no Newton of the grass-blade.[12] For Kant this ultimately meant that biology could not be a science, since we had no way of reconciling final causes with mechanical causes.

Johann Wolfgang von Goethe

Charlotte von Stein said of her friend Goethe's musings over the proto-evolutionary notions in Herder's *Ideen* that something interesting always flows from his imagination. What stimulated him, according to von Stein, was the thought that "we were first plants and animals, though what nature will further stamp out of us will remain unknown."[13] Goethe would find support for these fancies especially in his discussions with his protégé the young philosopher Friedrich Schelling.

Goethe's poetry, novels, and science were pivotal for the early Romantics, and there is every good reason to classify his work, despite the many modes of his mind and the usual demurs of scholars, as the quintessence of the Romantic. His nature poetry, the novel that made him famous—*Leiden des jungen Werthers*—his gothic love story—*Faust*--and his conception of the unity of science and art would urge this view. He himself admitted to Peter Eckermann, his Boswell, that his friend Schiller had convinced

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[12] Ibid., p. 516 (A334, B338).

[13] Charlotte von Stein to Karl Ludwig Knebel (1 May 1784), in Heinrich Düntzer, ed., *Zur deutschen Literatur und Geschichte: Ungedruckte Briefe aus Knebels Nachlass*, 2 vols. (Nürnberg: Bauer und Naspe, 1858), 1: 120.

him that he was indeed a Romantic.[14] Moreover, since Friedrich Schlegel, the founding spirit of the early Romantic movement, took Goethe's poetry as the very model of the Romantic, virtually by definition Goethe had to be a Romantic.[15] Finally, h e moved philosophically precisely in the direction of his young protégé Schelling, the philosophical architect of Romanticism, whose own path led back to Kant's Third Critique.

Goethe embraced the Third Critique because it seemed to unite his two passions, art and biological science. But like Schelling, and as a result of many conversations with the young philosopher, he became more Kantian than Kant. First, he assumed in a quite general way that aesthetic judgment and teleological judgment were two avenues to the underlying structures of nature. That is, he came to hold that the artist, for instance, had to comprehend the essential structures, the archetypes, in order to render natural objects in poetry or painting in the most exquisite way; indeed, the artist in composing a beautiful work in light of these archetypes was exercising the same creative power as nature when she produced living organisms.[16] Kant held that attributions of purposiveness in the explanation of natural kinds could only be regulative strategies for coming to grips, as best one could, with living organisms. Such attributions were not to be regarded as constitutive of the operations of nature, only, as

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[14] Johann Peter Eckermann, *Gespräche mit Goethe in den letzten Jahren seines Lebens,* 3rd ed. (berlin: Aufbau-Verlag, 1987), p. 350 (21 march 1830).

[15] I have discussed the evidence for classifying Goethe as Romantic in my *Romantic Conception of Life*, pp. 457-60.

[16] Goethe works out this conception in an essay he wrote just after his two-year stay in Italy. See his "Einfache Nachahmung der Natur, Manier, Styl," in *Sämtliche werke nach Epochen seines Schaffens* (Münchner Ausgabe), ed. Karl Richter et al., 21 vols. (Munich: Carl Hanser Verlag, 1985-98), 3.2: 186-91. See also his *Italienische Reise* (6 September, 1787), in *Sämtliche Werke*, 15: 478: "These great works of art are comparable to the great works of nature; they have been created by men according to true and natural laws. Everything arbitrary, imaginary collapses. Here is necessity, here is God."

it were, heuristic modes of understanding. Goethe, under the tutelage of the young Schelling, thought that if we were compelled to explain vital structures, employing ideas of purpose, then biological accounts were no different than explanations that employed mechanical causation. We could, then, formulate laws of life with as much justification as we could laws governing the apparently inorganic.

I just referred to the "apparently inorganic," since one of the principal theses of the German Romantics, at least those influenced by Goethe and Schelling, was that all of nature was organic and had to be understood ultimately from that point of view. Nature, whether living or the apparently inert, had to be conceived as a complex whose parts were adjusted to one another as both means and ends; and its operations had ultimately to be regarded as dependent on the idea of the whole. But as Kant had shown, the design of the whole had to be attributed to intelligence, to mind. In Schelling's formulation, "nature should be visible mind [Geist], mind invisible nature."[17] Schelling's thesis conformed to Goethe's long held predilection for Spinoza, according to whom nature and mind were two attributes of the same underlying substance: it was *Deus sive Natura*—God and nature were one. As a result of the interaction between Goethe and Schelling, the mentor's philosophy became more idealistic and the protégé's more objective. Both could thus assume that nature herself was creative and acted according to ideas.

Goethe's greatest impact on the science of the nineteenth century came not from his publications in optics and color theory, which failed to achieve the scientific

[17] Friedrich Wilhelm Joseph Schelling, *Ideen zu einer Philosophie der Natur,* in *Sämtliche Werke, ed. K.F.A. Schelling, 14 vols.* (Stuttgart: Cotta'scher Verlag, 1857), p. 56.

recognition he desired, but from the science that he created, morphology. That science found expression in his *Metamorphose der Pflanzen* and in the three volumes of essays traveling under the title *Zur Morphologie*. Goethe's work in morphology, in Hermann von Helmholtz's estimation, made the path easy in Germany for the reception of Darwin's evolutionary theory later in the century.[18] In his little book *Metamorphose der Pflanzen*, published in the same year as Kant's *Kritik der Urteilskraft,* 1790, Goethe argued that the various parts of the plant—roots, stem, leaves, petals, sexual organs—all had to be understood as transformations of an underlying *Bauplan* or archetype, a structure he symbolized by calling it the ideal leaf. In the essays in *Zur Morphologie*, published in the 1820s, but most written earlier, he expanded the notion of the archetype to animals, maintaining that comparative analyses of animal structures indicated comparable transformations. He came to hold, for instance, what was called "the vertebral theory of the skull," a conception resulting from both his anatomical studies and a chance observation in Venice. This theory maintains that the vertebrate skull is really composed of six transformed vertebrae, just as the parts of a plant are composed of the transformed leaf. Goethe generalized the idea to suggest that the limbs, pelvic girdle, ribs, and skull are to be understood as modifications of an underlying archetypal structure.[19]

Friedrich Joseph Schelling

Goethe was the civil administrator for Duke Carl August of Saxe-Weimar-Eisenach, and the individual most responsible for luring to the small provincial university

[18] Hermann von Helmholtz, *Goethes Vorahnungen kommender naturwissenschaftlicher Ideen, Rede, gehalten in der Generalversammlung der Goethe-Gesellschaft zu Weimar den 11 Juni 1892* (Berlin: Verlag von Gebrüder Paetel, 1892), pp. 30-33.
[19] Goethe, "Das Schädelgerüst aus sechs Wirbelknochen auferbaut, " in *Sämtliche Werke,*12: 359.

of the Saxon duchies at Jena some of the philosophic, artistic, and scientific luminaries of the period, including Friedrich Schiller, Johann Gottlieb Fichte, Georg Friedrich Hegel, and the young philosopher, Friedrich Joseph Schelling.

Goethe was initially reluctant to bring Schelling to Jena, since he did not trust his idealistic tendencies and French-Revolutionary sympathies. However, he was won over by Schelling's acumen, displayed when he spoke knowingly of the Geheimrat's papers on optics. They became good friends, with Goethe acting as a surrogate father, especially when Schelling fell into a deep depression over the death of a young woman—indeed, he was accused of murdering her. In summer of 1798, Goethe began struggling with Schelling's treatise *Die Weltseele* and shortly thereafter mentioned in his *Tag und Jahres Hefte* that he detected the book's propositions to be "incorporated into the eternal metamorphosis of the external world."[20] After the publication of Schelling's *Erster Entwurf eines Systems der Naturphilosophie*, he and Goethe met frequently in November 1798 to discuss the character of *Naturphilosophie*; the impact of that discussion seems to have redirected Schelling's idealism toward what ultimately became, with oxymoronic designation, his ideal-realism, the kind of Spinozistic objectivism that would cause a split with Fichte but bind him tightly to Goethe. Interaction with the young philosopher also caused Goethe to see that his morphology could be grounded in Schelling's kind of idealistic metaphysics. In any case, a brief time after their meetings, Schelling added a long introduction to the *Entwurf* in which he argued the necessity of experimental observation and empirical measure to establish natural law in the study of life.

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[20] Goethe, *Tag- und Jahres-Hefte 1798,* in *Sämtliche Werke*, 14:58.

If nature and God were the same—that is, the identity of nature and mind—then nature could not ultimately be reducible to inert, mechanical processes. The creativity and moral features of nature need not be imposed from without by a beneficent God, but should be regarded as original endowments of nature herself. "The objective world," in Schelling's happy epigram, would be "the original, though unconscious, poetry of mind [Geist]."[21] Moreover, that poetry would have a moral character. The laws of nature, from one perspective, would be seen as governing the development of nature, from another as moral rules.

Schelling argued that the structures of nature would result from an evolutionary process, a *dynamische Evolution* he termed it. Given his identification of mind with nature, his conception of evolution would have two features: a kind of rational dialectic in which the full development of a *Gattung* (i.e., a species or larger taxonomic group) would already have achieved its full development in the idea; and a temporal expression in empirical nature. Taking direct aim at Kant in his demur about a "daring adventure of reason," Schelling asserted that it was a "vintage delusion" to hold that "organization and life cannot be explained from natural principles." One only needed to cultivate that sense of reason as an adventure:

> One could at least take one step toward explanation if one could show that the stages of all organic beings have been formed through a gradual development of one and the same organization.—That our experience has not taught us of any formation of nature, has not shown us any transition

[21] Friedrich Wilhelm Joseph Schelling, *System des transscendentalen Idealismus,* in *Sämtliche Werke*, ed. K.F.A. Schelling, 14 vols. (Stuttgart: Cotta'scher Verlag, 1857), 2: 349.

> from one form or kind into another (although the metamorphosis of many insects . . . could be introduced as an analogous phenomenon)—this is no demonstration against that possibility. For a defender of the idea of development [*Entwickelung*] could answer that the alteration to which the organic as well as the inorganic nature was subjected . . . occurred over a much longer time than our small periods could provide measure.[22]

Schelling attributed his understanding of the possibility of such dynamic evolution to Goethe. In a letter to his mentor, after his mental breakdown, he confessed that

> the metamorphosis of plants, according to your theory, has proved indispensable to me as the fundamental scheme for the origin of all organic beings. By your work, I have been brought very near to the inner identity of all organized beings among themselves and with the earth, which is their common source [gemeinschaftlicher Stamm]. That earth can become plants and animals was indeed already in it through the establishment of the dynamic basic organization, and so the organic never indeed arises since it was already there. In future we will be able to show the first origin of the more highly organized plants and animals out of the mere dynamically organized earth, just as you were able to show how the more highly organized blooms and sexual parts of plants could come from the initially more lowly organized seed leaves through transformation.[23]

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[22] Schelling, *Von der Weltseele*, in *Sämtliche Werke*, 1: 416-17.
[23] Schelling to Goethe (26 January 1801), in F.W. J. Schelling, *Briefe und Dokumente*, ed. Horst Fuhrmans, 3 vols. to date (Bonn: Bouvier Verlag, 1962-), 1:243.

His remark that the "organic never arises since it was already there" was another swipe at Kant, who contended that a conceptual obstacle to any transformational theory would be the impossibility of spontaneous generation, that is, the development of the organic out of the inorganic. From Schelling's point of view, organicism was the fundamental property of the objective world. Schelling's theory of dynamic evolution caused the great historian of philosophy Kuno Fischer, when he was rector at Jena in the 1860s, to remind Ernst Haeckel that Lamarck and Darwin were not the first to advance a theory of the evolution of species.[24]

Carl Gustav Carus

[24] Kuno Fischer, *Friedrich Wilhelm Joseph Schelling*, 2 vols.: vol 6 of *Geschichte der neuern Philosophie* (Heidelberg: Carl Winter's Universitätsbuchhandlung, 1872), 2:448.

The theory of the archetype became a central notion of Goethean morphology, and it was instrumental in converting Schelling to a theory of Spinozistic identity. Goethe's theory was further advanced and made more available to biologists through the efforts of his disciple Carl Gustav Carus, who refined the theory in his *Von den Ur-Theilen des Knochen- und Schalengerüstes* (1828). In this work, Carus illustrated the archetypal unity of the vertebrates (figure 1), and showed how the entire vertebrate frame could be generated from the features of a single vertebra. And that vertebra could be idealized even further. Much like a new Copernicus, he demonstrated how that physical emblem could be understood as composed of geometrical spheres

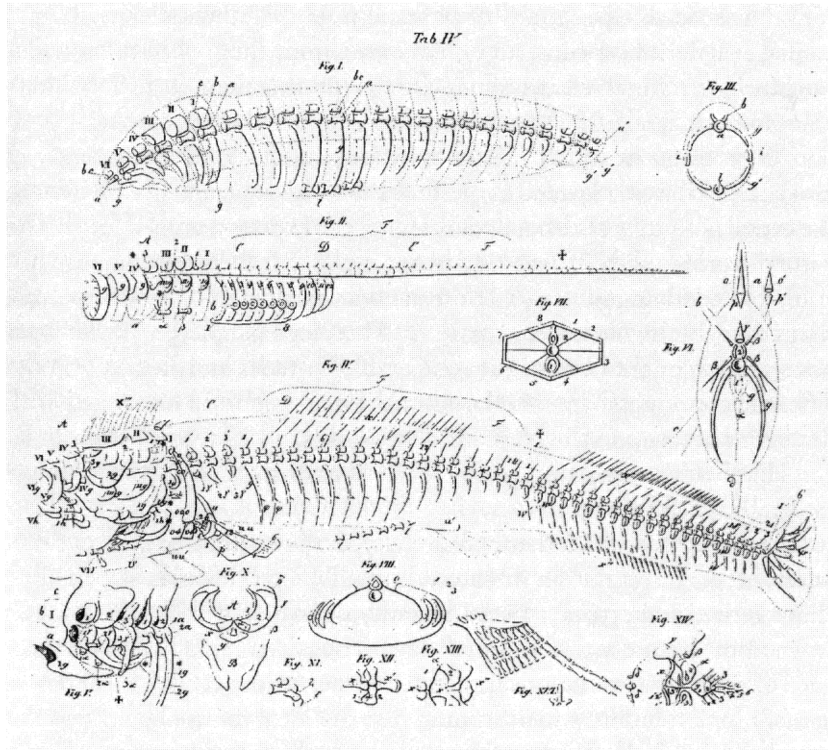


Figure 1: Illustrations of the vertebrate archetype (fig.1) and of an ideal vertebra (fig.3), from Carl Gustav Carus, *Von den Ur-Theilen des Knochen und Schalengerustes* (1828).

(figure. 2). This tradition of ideal geometrical analysis of animal form reached its apogee during the 1940s, with the publication in 1941 of D'Arcy Thompson's thousand page edition *On Growth and Form*. But long before that, it crossed the channel and played a crucial part in the development of British morphology, especially in the work of Joseph Henry Green, Richard Owen, and Charles Darwin.

For Carus and other German anatomists touched by the hand of Goethe and Schelling—Lorenz Oken, for example—archetype theory also illuminated embryological development. The embryo, it seemed, passed through stages morphologically similar to the lower stages of the animal hierarchy. The human embryo, for instances, sequentially took on the guise of a simple monad, then of an invertebrate, then of something like a fish, then the morphology of a primate, and finally achieved recognizably human form. The great embryologist Karl Ernst von Baer suggested that in all of these transformations, development occurred because of the idea which it realized. In nineteenth century biology, this became known as the doctrine of embryological recapitulation, and vast quantities of paper

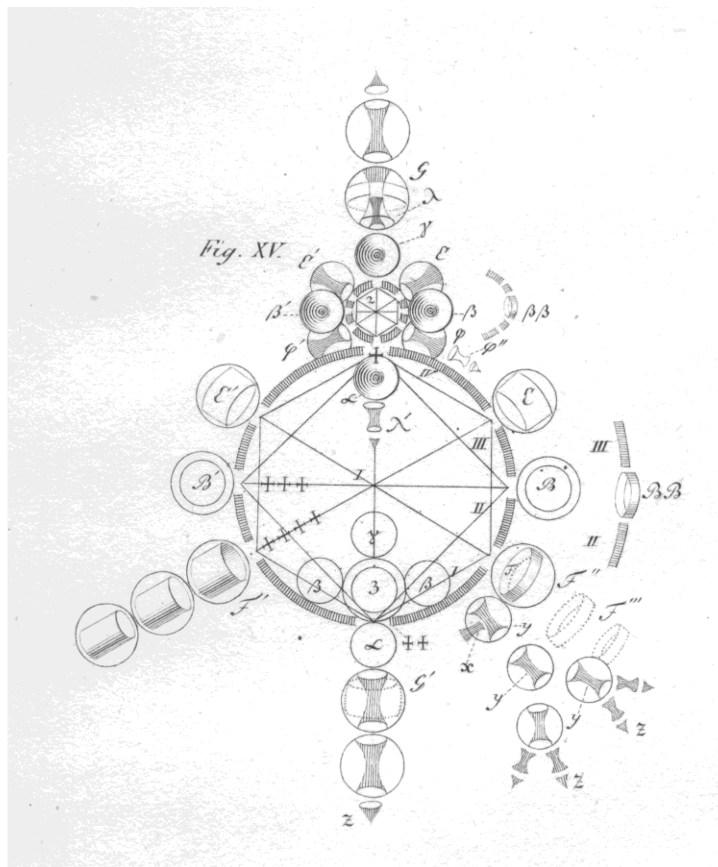


Figure 2: A vertebra as decomposable into ideal spherical forms. From Carl Gustav Carus, *Von der Ur-Theilen des Knochen- und Schalengerüstes* (1828).

were devoted to disputes about the exact character of recapitulation (figure 3).

Alexander von Humboldt

Alexander von Humboldt—another reader of Kant, disciple of Goethe, and friend of Schelling—helped spread the influence of German Romanticism beyond central Europe. During the late 1790s, he and Goethe performed many dissectional observations and conducted experiments in animal physiology at Jena. Humboldt was interested particularly in the new theories of animal electricity advanced by Luigi Galvanni, Alessandro Volta, and Johann Wilhelm Ritter. Humboldt became convinced, in support of Galvanni and in opposition to Volta, that animals could endogenously generate their own electrical current; indeed, one could construct a voltaic pile not only of metals of alternating mineral character, but also of animal muscles freshly excised. This suggested that the vital fluid flowing through the nerves was electrical in character and internally produced. Humboldt proposed that life itself consisted in the balance of forces within the organism—electrical, magnetic, caloric—that resisted dissolution. His view was consistent with that of Schelling, who maintained that the entire economy of nature depended upon a balance of these imponderable fluids. Humboldt published the results of his research in his two volume *Versuche über die gereizte Muskel- und Nervenfaser.* But even before the second

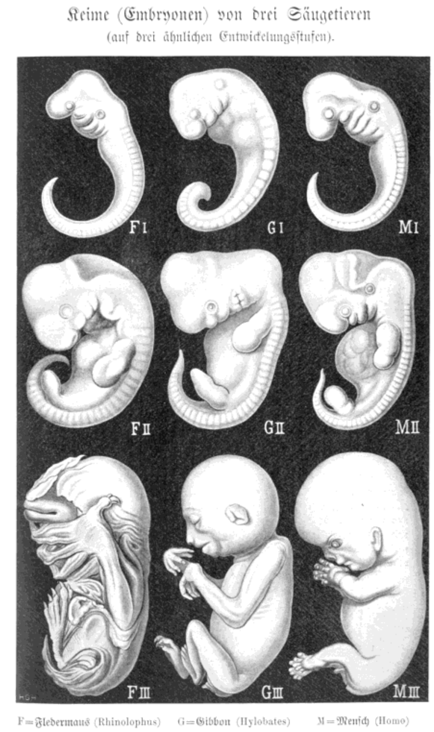


Figure 3: Illustration of embryological recapitulation, with embryos of bat, gibbon, and human at three stages of development; at earliest stage they morphologically resemble the common ancestor. From Ernst Haeckel's *Der Kampf um den Entwickelungs-Gedanken* 1905)

volume could appear, the ever restless Humboldt had embarked on a travel of adventure and research to the new world.

Humboldt spent some five years in South and Central America, traveling up and down the Orinoco River, with a concluding trip to Philadelphia and Washington, D.C. to meet with Thomas Jefferson. He wrote of his adventure in a large seven-volume account, translated into English as *Travels to the Equinoctial Regions of the New Continent, during the Years 1799-1804.* Darwin read the first several volumes while at Cambridge University; and the tales of exotic climes and wild Indians grew in his imagination until desire conquered improbability. When the chance to embark on a comparable journey arose, he overcame the many obstacles to make it happen. With the reluctant acquiescence of his father, Darwin signed on, in 1831, with *H.M.S. Beagle* as ship's naturalist and companion to the mercurial Captain, Robert FitzRoy. Like Humboldt's own journey, Darwin's lasted almost five years. He brought Humboldt's *Personal Narrative* and several other of the German's works as his companions on a trip that would make the intellectual world forget its original inspiration. But Darwin did not forget. Later in 1845, he asked his friend Joseph Hooker, who was visiting the ailing Humboldt in Paris, to convey his "most respectful and kind compliments, and say that I never forget that my whole course of life is due to having read and re-read as a youth his 'Personal Narrative.'"[25]

The lush descriptions of the jungles and plains of the upper part of South America so enraptured the young Darwin, that when he experienced the reality for

[25] Charles Darwin to Joseph Hooker (10 February 1845), in *The Correspondence of Charles Darwin*, 18 vols. to date, ed. Frederick Burkhardt et al. (Cambridge: Cambridge University Press, 1985--), 3:140.

himself, he could not help but interpret it through the eyes of his predecessor. A few weeks after disembarking in Bahia, Darwin penned in his diary:

> I believe from what I have seen Humboldts glorious descriptions are & will for ever be unparalleled; but even he with his dark blue skies & the rare union of poetry with science which he so strongly displays when writing on tropical scenery, with all this falls far short of the truth. The delight on experiences in such times bewilders the mind. . . . The mind is a chaos of delight, out of which a world of future & more quiet pleasure will arise.—I am at present fit only to read Humboldt; he like another Sun illumines everything I behold.[26]

Behind Humboldt's glorious descriptions lay a theory about nature derived from Kant and Goethe, which he more explicitly expressed in his five-volume *Kosmos*. Like Kant he understood the laws of nature to form an intricate balance in which the principles from quite diverse sciences—astronomy, chemistry, botany, and zoology—formed a patterned whole displaying "a common, lawful, and eternal bond that runs through all of living nature."[27] This assumption of balanced lawfulness throughout nature, in Kant's view, resulted from a regulative judgment but one of aesthetic character. We aesthetically sense the tessellated complex of laws of nature and, like an artist, continue to weave new laws into the matrix. For Humboldt, this meant that the naturalist's

[26] Charles Darwin, *Beagle Diary,* ed. R. D. Keynes (Cambridge: Cambridge University Press, 1988), p. 42 (entry for 28 February 1832).
[27] Alexander von Humboldt, *Kosmos: Entwurf einer physischen Weltbeschreibung* 5 vols. (Stuttgart: Cotta'scher, 1845-1858), 1: 9.

> descriptions of nature can be sharply delimited and scientifically exact, without being evacuated of the vivifying breath of imagination. The poetic character must derive from the intuited connection between the sensuous and the intellectual, from the feeling of the vastness, and of the mutual limitation and unity of living nature.[28]

This conception of the union of science and art became so completely absorbed by Darwin that upon receipt of the scientific journals he sent back to England during the voyage, his sister Caroline reproved him gently for using Humboldt's "phraseology . . . [and] the kind of flowery French expressions which he uses, instead of your own simply straight forward & the more agreeable style."[29] But, as I will relate in a moment, Humboldt's mode of conception had an even greater impact on Darwin's own representations of the operations of nature.

The Influence of German Romanticism and Idealism on British Biology

There are numerous ways German Romanticism and Idealism shaped British biology in the nineteenth century. I will focus only on five principal modes: archetype theory, nature as an organic and creative power, living nature as governed by law, the aesthetics of science, and nature as a moral power.

Archetype Theory: Green, Owen, and Darwin

Joseph Henry Green, friend of Coleridge and Hunterian lecturer at the Royal College of Surgeons, had studied in Germany, where he cultivated the most exacting

[28] Ibid., 2: 74.
[29] Caroline Darwin to Charles Darwin (28 October 1833), in *Correspondence of Charles Darwin*, 1: 345.

kind of anatomical knowledge, both in its mundane and more ethereal features. He was a devoted reader of the work of Goethe and Schelling especially, and he brought to British shores the theory of the archetype. Drawing on the "objective idealism of Schelling," Green construed an archetype as

> a causative principle, combining both power and intelligence, containing, predetermining and producing its actual result in all its manifold relations, in reference to a final purpose; and realized in a whole of parts, in which the Idea, as the constitutive energy, is evolved and set forth in its unity, totality, finality, and permanent efficiency.[30]

Being British, however, he located archetypal ideas in the mind of God and not simply in the depths of nature. He did, however, follow Schelling's theory of dynamic evolution, maintaining that new species appeared over time, each advancing toward the realization of organism in general, the perfection of which, according

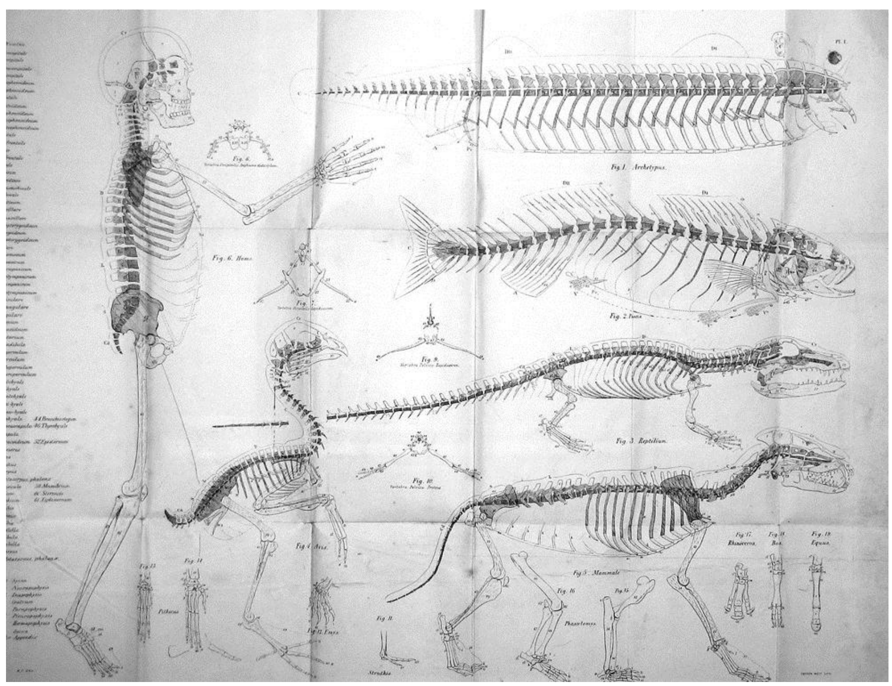


Figure 4: Illustration of the vertebrate archetype (top right) and its teleological modifications in various vertebrate species. From Richard Owen's *On the Nature of Limbs* (1849).

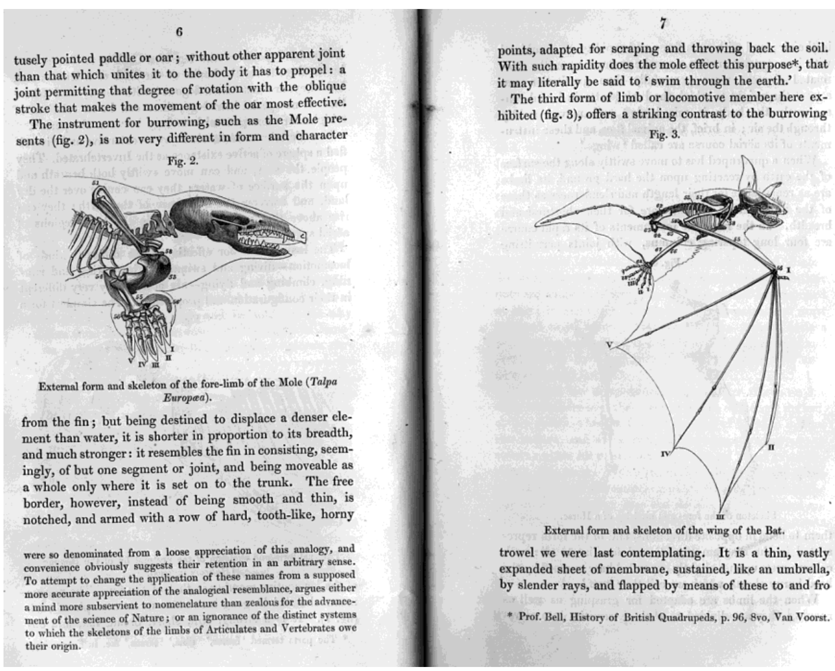
[30] Joseph Henry Green, *Vital Dynamics: The Hunterian Oration before the Royal College of Surgeons in London, 14th February 1840* (London: William Pickering, 1840), pp. xxv-xxvi. The dynamical aspect of Green's theory followed the path into "objective Idealism" laid by Schelling (pp. xxix-xxx). He also cited Goethe, Oken, Spix, and Carus as developing the archetype theory that he himself was further elaborating (pp. 57-58).

to Green, was the appearance of the human form.

Richard Owen, certainly the most famous and influential biologist in England in the first half of the nineteenth century, succeeded Green as Hunterian lecturer and a bit later became Hunterian Professor at the Royal College of Surgeons. He was a scientific worker of prodigious ability and an ego to match. Darwin depended on this authority after returning from the *Beagle* voyage to aid in sorting his vertebrate specimens and in writing their descriptions for the multi-volume catalogue depicting the scientific results of the voyage. He and Darwin would later have a falling out after Owen published anonymously a scurrilous review of the *Origin of Species*, in which he accused Darwin of weak-mindedness and asserted that, after all, Richard Owen had first laid out the convincing evidence for species change.[31]

[31] [Richard Owen] "Darwin on the Origin of species," *Edinburgh Review* 11 (1860): 487-532.

Owen focused his work on the anatomy of vertebrates and was the first to provide systematic description of a class of extinct, giant lizards, giving it the taxonomic name *Dinosaria.* It was Owen who made archetype theory well known in Britain through his *Report on the Archetype* in 1847 and his *On the Nature of Limbs* two years later. In working out his ideas he was in debt to Schelling and Carus in particular, but he advanced considerably on them, especially in developing the idea of "homology." Owen maintained, comparable to Schelling and Carus, that one could perceive a common plan uniting the various and greatly divergent vertebrate organisms. For this basic idea he borrowed heavily from Carus's *Von den Ur-Theilen des Knochen- und Schalengerüstes*, as a comparison of their respective illustrations of the vertebrate archetype suggests (figures 1 and 4). Both maintained that the different vertebrate skeletons were essentially a series of vertebrae whose processes had altered to form limbs, ribs, pelvis, and head. For example, if one considered the claw of a mole and the wing of a bat (figure 5), it's clear that the bones of the limb, though modified for different purposes, nonetheless have the same topological arrangement of bones, which Owen referred to in



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tusely pointed paddle or oar; without other apparent joint than that which unites it to the body it has to propel: a joint permitting that degree of rotation with the oblique stroke that makes the movement of the oar most effective.

The instrument for burrowing, such as the Mole presents (fig. 2), is not very different in form and character

Fig. 2.

External form and skeleton of the fore-limb of the Mole (*Talpa Europæa*).

from the fin; but being destined to displace a denser element than water, it is shorter in proportion to its breadth, and much stronger: it resembles the fin in consisting, seemingly, of but one segment or joint, and being moveable as a whole only where it is set on to the trunk. The free border, however, instead of being smooth and thin, is notched, and armed with a row of hard, tooth-like, horny

were so denominated from a loose appreciation of this analogy, and convenience obviously suggests their retention in an arbitrary sense. To attempt to change the application of these names from a supposed more accurate appreciation of the analogical resemblance, argues either a mind more subservient to nomenclature than zealous for the advancement of the science of Nature; or an ignorance of the distinct systems to which the skeletons of the limbs of Articulates and Vertebrates owe their origin.

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points, adapted for scraping and throwing back the soil. With such rapidity does the mole effect this purpose*, that it may literally be said to 'swim through the earth.'

The third form of limb or locomotive member here exhibited (fig. 3), offers a striking contrast to the burrowing

Fig. 3.

External form and skeleton of the wing of the Bat.

trowel we were last contemplating. It is a thin, vastly expanded sheet of membrane, sustained, like an umbrella, by slender rays, and flapped by means of these to and fro

* Prof. Bell, History of British Quadrupeds, p. 96, 8vo, Van Voorst.

Figure 5: Homologous limb structures in mole and bat. From Richard Owen's *On the Nature of Limbs* (1849).

his Germanophilic way as their “Bedeuting.”

The *Bedeuting* of the limb, for instance, allowed the researcher to compare the limb bones of one vertebrate to another of a different species and establish what Owen called their homologous relationship—namely, that they could be referred to the same pattern in the archetype of the limb. Like Carus, he thought the vertebrate archetype could really be reduced to the ideal vertebra (figure 6). According to Owen, then, the plan of all the vertebrates was contained in an ideal structure, much like Goethe’s ideal leaf.

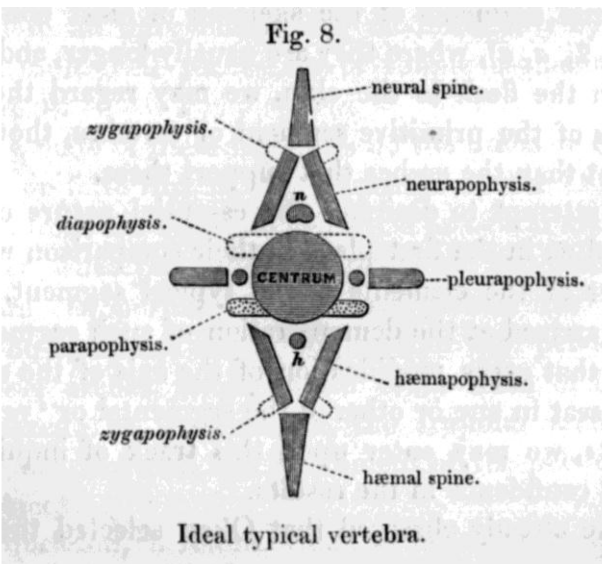

Figure 6: Ideal vertebra. From Richard Owen's *On the Nature of Limbs* (1849)

Owen initially conceived of the archetype as more than a model or plan by which to understand the relationships that might exist among the vertebrate species. The archetype, as the Romantics had suggested, was a creative power, one that constrained another, expanding vital power, to produce the structures of vertebrate creatures:

> Besides the *ίδεα,* organizing principle, vital property or force, which produces the diversity of form belonging to living bodies of the same materials. . . there appears also to be in courter-

> operation during the building up of such bodies the polarizing force pervading all space.[32]

In this conception it's not too difficult to detect Schelling's comparable expanding and contracting polarizing powers. In Owen's formulation, the expanding ideational force adjusts the skeletons of vertebrates to their different environments, and the contracting force (which he calls the archetype) restricts the basic pattern of bones to maintain homologous relations among the vertebrates.

Owen's enemies had little difficulty in detecting the *Naturphilosophischen* assumptions behind these postulated vital forces, atheistical assumptions that seemed to suggest that nature herself had creative power. Two years later Owen made amends for this heterodox theory in his quite influential book *On the Nature of Limbs* (1849). There he collapsed the vital forces into one, which he simply denominated "the archetype": it answered "to the 'idea' of the Archetypal World in the Platonic cosmogony, which archetype or primal pattern is the basis supporting all the modifications of such part [as the limb] for specific powers and actions in all animals possessing it."[33] If the archetype were a Platonic ideal, as it were, it might more easily be identified, as Green had, with ideas in the mind of God. In the conclusion to his book, Owen yet reiterated a conception that hardly severed its connection to the German Romantic tradition:

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[32] Richard Owen, *Report on the Archetype and Homologies of the Vertebrate Skeleton*, in *Report of the Sixteenth Meeting of the British Association for the Advancement of Science* (London: Murray, 1847), pp. 339-40.
[33] Richard Owen, *On the Nature of Limbs* (London: Van Voorst, 1849), pp. 2-3.

> We learn from the past history of our globe that she [i.e., Nature] has advanced with slow and stately steps, guided by the archetypal light, amidst the wreck of worlds, from the first embodiment of the Vertebrate idea under its old Ichthyic vestment, until it became arrayed in the glorious garb of the Human form.[34]

To casual appearance, Owen's conclusion seems to endorse the German Idealist notion of a creative transmutation of species. But Owen had already introduced into his Hunterian lecture of 1837 the kind of distinction that he thought made a crucial difference. He maintained that species did progressively replace one another over vast stretches of time, moving from primitive fishes to modern man, but that this was not a genealogic development; rather, it was, he suggested, simply the work of the Divine hand that introduces into nature ever more developed species guided by an eternal, developmental ideal. He dismissed the notion of the "transcendental school" that one species arose out of another, following the pattern of embryonic development. He recognized that "the doctrine of transmutation of forms during the Embryonal phases is closely allied to that still more objectionable one, the transmutation of species."[35] After Darwin's triumph, Owen attempted to retrieve his own scientific fortunes by discovering in his early work that he actually had argued for the transmutation of species.

During the *Beagle* voyage, Darwin had remained orthodox both in his biological views and his religious convictions. It was only after his return, in cataloguing his specimens at the British Museum, that he began to suspect that species changed over

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[34] Ibid., p. 86.
[35] Richard Owen, *Richard Owen's Hunterian Lectures, May-June 1837I,* ed. Phillip Sloan (Chicago: University of Chicago Press, 1992), p. 192.

time. During his period of early theorizing, he immersed himself in vast quantities of geological, zoological, and botanical literature. It is fair to say, I believe, that the theory established in the *Origin of Species* some twenty years later arose as much out of his voluminous reading as out of his observations on the *Beagle* and subsequent experimental work. Owen's conception of the archetype became a lynchpin of for Darwin's theory, but in this case he brought that theory back closer to its Romantic moorings.

When Darwin finished Owen's *On the Nature of Limbs,* he penciled a note on the back flyleaf: "I look at Owen's Archetypes as more than idea, as a real representation as far as the most consummate skill & loftiest generalization can represent the parent form of the Vertebrata."[36] Darwin interpreted the archetype not as an idea in the mind of God, but as the form of the progenitor of the particular species. Thus contemporary vertebrates, he supposed, have limbs with digits because their ancient ancestors, after they crawled out of the waters, initially developed the tetrapod limb. Here as in other instances, the connection with German Romanticism is indirect, but quite traceable. But on the matter of the archetype, there are more direct routes back to Germany.

Darwin became familiar with Goethe's morphological ideas from two different sources: William Whewell, who wrote about the subject in his *History of the Inductive Sciences*, which Darwin read in summer of 1838; and from the account provided by M.F.G. Pictet's article "On the Writings of Goethe relative to Natural History," which he

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[36] Back flyleaf of Darwin's copy of Richard Owen's *On the Nature of Limbs*, held in manuscript room of Cambridge University Library.

read in January, 1839.[37] Commenting on that latter article in his *Notebook E*, Darwin construed Goethe's theory of the vertebrate skull as substantiating his own historical interpretation of the archetype: "The head being six metamorphosed vertebrae, the parent of all vertebrate animals.—must have been some molluscous <<bisexual>> animal with a vertebra only & no head.--!"[38] The notion that the vertebra constituted the type of the higher animals also appears in the *Origin of Species,* where Darwin compared it to Goethe's botanical view that all of the parts of a plant were "metamorphosed leaves."[39] But this engagement with Goethe only begins to reveal Darwin's connections with German Romanticism

Darwin's Debt to German Romanticism

The Creative Force of Nature

I have already indicated the ways in which Darwin, during his voyage, perceived nature through Humboldtian eyes. At the conclusion of his *Journal of Researches of H.M.S. Beagle* (1839)—a book that brought Humboldt himself to recognize a kindred spirit—Darwin affirmed his overriding debt: "as the force of impression frequently depends on preconceived ideas, I may add that all mine were taken from the vivid descriptions in the Personal Narrative which far exceed in merit anything I have ever read on the subject."[40] Inspired by Humboldt, Darwin began to attribute to nature powers that had been reserved to a transcendent God. This move was presaged in the

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[37] M.F.G. Pictet, "On the Writings of Goethe relative to Natural History," *Annals of Natural History* 2 (January 1839): 313-22.

[38] Charles Darwin, *Notebook E,* MS 89, in *Charles Darwin's Notebooks, 1836-1844,* ed. Paul Barrett et al. (Ithaca: Cornell University Press, 1986), p. 420.

[39] Charles Darwin, *On the Origin of Species* (London: John Murray, 1859), p. 436.

[40] Charles Darwin, *Journal of Researches into the Geology and Natural History of the Various Countries Visited by H.M.S. Beagle* (London: Henry Coburn, 1839), p. 604.

Journal, as Darwin reflected precisely on those features of nature suggested by Humboldt:

> Among the scenes which are deeply impressed on my mind, none exceed in sublimity the primeval forests, undefaced by the hand of man, whether those of Brazil, where the powers of life are predominant, or those of Tierra del Fuego, where death & decay prevail. Both are temples filled with the varied productions of the God of Nature—No one can stand unmoved in those solitudes, without feeling that there is more in man than the mere breath of his body.[41]

It wasn't the God of Abraham, Isaac, and Jacob that Darwin found, but the God of Nature, a force that manifested itself in the sublime drama of life. He had begun to transfer the creative power exhibited in the biological world to nature, but a nature of decidedly Romantic features.

Whewell's Mediation of German Thought

A stimulus to this transfer was provided by the master of Trinity College and extraordinary polymath, William Whewell, who was one a small cadre in England at the beginning of the nineteenth century to read German science and philosophy. His friendship with Samuel Taylor Coleridge seems to have led him to German literature as well; he translated some of Goethe's poetry into English. Whewell's three-volume *History of the Inductive Sciences* appeared shortly after Darwin had returned from his *Beagle* voyage. Probably because Darwin knew Whewell from his student days, he

[41] Ibid.

read the biological sections of Whewell's third volume with alacrity in summer of 1838. In his book, Whewell sought to trace the history of the various natural sciences from their earliest period right up through his own time, which thus required an account of the German contribution; by the late eighteenth and early nineteenth centuries that contribution had already become quite substantial. Whewell's considerations of the nature of science reflected his reading of Kant and the company of German idealists from Fichte, Schelling, and Goethe to Hegel, the latter of whom Whewell had little use for.

Following Kant, Whewell demanded strict separation of science from theology. Science operated on the basis of empirical evidence and rational inference, which yielded explanatory laws, whereas theology depended on revelation and hope, which succored a faith in "things not seen." Science explored the causal framework of nature and the principles of its operation; theology unveiled the spiritual forces that erected the framework and authored its laws. Though the natural sciences were based on observation and experience, they nonetheless required certain a priori concepts like space, time, causality, resemblance, and so on; these ideas were not derived from experience but from the mind's own activity. In the process of induction, these a priori ideas organized facts through what Whewell called "colligation." In the history of science, when the meaning of such fundamental ideas as space, number, equality, addition, and the like became explicit, the self-evident proposition of mathematics immediately followed. This quasi-Kantian conception fueled Whewell's famous dispute with John Stuart Mill over the status of the natural sciences and mathematics. Whewell yet differed from Kant in holding that the fundamental ideas not only derived from the mind's activity but that they offered accurate depictions of a nature that did not lie shrouded behind a noumenal veil. More in the spirit of Kant's followers, like Schelling, Whewell believed that the fundamental ideas that operated in contemporary science came to explicit consciousness only in the development of the sciences throughout their history. This feature of Whewell's epistemology—the notion of historical development being requisite for the temporal unfolding of fundamental ideas—reflects his deep engagement with German Idealism.

One of those necessary ideas that came to fruition quite early in the history of science was that of *purpose*, especially as required for understanding biological organisms. It was not, however, simply a Kantian regulative idea; rather, in harmony with the views of Schelling and Goethe, Whewell asserted that purposive principles were reflective of the real structure of organisms and functioned as necessary constituents of the science of zoology. The position was reinforced by the ways in which the great French zoologist George Cuvier utilized the conception of purpose as foundational for biological science.

Cuvier instantiated the concept of purpose in two principles that dominated biological thought in the first half of the nineteenth century, principles that Darwin would also employ, though from a somewhat different angle. They were: *correlation of parts* and *the conditions of existence*. The correlation of parts was a version of Kant's notion that the parts of organisms acted reciprocally as means and ends in respect of one another and that a concept of the whole was required to understand their interactions. The conditions of existence indicated that organisms fit into their environments as a key into a lock—that is, the parts functioned in relation to the ends determined by the creature's surroundings. Should the environment change radically, creatures would of necessity go extinct and their specific type would vanish from the living. These two principles of purposiveness in nature were simply not reducible to any mechanistic laws. Nor could the naturalist breach the fast boundary between science and theology to give teleological principles an account. In this respect, Whewell fully endorsed Kant's constraint on biology as a science: there could be no Newton of the grass blade.

The Kantian idea of purpose, Whewell argued, complemented the idea of the unity of type (his version of the theory of the archetype). He thought Goethe had shown the effectiveness of the idea in botany, where the ideal leaf designated the type of all plants. He recognized the shrewd way Goethe extended the concept of type to animals, especially in the case of the vertebrate skeleton. The concept of type allowed the anatomist to recognize the fundamental architecture uniting extinct creatures with those yet living; the differences among creatures exhibiting a common pattern could be scaled according to a measure of progressive complexity, from simplest marine organisms fossilized in rocks even high in the mountains to the most complex organism extant in the contemporary period, namely, man.

The fossil evidence, according to Whewell, did indicate the extinction of ancient organisms and their replacement by progressively higher creatures. But this did not allow any inference of the sort made by Lamarck, namely of a genealogical transmutation of species. Cuvier had shown that over long periods of time no fundamental alteration of species had occurred: mummies of humans, cats, and deer from Egyptian tombs remained recognizably the same as their living embodiments in Paris and in the woods around the city; moreover, the "conditions of existence" would have prevented fundamental species change. Both fact and theory thus argued that "*species have a real existence in nature* and a transmutation from one to another does not exist."[42] Since the scientist could not appeal to scripture for the needed miracles to explain the progressive replacement of species and since lawful physical causes did not avail to explain either the design of species or their progressive replacement, rational inquiry into the origin of species was forestalled. Theology might well provide an answer to the question of the origin of species, as Whewell thought it did; but science would have to remain mute. From a scientific point of view, the matter remained "shrouded in mystery, and [was] not to be approached without reverence."[43]

The Mystery of Mysteries: the Origin of Species

When Darwin read Whewell in summer of 1838, he had already become convinced that species changed over time. His conviction, though, hardly placed him outside the bounds of orthodoxy. Naturalists had recognized that vast numbers of species had gone extinct. Charles Lyell, the geologist from whom Darwin said half his ideas came, had argued that over immense stretches of time extinct species had to be replaced in order to maintain the balance of nature. Moreover, the progressive replacement of species seemed ever more evident, as Whewell had claimed. Darwin's grandfather Erasmus Darwin and Lamarck had both attempted to explain progressive advance, but their theories were mostly derided. Whewell claimed that no scientific account of species advance was possible, though theology would suggest that the Divine hand stood behind the trajectory of species. Whewell's analysis amounted to a

[42] William Whewell, *History of the Inductive Sciences, from Earliest to Present Times, 3rd ed.,* 3 vols. (London: Parker & Son, [1837] 1857): 3: 478. The changes in the subsequent editions are marked in separate sections. The main text is that of the 1st edition of 1837.
[43] Ibid., p. 476.

challenge: Could a naturalist discover laws that would explain the teleological structure of organisms and their progressive advance over time? Could there be a Newton of the grass blade?

Darwin opened his first transmutation notebook, in spring of 1837, and for the next five years kept some seven or so notebooks detailing his thinking about the species question. In 1842 and 1844, he worked out his burgeoning ideas in two essays that sketched a theory that seemed to meet Whewell's challenge: an explanation of progressive change according to natural law. Finally, in 1856 Darwin began to work on a manuscript that would eventually appear in 1859 as *On the Origin of Species*. Let me briefly turn back to the notebooks and essays to trace out what I see are the distinctive signs of the echoing impact of German Romanticism on the formulation of his theory of species change. I have already mentioned the role of the archetype in Darwin's thinking and the way in which he began attributing creative power to nature herself. Now I wish to show how his formulation of the principle of natural selection allowed him to conceive nature as having a specific telos, namely, human beings as moral creatures. I think Darwin believed he could accomplish this while yet meeting Whewell's challenge of explaining this teleological trajectory in terms of natural law. I will add, as if it were not already obvious, this is not the usually conception of Darwin's accomplishment.

Through the thicket of entries in his early notebooks, one can detect Darwin attempting to formulate hypotheses by which to explain the progressive development of species. Just about the time he finished with Whewell's three volumes, in late summer of 1838, he picked up Thomas Malthus's *Essay on the Principle of Population*—for "amusement," he recalled—wherein he found the kind of treatment of demographic phenomena that seemed to meet Whewell's requirement for a scientific study. Malthus had suggested that the rise and fall of human populations conformed in a mathematically precise way to the sufficiency of food production. As is well known, reading Malthus furnished Darwin, as he said in his *Autobiography,* "a theory by which to work."[44]

Indicative of the way Darwin thought about the processes of nature is the rough construction of the principle that in time became natural selection. He described the moment of original discovery this way:

> Even the energetic language of Decandoelle does not convey the warring of the species as inference from Malthus . . . . population in increase at geometrical ratio in FAR SHORTER time than 25 years---yet until the one sentence of Malthus no one clearly perceived the great check amongst men. . . One may say there is a force like a hundred thousand wedges trying [to] force . . . every kind of adapted structure into the gaps in the oeconomy of Nature.[45]

What here began as a quasi-mechanistic conception was immediately transformed by Darwin into a teleological rendering: "The final cause of all this wedging, must be to sort out proper structure & adapt to change.—to do that, for form, which Malthus shows, is the final effect, (by means however of volition) of this populousness, on the energy of

[44] Charles Darwin, *The Autobiography of Charles Darwin*, ed. Nora Barlow (London: Collins, 1958), p. 120.
[45] Darwin, *Notebook D* MS 134e-135e, in *Charles Darwin's Notebooks,* pp. 374-75.

Man."[46] Darwin, like Whewell, deployed the necessary notion of purpose in discussing biological phenomena.

The appeal to final causes in this instance might be thought simply a façon de parler, something the careful historian need not take seriously. After all, most scholars have contended that Darwin's new theory completely banished teleology from modern biology. If we're talking about Darwin's legacy, then I believe that's true; but it's not true of the theory that appears in the *Origin of Species*. I think it's quite clear that during the almost two decades prior to the publication of Darwin's book, the concept of final causality played a fundamental role in the construction of his theory. Whewell, in the wake of Kant, made telic considerations simply part of the standard repertoire of the naturalist's understanding of life, and Darwin accepted that requirement.

A salient example of Darwin's usage of teleological notions, and there are many, came shortly after the Malthus episode, from early November 1838, when he was tackling a problem that still intrigues biologists—why is there sexual generation instead of the more simple asexual modes? Darwin understood the role of sex as requiring a teleological explanation. He wrote in his *E Notebook*:

> My theory gives great final cause of sexes: for otherwise, there would be as many species, as individuals, . . . if all species, there would not be social animals . . . which as I hope to show is the foundation of all that is most beautiful in the moral sentiments of the animated beings. If man is

[46] Darwin, *Notebook D* MS 135e, in *Charles Darwin's Notebooks*, p. 375.

> one great object, for which the world was brought into present state.--& if my theory be true then the formation of sexes rigidly necessary."[47]

This is a perfectly teleological explanation: sex came to exist for the purpose of producing social animals; and social animals came to exist for the purpose of ultimately producing moral animals, namely us. Quite clearly, then, Darwin proposed that his theory recognized "man as the one great object for which the world has come into existence"—that is, the one great purpose or end for which the world came to be.

At the conclusion of the *Origin of Species,* Darwin summarized his accomplishment. From the laws that he had established in his "long argument," particularly natural selection, "the most exalted object which we are capable of conceiving, namely, the production of the higher animals directly follows."[48] Of course, the highest animal is the human, with its moral nature. If one does an archeology of Darwin's texts, the intellectual stratigraphy reveals the sources of his assertion about "the most exalted object which we are capable of conceiving":

> 4. 1859 (*Origin*): "the most **exalted object**, which we are capable of conceiving, namely, the production of the higher animals, directly follows."[49]
>
> 3. 1844 (Essay): "… the most **exalted end** which we are capable of conceiving, namely, the creation of the higher animals, has directly proceeded."[50]

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[47] Darwin*, Notebook E* MS 48-49, in *Charles Darwin's Notebooks*, p. 409.
[48] Darwin *Origin of Species*, p. 490.
[49] Darwin, *Origin of Species*, p. 490.

2. 1842 (Essay): "… the **highest good**, which we can conceive, the creation of the higher animals has directly come."[51]

1. 1838 (*E Notebook*): "… man is *one* **great object**, for which the world was brought into present state."[52]

The orthodox, mechanistic interpretation of Darwin's principle of natural selection has obscured the roots of his conception. But the flower manifests its origins as well. In his essays of 1842 and 1844, which provided the schemata for the *Origin of Species*, Darwin conceived the operations of natural selection in quite metalistic terms, as if nature herself were endowed with mind.

After indicating that the human breeder selects the best of his flocks, segregates them from the rest, and brings the chosen together for mating, Darwin asked himself the question: "[In nature] is there any means of selecting those offspring which vary in the same manner, crossing them and keeping their offspring separate and thus producing selected races: otherwise as the wild animals freely cross, so must such small heterogeneous varieties be constantly counter-balanced and lost, and a uniformity of character preserved?"[53] So the question is: what in nature does the selecting? The issue is especially acute, since, as Darwin here recognized, not only do certain favored organisms have the advantage, but there must be a way of segregating them from the larger flock and then bringing them together for mating. Without segregation and then arranged mating, the favorable variations would be swamped out by the average and

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[50] Charles Darwin, *The Foundations of the Origin of Species: Two Essays Written in 1842 and 1844*, ed. Francis Darwin (Cambridge: Cambridge University Press, 1909), p. 254.
[51] Ibid., p. 52.
[52] Darwin, *Notebook E* MS 49, in *Charles Darwin's Notebooks,* p. 409.
[53] Darwin, *Essay of 1842*, p. 5.

unfavorable traits. After recognizing the swamping problem, Darwin immediately brought a model of natural selection to the fore. What needs be stressed is that Darwin, in the essays, was also explaining to himself how his principle would solve the swamping problem.

> Let us now suppose a Being with penetration sufficient to perceive differences in the outer and innermost organization quite imperceptible to man, and with forethought extending over future centuries to watch with unerring care and select for any object the offspring of an organism produced under the foregoing circumstances; I can see no conceivable reason why he could not form a new race (or several were he to separate the stock of the original organism and work on several islands) adapted to new ends. As we assume his discrimination, and his forethought, and his steadiness of object, to be incomparably greater than those qualities in man, so we may suppose the beauty and complications of the adaptations of the new races and their difference from the original stock to be greater than in the domestic races produced by man's agency."[54] (1844)

When Darwin was trying to work out for himself the features of natural selection, he chose, not a mechanical model, but a model of a very powerful mind, a selector with preternatural "forethought" and "discrimination," who picks out organisms because of their "beauty and complications of adaptations" and does so with "unerring care." And like the domestic breeder, this natural selector would segregate favored individuals and

[54] Darwin, *Essay of 1844,* p. 85.

prevent backcrosses to the rest of the group. The move from an intervening Deity to nature as the creative poetry of mind was complete by the early 1840s.

In the public expression of his theory, Darwin retained this appeal to mind in nature. When describing the actions of natural selection in the *Origin of Species* he did so in images both consonant with the model first articulated more than two decades before, a model that a Goethe or Schelling could well embrace:

> Man can act only on external and visible characters: nature cares nothing for appearances, except in so far as they may be useful to any being. She can act on every internal organ, on every shade of constitutional difference, on the whole machinery of life. Man selects only for his own good; Nature only for that of the being which she tends. . . . Can we wonder, then, that nature's productions should be far "truer" in character than man's productions; that they should be infinitely better adapted to the most complex conditions of life, and should plainly bear the stamp of far higher workmanship?"[55]

No machine of Darwin's acquaintance could penetrate to the inner fabric of organisms or act on "every shade of constitutional difference." Only a powerful mind could do that. Darwin portrayed natural selection as a powerful intellectual force. And we should notice that this force acts only for the good "of the being which she tends." This is a phrase repeated several times in the *Origin*, with greatest resonance in the penultimate paragraph: "And as natural selection works solely by and for the good of each being all

[55] Darwin, *Origin of Species,* pp. 83-84.

corporeal and mental endowments will tend to progress towards perfection."[56] In our contemporary understanding, natural selection does not work for the good of each being; it destroys most beings; it eliminates them. The model Darwin deployed in his theory was that of a benign moral force, one that had the perfection of human beings as a goal.

In answer to the challenge of Whewell, Darwin argued that the origin of species could be explained by a law, namely, that of natural selection. The progressive development of creatures need not lie raped in mystery. But the force that Darwin placed at the center of his theory answered to a higher kind of intellect. He wrote his friend Asa Gray shortly after the publication of the *Origin*: "I am inclined to look at everything as resulting from designed laws, with the details whether good or bad, left to the working out of what we may call chance." Thus behind the law of natural selection Darwin found an *intellectus archetypus*.

Conclusion

The impact of the German Romantic movement on biology in the late eighteenth through the nineteenth centuries was profound. The scientifically inclined Romantics such as Schelling and Goethe found resources in Kant to reconstruct biology as both a teleologically structured science and one that met the requirements of authentically valid science. Their convictions about the creative power of nature penetrated across the channel to alter conceptions even among the more empirically minded British, finally giving even Darwin's theory the tinge of the Romantic. In the later 1860s, Darwin

[56] Ibid., p. 489.

became less sanguine about any higher powers in the universe; and though he could not believe the trajectory of nature, with its astounding beauty and evolved patterns, resulted from mere chance, he could not embrace any idea of a transcendent mind, even one shorn of the traditional majesty of religion. His theory, nonetheless, was forged in the heat provided by the likes of Humboldt and Goethe, and its structure retained that emboss.

Perhaps no figure did more to disguise the provenance of Darwin's theory than his German disciple Ernst Haeckel. Haeckel maintained that Darwin's conception of nature was materialistic and the operations of natural selection mechanically causal. The great historian of biology Erik Nordenskiöld observed that more people learned of evolutionary theory at the turn of the twentieth century though Haeckel's voluminous writings than from any other source, including Darwin's own work. If Haeckel is largely responsible for stamping Darwin's theory as mechanistic and materialistic, as I believe he is, there is some sweet Romantic irony in that. Haeckel was devoted to Goethe and he was willing to embrace Goethe's monism, declaring the stuff of nature had both a mental and a material side. But in most of his more popular works, it was only the mechanistic side that he stressed. And perhaps rightly, since today that is surely the metaphysics underlying contemporary biology.