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BOOK REVIEW

Richard Owen's "Most Interesting Department of Natural History … Its Very Soul"

***On the Nature of Limbs: A Discourse*, by Richard Owen, edited by Ron Amundson, with a preface by Brian K. Hall, and introductory essays by Amundson, Kevin Padian, Mary P. Winsor, and Jennifer Coggon. Chicago: University of Chicago Press, 2007. Pp. cii + 119. S/b $20.00.**

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> We have seen that the members of the same class, independently of their habits of life, resemble each other in the general plan of their organisation. This resemblance is often expressed by the term "unity of type;" or by saying that the several parts and organs in the different species of the class are homologous …. This is the most interesting department of natural history, and may be said to be its very soul. What can be more curious than that the hand of a man, formed for grasping, that of a mole for digging, the leg of the horse, the paddle of the porpoise, and the wing of the bat, should all be constructed on the same pattern, and should include the same bones, in the same relative positions? … 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.* (Darwin 1964, pp. 434–5)

What is a bird's wing? A whale's flipper? A human hand? Are they, respectively, for flying, swimming, grasping? These answers place the wing, flipper, and hand into *functional* categories, organizing them according to what they are supposed to do. This is not the only way to answer this kind of "what is" question. "What is an arm?" can also be answered in terms of the skeletal components of which it is constructed. As it happens, each of the three kinds of limbs just described are structurally similar; each is a variation on a single theme, each variant an adaptation for a different way of life.

The University of Chicago's facsimile reprint of Owen's important work, a talk delivered on 9 February 1849, is significant because it opens access to *On the Nature of Limbs*. The work does not appear to have been reprinted or reissued in the years between 1849, when it was first published by Van Voorst of London, and 2007, the publication year of the Chicago reprint reviewed here. The library collections of the American Museum of Natural History, the Library of Congress, and Columbia University do not contain the 1849 copy; although they do contain the work reviewed. There are 169 copies of the 1849 edition in libraries worldwide, and 131 copies of the 2007 edition.[1] In contrast, *The Origin of Species* is held in many thousands of libraries worldwide.[2] Darwin owned a copy of the book, and was, apparently, influenced by it—although the learner has clearly far outstripped the teacher in this case.

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[1] This information was obtained on 26 March 2010 by searching the WorldCat bibliographic database for works authored by "Owen" and with the title "Nature of limbs."

[2] This information was obtained on 26 March 2010 by searching the WorldCat bibliographic database for works authored by "Darwin, Charles" and with the title "Origin of Species."

Owen opens *On the Nature of Limbs* with a brief discussion of how he went about answering the question, posed to him by the lecture's organizers, "By what title shall I introduce your Lecture?" Owen concludes, after considering various alternatives, that "the *nature* of limbs" best captures, for the English-speaking reader, the central topic of his lecture. "Nature," he explains, is the appropriate English term for the German "Bedeuting," literally translated as "signification;" and "idea," understood by Plato as the unchanging essence of a thing,[3] might also describe his topic (pp. 1–2).

> The "Bedeuting," or signification of a part in an animal body, may be explained as the essential nature of such part—as being that essentiality which it retains under every modification of size and form, and for whatever office such modifications may adapt it. (p. 2)

The central aim of *On the Nature of Limbs* is to argue that there indeed exists such a "predetermined pattern answering to the 'idea' of the Archetypal World … which archetype … is the basis supporting all the modifications of such part for specific powers" (pp. 2–3). This entails more than showing that the bat's wing, whale's flipper, and human being's arm have a similar structure. This is uncontroversial. Owen terms this resemblance "special homology." His quarry is an unobservable, ideal object which explains the special homologies, a general plan or form of their consistent arrangement in the vertebrates, which Owen terms "general homology."

A key premise in Owen's argument is that adaptation to their environments cannot fully explain the form of the vertebrate limb: though they are finely adapted for flying, swimming, digging, or grasping, each is formed by modifying a basic design common to all. This is not what one would expect, if limbs of the various species were constructed on purely functional criteria.

> By whatever means or instruments Man aids, or supersedes, his natural locomotive organs, such instruments are adapted expressly and immediately to the end proposed. He does not fetter himself by the trammels of any common type of locomotive instrument, and increase his pains by having to adjust the parts and compensate their proportions, so as best to perform the end required without deviating from the pattern previously laid down by all. There is no community of plan between the boat and the balloon, between Stephenson's locomotive engine and Brunel's tunnelling machinery. … The teleologist would rather expect to find the same direct and purposive adaptation of the limb to its office as in the machine." (pp. 9–10)

Owen's argument for this claim occupies a significant proportion of the book (pp. 9–39). In a tight argument framed precisely in anatomical and morphological terms, he convincingly demonstrates similarities among the limbs of animals with different ways of life, proceeding pairwise, comparing human and bat, bat and mole, mole and human, and finally, human and horse. He then considers, at length, what is known as "serial homology," or "the bilateral symmetry of the body and the consequent answerableness or parallelism of the parts or organs of one side to those of another" (p. 15). For instance, human beings have two arms, both like one another, one on each side of our bodies; hands, legs, and feet match, respectively, one on the left and another on the right. Owen takes a comparative perspective. He argues that serially homologous limbs are homologous across vertebrate species, pointing, for instance, to the similarities between human feet and toes and a horse's feet and toes. They are serially homologous in both species, and the serially homologous bones are homologous across the species as well.[4]

After having made the case for special and serial homologies, Owen turns to the argument for general homology. Owen employs a strategy of argument known as the method of hypothesis. The aim is to formulate a general law describing the observed phenomena. Hypotheses—statements which, if true, would explain the phenomena—are proposed. The hypothesis which best explains the phenomena is favored, that is,

[3] "Idea" is a synonym for "form," in Plato. Recently, the latter has been used more often.

[4] Strangely, Owen does not consider the similarities in serially homologous structures across species to be a kind of special homology. He relies on the comparison of serially homologous structures across species to demonstrate that, even in cases in which some parts such as bones of the fingers or toes are not present or are present in a reduced form, as in a horse's hoof compared with the human hand, they are nonetheless serially homologous when considered on a given creature.

is regarded as better-confirmed than the alternatives.[5] Owen (pp. 39–40) considers three hypotheses.

1. There is no reason for special and serial homologies across vertebrate taxa, that is, whatever commonalities in structure there are among the taxa are due to chance.
2. Morphology of the vertebrate limb results from adaptation of organisms to their environments.
3. There exists a general plan for the vertebrate limb, that is, general homology.

The first hypothesis, "that the organic atoms have occurred fortuitously to produce such harmony," is an "Epicurean slough of despond" from which "every healthy mind naturally recoils" (p. 40). Owen believes that he has adequately disposed of the second hypothesis, the "teleological" view according to which adaptation to environment alone explains the vertebrate limb. His argument for this is discussed above. This leaves the third hypothesis, the existence of general homologies. Having eliminated what he believes to be the only other plausible alternatives, Owen believes the third alone is adequate, and that there must be general homology. The remainder of *On the Nature of Limbs* is devoted to showing that the special and serial homologies across the vertebrate taxa, taken together, have the same structural conformation, and that there is a single organizational scheme for the entire complex of bones that make up our shoulders, arms, hands, legs, fingers, and toes. As in the case of his arguments for special and serial homologies, his argument for general homology is painstakingly detailed, establishing correspondences between a vast number of points on the limb bones of a large number of vertebrate creatures.

The central problem with the method of hypothesis is that it requires the elimination of competitors to one's favored view. Owen proposes that neither chance nor adaptation to the environment are particularly good explanations for the phenomena of special and serial homology. He is mistaken if the thinks that these are the only alternatives to the thesis of general homology. The Darwinian competitor to Owen's favorite hypothesis is that all vertebrates have a common ancestor with a generalized vertebrate limb system which was modified through time in the different lineages as the vertebrates diversified. This historical explanation, which is something like what biologists of today believe, does not imply that there is any general homology or "idea" of the vertebrate limb—only that the general structure of the vertebrate limb is preserved across generations, allowing for whatever changes occur due to adaptation.

The importance of Owen's work today, and of *On the Nature of Limbs* in his body of work, is open for debate among historians of science and scientists. How deeply did Owen's commitment to divine intervention in the creation of organisms extend? Do the positions advanced in *On the Nature of Limbs* entail that organisms are the creations of a divine designer? How was Owen's argument against design for the environment viewed at the time he made it, and what impact did *On the Nature of Limbs* play in the directions taken by functional anatomists in the late nineteenth and early twentieth centuries? Owen's argument, discussed above, that the form of vertebrate limb cannot be explained by adaptation alone, is a powerful argument against a divine designer, and is often used today for that purpose. The idea that there are important high-level agreements in the structure of vertebrate limbs is firmly established among evolutionary biologists and functional anatomists today, even to the extent that human gross anatomy can be taught to medical students from an evolutionary perspective, as Neil Shubin explains in *Your Inner Fish* (2008).

Brian K. Hall, in the preface, enthusiastically recommends the reprint of *On the Nature of Limbs* as "especially timely" because "several topics treated by Owen have become entire fields of investigation" and because there has been a "resurgence of interest in fins and limbs in developmental, evolutionary, and evolutionary developmental biology" (p. ix). Ron Amundson, in his introductory essay, also argues for Owen's relevance in the present day, stating that "current developments in evolution biology, especially work in evolutionary developmental biology (evo-devo), make Owen's work relevant today in a way that it was not in the 1970s and 1980s" (p. xvii). The aim of his essay is to place Owen in the context of the nineteenth century controversy over the explanation of anatomical form adaptation to the environment ("functionalism") or an underlying structural stability and common form ("structuralism"). Amundson also argues that Owen's views are compatible with evolutionary thought, taking issue with the received interpretation that Owen's proposals are

[5]The issue of what exactly makes a good explanation is enormously important and just as intriguing. Note as well that, according to the method of hypothesis, although explaining the phenomena is the central mark of a hypothesis' credibility, there are others often used. These include, for instance, simplicity of a hypothesis or the unification of areas of inquiry usually taken to be independent of one another.

intrinsically anti-evolutionary. Kevin Padian's essay describes how Owen negotiated tensions among strains of thought in Victorian science.

Jennifer Coggon and Mary P. Winsor contribute a charming essay about the path of their research into the source of the frontispiece illustration of *On the Nature of Limbs*. Reasoning in the style of Sherlock Holmes, Coggon and Winsor proceed by intellectual sleuthing and library and museum research, and, with modest help from serendipity, identify a sculpture which they convincingly argue served as the model for Owen's illustration. As well, they advance a theory about Owen's motivations for having chosen that particular illustration, and his audience's likely response to it.

References

Darwin C. On the origin of species. Facsimile of the 1859 London (John Murray) edition, edited and with an introduction by Ernst Mayr. Cambridge: Harvard University Press; 1964.

Shubin N. Your inner fish: a journey into the 3.5-billion-year history of the human body. 1st ed. New York: Pantheon Books; 2008.