The Evolution of Richard Owen

By David Lowther

The theory of the vertebrate archetype is one of the most important developments in early nineteenth-century science. Although later a key component in Darwin's evolutionary synthesis, it was originally the great shibboleth of the transcendental, Romantic science that Darwinians sought to discredit. In the hands of Sir Richard Owen, the most high profile man of science of the age, the archetype became a highly sophisticated interpretive tool, facilitating brilliant advances in the disciplines of anatomy, morphology and palaeontology. However the concept, smacking of pantheism, was deemed scientifically and theologically unsound by many of Owen's patrons and peers, leading to an extraordinary exercise in rebranding which saw Owen retreat from his advanced position and adopt the language of scientific reaction.

This article attempts to avoid a teleological interpretation of the archetype, and instead offers an analysis of its most sophisticated manifestation and application to British natural science between 1840 and 1860. In doing so, it will demonstrate three key points. First, that British science during this period deviated considerably from its long-standing traditions, drawing upon a wide and varied array of intellectual sources; second, that the development of scientific theory is closely interlinked with its wider political and social context, subject to pressures wholly divorced from the narrow scientific sphere; and third, that the work of Richard Owen, a much-maligned figure, was a highly sophisticated response to the unprecedented challenges facing scientists in the decade immediately preceding the 'Darwinian Revolution'.

Richard Owen was born in 1804 in Lancaster, the son of a merchant. He attended school with that other 'great' of pre-Darwinian science and fellow Lancastrian, William

Whewell. The paths of Owen and Whewell were subsequently to cross many times, and Whewell was to exert crucial influence on Owen at several key points throughout his career. Whereas Whewell went on to become a fixture at Cambridge University, becoming almost gentrified in the process, Owen ended up in London, appointed as assistant conservator of the Royal College of Surgeons' (RCS) Hunterian Collection at the age of 23.[1] He was to stay at the RCS for over twenty years, his brilliance earning for him a pre-eminence almost wholly independent of the series of ill-paid positions he held within the college organisation.

Owen's eminence as a public scientist is one of the most fascinating aspects of his career and one that has a direct bearing upon the development of his theory of the archetype. It is often remarked by historians that, before science became a professional discipline in the 1860s, salaried positions were few and far between, and those that did exist were almost always miserably paid.[2] The top jobs within scientific and medical institutions were the preserve of gentlemen with sufficient independent wealth to nullify the need for a salary. This was to prove a flashpoint between the RCS and London's medical community in the 1830s, which violently challenged the self-perpetuating dominance of the amateur elites at the top of the profession. In *The Politics of Evolution*, Adrian Desmond analyses this conflict in considerable depth, drawing a highly-politicised account in which the council of the RCS is an obstruction to all progress and Owen is its primary weapon.[3] Both of these conclusions have much to recommend them. The council of the RCS *was* opposed to throwing open the medical profession to all-comers, and it *did* use Owen, in his pomp and through the medium of his public lectures and publications, to counter the efforts of the reformers at an intellectual level with a powerful alternative to their materialist evolutionary theory. However, this is

[1] Michael White, *Rivals: Conflict as the Fuel of Science* (London: Secker & Warburg, 2001), 119.
[2] The issue of status, pay, and professional prestige is dealt with at length in Adrian Desmond's book-length study *The Politics of Evolution: Morphology, Medicine, and Reform in Radical London* (Chicago: University of Chicago Press, 1989), particularly 101-152.
[3] For example, Desmond, *The Politics of Evolution*, 276-334; Philip F. Rehbock, *The Philosophical Naturalists: Themes in Early Nineteenth-Century British Biology* (Madison: University of Wisconsin Press, 1983), 31-55.

only half the story, and it perpetuates one of the most damaging myths to have sprung up around Owen; that he was a creationist opposed to any notion of species development and transmutation. As study of both his lecture notes and published writings demonstrate, this was far from being the case, but this is how he has gone down in history and this is how, for the most part, he is still judged.[4]

This is partly Owen's own fault. A public man of science is judged by his public pronouncements just as much as a politician, and in never coming out unequivocally in favour of any theory of evolution Owen damned himself in the eyes of his evolutionist peers. His original theory of the archetype, before it was given a Platonist, theological gloss at the height of the Chartist agitations of 1848, was not an anti-evolutionary construct, nor was it overly metaphysical. However, it *is* complex, and for reasons of time this paper deals only with German Romanticism, which played the most important role in its development. We can trace a clear line of descent, through Romanticism, to Aristotle's biological writings, particularly the *Generation of Animals*. However, this Aristotelian ancestry is perhaps more obvious with the benefit of hindsight, and I shall concentrate more fully on the Platonism commonly identified with Owen's work.

Figure 1 depicts the archetype as Owen conceived it in 1848. We can see that it resembles no known living creature but is recognisably a vertebrate, with a head, spinal column, modified appendages and limbs. Indeed, it resembles nothing so much as a *theoretical* vertebrate, a lowest common denominator of vertebrates, with the potential to develop into any vertebrate animal. Hold on to this word 'potential'; it is important a little later on. For now, note that this potential was seen to be realised through the working of an all-pervading 'polarising force' – a self-developing, natural force. This vertebrate blueprint is

[4] Michael Ruse, *The Darwinian Paradigm* (London: Routledge, 1989) and *The Darwinian Revolution* (Chicago: University of Chicago Press, 1999), 228.

a development of his earlier work on **homology** - a term of Owen's own creation - the notion that a similarity between two anatomical features is due to the inheritance of the same feature from a common ancestor. One example of this is the pentadactyl limb, a feature common to both humans and birds, for example, where the bones of the forelimb are arranged on a similar plan, ending in five digits, but are adapted for radically different functions. Homologies can be distinguished from **analogies,** which are correspondences between anatomical structures that perform the same function but are the result of *independent* development, such as the wings of a bird and those of a bat.

Wary of ascribing the development of organisms to natural causes, Owen believed that homologies were representative of a divine 'groundplan' of component parts, and explicitly rejected recapitulation as a mechanism of development.[5] In embryology, the study of the development of the

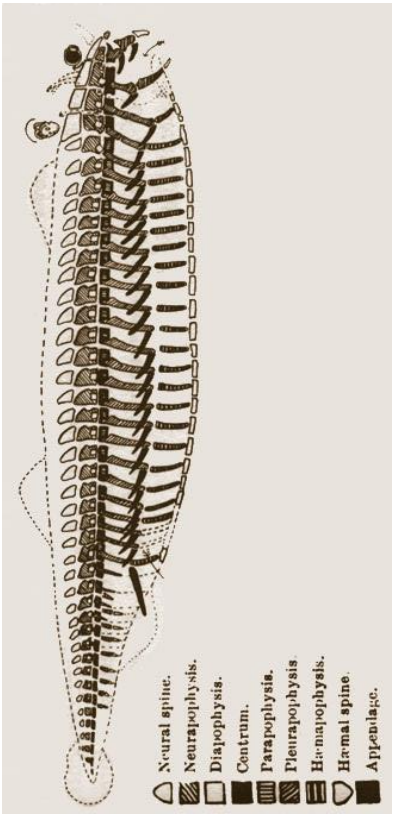

Figure I: Diagram of the archetype, from *Report on the Archetype and Homologies of the Vertebrate Skeleton* (London: Richard & John E. Taylor, 1847).

[5] R. Owen, *On Parthenogenesis* (London: Jan Van Voorst, 1849), 32-33.

embryo, recapitulation was fast becoming popular with those who believed in some form of evolution.[6] Its basic tenet is that in developing from embryo to adult, all living organisms go through stages which resemble successive stages in the evolution of their ancestors. Recapitulation, tied in with Lamarck's linear theory of evolution, appalled the scientifically and theologically orthodox.[7] Owen's notes for his Hunterian lectures in 1837 strongly reject the claim that the human embryo goes through lower stages in its development, and when Robert Chambers repeated the heresy in his *Vestiges of the Natural History of Creation* in 1844, the book became a national scandal.[8] The furore was such that Darwin, sitting on his own evolutionary theory which had natural selection rather than recapitulation as its driving mechanism, waited another 15 years to publish the *Origin of Species*.

The uproar over the *Vestiges* had an effect on Owen, too. Although a sincere and orthodox Christian, associated with many of the most prominent figures in the early-Victorian Anglican Church, Owen's work on homologies in the 1830s had persuaded him that the creationist standpoint adopted by many of his scientific peers, Whewell included, was increasingly untenable.[9] The similarities between 'lower' and 'higher' species were too apparent to be explained by anything other than inter-relatedness. Owen was informed in his thinking by the German Romantic school of Goethe, Lorenz Oken and Carl Gustav Carus, to which he had been introduced in the late 1820s by a senior colleague at the RCS, Joseph Green. Carus, in particular was to exert a profound influence on Owen's thinking.

---

[6] D. Ospovat, *The Development of Darwin's Theory: Natural History, Natural Theology and Natural Selection, 1838-1859* (Cambridge: Cambridge University Press, 1981) 118-120 and 151-153.

[7] Jean-Baptiste Lamarck (1744-1829), an early and controversial proponent of evolution by natural laws. His theory, which enjoyed a considerable vogue in the 1840s thanks to the popularity of James Chambers *Vestiges of the Natural History of Creation* (1844), rested upon two central premises; that environmental change causes corresponding changes in animals (adaptation), and that there is an inherent tendency for life to become more complex. Lamarck's theory was widely viewed by the theologically-minded as materialistic and antagonistic to Christian teaching.

[8] For a full treatment of the furore surrounding Chambers' book, see Secord, J. A., *Victorian Sensation: The Extraordinary Publication, Reception , and Secret Authorship of Vestiges of the Natural History of Creation* (Chicago: The University of Chicago Press, 2000).

[9] N. A. Rupke, *Richard Owen: Victorian Naturalist* (New Haven: Yale University Press, 1994), 236.

Owen's biographer, Nicholas Rupke, has rightly pointed out that there is nothing in the anatomical literature before Owen that comes closer to his archetype than Carus' earlier work. First published in 1828, his sketch of the archetype strongly resembles a simplified version of Owen's later version, which we can see in this comparative diagram. Intended purely as a schema, **not** a metaphysical ideal nor a real, as-yet-undiscovered creature, it is a generalisation of the vertebrate.[10] In Owen's papers, held in the archives of the RCS, I found a small copy of Carus' diagram tucked away in an envelope of sketches dated from the early 1840s, but his engagement with Carus' morphological ideas undoubtedly stretches back to the early 1830s. Significantly, Owen long denied being influenced by Carus' archetype, only admitting to it in 1868, by which time no-one much cared one way or the other. Why he should have been so shy of admitting to German influence is clear if we take a step back from the relatively closed world of London science and regard Owen's place in the wider intellectual culture of the 1840s.

As the early concept of the archetype demonstrates, the Romantic naturalists, of whom Carus was a leading representative, sought not only to describe and classify nature but to establish the relatedness of organic forms. This was at direct variance with both accepted Church teaching and the rudimentary scientific curriculum at the two universities.[11] It is important to note that, at this date, the majority of academics working in the natural sciences were not only devout and reasonably orthodox members of the Anglican Communion. Many of the most prominent were also ordained Anglican ministers. William Whewell and his Cambridge colleague, the geologist Adam Sedgwick, were both members of this high priestly caste, and they took their religious duties seriously. This entailed protecting the Church hierarchy, and the soul of the nation, from the onslaught of scientific materialism, which both

[10] Rupke, *Owen*, 188-196,
[11] D. von Engelhardt, 'Science, society and culture in the Romantic *Naturforshung*', in Teich, M., Porter, R., Gustafsson, B. (Eds.), *Nature and Society in Historical Context* (Cambridge: Cambridge University Press, 1997), 195-208.

men associated with immorality and saw as a danger to the existing social order. Faced with the vast social and political ramifications of industrial mechanisation, a series of disastrous failures in the harvest, and political unrest in London and provincial cities, the governing classes of 1840s Britain looked to intellectual developments on the Continent with mounting unease.

Owen, by now a close friend of Prince Albert and the Prime Minister, Sir Robert Peel, was regarded as a solid associate of this establishment circle. The astonishment when he published *On the Archetype* in 1848, at the very height of the perceived Chartist threat, was therefore profound. Sedgwick, who had gained a reputation as a trenchant opponent of anything European in the furore over the *Vestiges* in 1844, thundered that his friend had opened the door to Godless, continental ideas.[12] What he feared particularly was the threat of a pantheism he believed to be latent in the thought of the leading German Romantics. He was not altogether wrong. Goethe, Schelling and Oken had all flirted with pantheism to one degree or another; Heinrich Heine, in a widely read essay of 1834, argued that Goethe was influenced by Spinoza and that the Romantics, taken as a group, were motivated by a pantheistic instinct.[13] Rightly or wrongly, both Owen's fellow men of science and the popular press saw in pantheism the seeds for a form of organic evolution. Twice in December 1848 alone, the *Manchester Spectator* accused him of advocating a pernicious doctrine damaging to the fabric of society.[14] Owen responded by adopting a policy of scuttle. Over the next few months, until he published on the subject again in 1849, Owen frantically recast the archetype. In *On the Nature of Limbs*, he executed a 'U-turn', declaring that the archetype was **not** simply an intellectual construct but was a 'predetermined pattern', a kind of Divine

[12] A. Sedgwick, *Discourse on the Studies of the University* (Leicester: Leicester University Press, 1969), 230.
[13] N. A. Rupke, 'Richard Owen's Vertebrate Archetype', *Isis*, Vol. 84, No. 2 (Jun., 1993), 231-251 and 233.
[14] *Manchester Spectator*, 8 December 1849: 22 December 1849.

blueprint, which placed it firmly within a Platonic cosmogony. Pantheism was out; Plato was in.

Incredibly, this extraordinary exercise in dissimulation seemed to work. Just how impressive were his mental evolutions can be seen when we briefly contrast his original theory with the Platonic archetype. In Plato's view, advanced in the *Republic*, the notions we have of natural phenomena are not the products of our own mind, but are sense impressions of the ideas of those phenomena, which have an independent metaphysical existence. So, separate from the material, sensory world is a world of ideas, perfect and immutable. Each of these ideas is a 'form', an 'archetype', of which all visible representatives are imperfect approximations. The Platonic archetype therefore is the *highest*, most perfect reality. Turn now to Owen's vertebrate archetype, and it is clear that it represents the opposite extreme; the lowest common denominator, the simplest and least perfect notion of a vertebrate, an intellectual construct, moreover, with neither metaphysical nor physical reality. It is all *potential*, a notion which runs through Carus' thought and, before him, was suggested by Aristotle in his writings on *The Generation of Animals*.[15] For Plato, Man was the archetype, from which the organic world, by a process of degradation, was formed. Owen urged the contrary, noting that 'Man, whose organisation is regarded as the highest, departs most from the vertebrate archetype'.[16] In 1847 and 1848, Owen was at pains to distinguish archetype from the Platonic form and placed his own theory at the opposite end of the spectrum.

Just how superficial was Owen's adherence to Platonism in the mid to late 1840s is indicated by unpublished notes dating from 1844. Arguing that an understanding of Aristotle's work is 'essential' to comparative anatomy 'as it is now known' – Owen's own

[15] Aristotle, *Generation of Animals* (London: William Heinemann Ltd., 1953), Book 1, Chapter 1 for an outline of the Causes. For the manifestation of Causes in Aristotle's theory of sexual generation, see Book 1, Chapter 17.
[16] R. Owen, *On the Archetype and Homologies of the Vertebrate Skeleton* (London: Jan Van Voorst, 1848).

conception of the discipline – he goes on to eulogise Aristotle as 'the glorious exception to the blindness of Greek philosophers to the natural sciences'. Interestingly, given what the archetype was soon to become, he strongly denies that detailed anatomical conclusions can be formed 'a priori'. They must 'necessarily' be based upon a 'profound observation of facts', and it was by such methods of observation and generalisation that Owen had arrived at his original vertebrate blueprint.[17]

In this early form, Owen's concept was intended as a scientific model rather than a metaphysical entity. It would likely have stayed like this were it not for developments in the wider world of science and British culture. Between 1840 and 1860, Platonism enjoyed a resurgence of popularity in the British universities, notably at Cambridge under William Whewell. As Master of Trinity College, Whewell exerted considerable intellectual and institutional influence, and was remarkable for the breadth of his academic interests. These included Platonic philosophy and his work gave it wide currency. Previous Christian thinkers, particularly St. Augustine, had taken the theory of the forms and re-jigged it, whereby they were transformed into plans by which God had created the visible world. Invested with a metaphysical reality as a divine groundplan, the forms are the most 'perfect' reality, the archetypal world originally conceived by God before the fall of Man. Remarkably, Whewell was able, superficially at least, to reconcile this idealist construct with the tradition of Baconian inductivism that had long enjoyed a protected status in British science.[18]

In this context, a Platonised archetype was a potentially powerful intellectual counter to the radicalised Lamarckian evolution so abhorred by existing institutional elites. And, for a

[17] Richard Owen, unpublished lecture notes, 1844 series. Royal College of Surgeons, MS0025/1/3/1 - Museum Lectures, 1837-1844. Pages not numbered in original manuscript.

[18] Perry Williams, 'Passing on the Torch', in Fisch and Schaffer, *William Whewell: A Composite Portrait* (Oxford: Clarendon Press, 1991), 117-148. Commonly accredited with developing the fundamentals of modern scientific method, Francis Bacon (1561-1626) laid emphasis on experimental science and the primacy of observation in the generation of hypotheses. He outlined his philosophy in a hugely influential series of works, of which *Novum Organum* (1620) was perhaps the most enduringly influential, reaching new audiences in the nineteenth century through the works of William Whewell.

little while, it appeared to work. With the final collapse of Chartism in 1848, much of the immediate danger to the elites' position seemed to dissipate, ushering in what a generation of historians has called 'The Age of Equipoise' – that most comfortable, complacent decade, the 1850s.[19] Linear, Lamarckian evolution was roundly condemned as both immoral and unsupported by evidence, and rapidly became a non-issue. However, the end of the decade brought with it the seeds of Owen's fall from grace. Darwin, who had followed Owen's strides in comparative anatomy with avid interest, saw in homologies and the archetype an indication of heredity and genetic relationships, and therefore evidence of organic evolution. Stripping it of its fatuous Platonism, Darwin reimagined the archetype as a real, primitive ancestor – one step further than Owen's original idea back in 1846 – and made it a central part of his evolutionary program.[20]

Tragically, Owen himself had been creeping, by fits and starts, towards this position for several years. Those who attended his lectures, and even his fellow naturalists, could be forgiven if they could not immediately see this shift. With his habitual lack of clarity, Owen spoke out frequently against transmutation in public whilst exploring it in private, engaging with Darwin about possible evolutionary mechanisms and offering the radical publisher, John Chapman, six possible ways by which, he believed, evolution could occur.[21] In 1849, the very same year in which he successfully Platonised the archetype, he threw caution to the winds and declared that natural laws, 'guided by the archetypal light', were responsible for both the origin and development of species. Whilst he was careful to argue that this involved no diminishment of Divine power, the implications are to the contrary; that God has not populated the world with a series of creations, but through the operation of general laws. Yet

[19] A classic overview of the main themes that characterise the period can be found in W. L. Burn, *The Age of Equipoise* (London: George Allen & Unwin, 1964), 15-54.
[20] A. Desmond and J. Moore, *Darwin* (London: Penguin Books Ltd., 1992), 432-434.
[21] Richard Owen to John Chapman, early 1848. Quoted in R. Owen, *The Life of Richard Owen* (London: John Murray, 1894), Vol. 1, 310.

again, he was publically accused of pantheism and, rather like a squid confronted by a bigger adversary; Owen retreated behind a cloud of ink. 'Natural laws' became rather ambiguous 'creative acts', which had a safely orthodox ring about it, and he concentrated his energies on paleontology. By the time he reaffirmed his belief in natural causes in 1858 Darwin and Wallace had read their groundbreaking papers at the Linnean Society, and Owen found himself adrift.

Conclusion

At a general level, we can see in the archetype one of the most notable examples of scientific theory shaped by social and political demands. That this was the case demonstrates the fallacy of the argument, still widespread, that the generation of high-level scientific theory is somehow divorced from its wider context. It also serves to highlight the varied pressures constantly at work on a high profile Victorian man of science. At the height of his fame, Owen eclipsed all of his rivals, yet his position was always rather more fragile than it appeared. A salaried professional in a class-conscious time, Owen was acutely aware of his relatively humble origins and his reliance upon the patronage of powerful, establishment figures and institutions. He found himself constantly called upon to modify his opinions in order to serve larger social and political agendas, and it is not wholly to credit that he readily agreed to do so. Lacking the reckless courage of conviction that marked out contemporaries like Robert Grant and, after a fashion, Darwin himself, Owen hid behind a mystifying cloud of technical jargon and rhetoric, a loss of nerve that was to alienate potential supporters and prove disastrous to his historical reputation.

However, taking these limitations into account, Owen's achievements in the field of comparative anatomy – effectively establishing it as a serious discipline – should not be lightly dismissed. His extraordinary insights in the late 1830s and 1840s were radical in their

genesis and their implications. Cutting across long-established scientific and theological conventions, his grand synthesis of Continental and British scientific practice paved the way for Darwin and later evolutionary theorists. It is the great irony of Owen's life that his work in this field would provide Darwin, whose theory of natural selection he opposed so bitterly, with some of his most compelling evidence.

Bibliography

Primary Sources

Manuscripts

Richard Owen, unpublished lecture notes, 1844 series. Royal College of Surgeons, MS0025/1/3/1 - Museum Lectures, 1837-1844.

Books

Aristotle, *Generation of Animals* (London: William Heinemann Ltd., 1953).

Mantell, G., *The Wonders of Geology* (London: Relfe and Fletcher, 1839).

Owen, R., *Memoir on the pearly nautilus (Nautilus pompilius, Linn.): With illustrations of its external form and internal structure* (London: W. Wood, 1832)

Odontography: or, A treatise on the comparative anatomy of the teeth; their physiological relations, mode of development, and microscopic structure, in the vertebrate animals (London: Hippolyte Bailliere, 1840).

Lectures on the comparative anatomy and physiology of the invertebrate animals (London: Longman, Brown, Green, and Longmans, 1843).

Report on the Archetype and Homologies of the Vertebrate Skeleton (London: Richard & John E. Taylor, 1847).

On the Archetype and Homologies of the Vertebrate Skeleton (London: Jan Van Voorst, 1848).

On Parthenogenesis (London: Jan Van Voorst, 1849).

The Principal Forms of the Skeleton and the Teeth as the basis for a System of Natural History and Comparative Anatomy (London: Charles Griffin, 1854).

Palaeontology, or, A systematic summary of extinct animals and their geological relations (Edinburgh: A. and C. Black, 1860).

On the Anatomy of Vertebrates (London: Longmans, Green & Co., 1866).

On the Nature of Limbs (Chicago: University of Chicago Press, 2009).

Secondary sources

Online sources

ONDB

Kate Fletcher, 'Flower, Sir William Henry (1831–1899)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004 [http://www.oxforddnb.com/view/article/9766

Jacob W. Gruber, 'Owen, Sir Richard (1804–1892)', *Oxford Dictionary of National Biography*, Oxford University Press, 2004; online edn, Jan 2006 http://www.oxforddnb.com/view/article/21026

Books

Allen, D. E., *The Naturalist in Britain: A Social History* (London: Allen Lane, 1976).

Barber, L., *The Heyday of Natural History, 1820 – 1870* (London: Jonathan Cape, 1980).

Coleman, W., *Biology in the Nineteenth Century* (Cambridge: Cambridge University Press, 1971).

Collini, S., *Public Moralists: Political Thought and Intellectual Life in Britain, 1850-1930* (Oxford: Clarendon Press, 1991).

Desmond, A., Moore, J., *Darwin* (London: Penguin Books Ltd., 1992).

Desmond, A., *Archetypes and Ancestors: Palaeontology in Victorian London, 1850-1875* (London: Blond & Briggs, 1982).

Huxley: From Devil's Disciple to Evolution's High Priest (London: Penguin Books Ltd, 1994).

Hesketh, I., *Of Apes and Ancestors: Evolution, Christianity, and the Oxford Debate* (London: University of Toronto Press, 2009).

Ospovat, D., *The Development of Darwin's Theory: Natural History, Natural Theology and Natural Selection, 1838-1859* (Cambridge: Cambridge University Press, 1981).

Owen, R., *The Life of Richard Owen* (London: John Murray, 1894).

Mayr, E., *The Growth of Biological Thought: Diversity, Evolution, and Inheritance* (Cambridge, Mass.: Harvard University Press, 1982).

Rehbock, P. F., *The Philosophical Naturalists: Themes in Early Nineteenth-Century British Biology* (Madison: University of Wisconsin Press, 1983).

Rupke, N. A., *Richard Owen: Victorian Naturalist* (New Haven: Yale University Press, 1994).

Rupke, N. A., *Richard Owen: Biology without Darwin* (London: University of Chicago Press, 2009).

Thackray, J., Press, B., *The Natural History Museum: Nature's Treasurehouse* (London: The Natural History Museum, 2001).

Stearn, W. T., *The Natural History Museum at South Kensington: A History of the British Museum (Natural History) 1753 – 1980* (London: Heinemann, 1981).

Yanni, C., *Nature's Museums: Victorian Science and the Architecture of Display* (London: The Athlone Press, 1999).

White, M., *Rivals: Conflict as the Fuel of Science* (London: Secker & Warburg, 2001).

Articles

Camardi, G., 'Richard Owen, Morphology and Evolution', *Journal of the History of Biology*, Vol. 34, No. 3 (Winter, 2001), 481-515.

Corsi, P., 'Before Darwin: Transformist Concepts in European Natural History', *Journal of the History of Biology*, Vol. 38 (2005), pp. 67 – 83.

Desmond, A., 'Designing the Dinosaur: Richard Owen's Response to Robert Edmond Grant', *Isis*, Vol. 70, No. 2 (Jun., 1979), 224-234.

'Richard Owen's Reaction to Transmutation in the 1830's', *The British Journal for the History of Science*, Vol. 18, No. 1 (Mar., 1985), pp. 25 – 50.

'Redefining the X Axis: "Professionals," "Amateurs" and the Making of Mid-Victorian Biology - A Progress Report', *Journal of the History of Biology*, Vol. 34, No. 1 (Spring, 2001), 3 – 50.

Hunt, G., 'Evolution in Fossil Lineages: Palaeontology and The Origin of Species', *The American Naturalist*, Vol. 176, No. S1, Darwinian Thinking: 150 Years after The Origin, A Symposium Organised by Douglas W. Schemske (Dec. 2010), pp. S61 – S76.

Lenoir, T., 'Kant, Von Baer, and Causal-Historical Thinking in Biology', *Poetics Today*, Vol. 9, No. 1, Interpretation in Context in Science and Culture (1988), 103-115.

MacLeod, R. M., 'Evolutionism and Richard Owen, 1830-1868: An Episode in Darwin's Century', *Isis*, Vol. 56, No. 3 (Autumn, 1965), 259-280.

Oppenheimer, J. M., 'Science and Nationality: The Case of Karl Ernst von Baer (1792-1876)', *Proceedings of the American Philosophical Society*, Vol. 134, No. 2 (Jun., 1990), 75-82.

Ospovat, D., ‘The Influence of Karl Ernst von Baer's Embryologv, 1828- 1859: A Reappraisal in Light of Richard Owen's and William B. Carpenter's "Palaeontological Application of'Von Baer's Law"', *Journal of the History of Biology*, Vol. 9, No. 1 (Spring, 1976), 1-28.

Padian, K., ‘A Missing Hunterian Lecture on Vertebrae by Richard Owen, 1837’, *Journal of the History of Biology*, Vol. 28, No. 2 (Summer, 1995), 333-368.

‘The Rehabilitation of Sir Richard Owen’, *BioScience*, Vol. 47, No. 3 (Jul. – Aug., 1997), pp. 446 – 453.

Rupke, N. A., ‘Richard Owen's Vertebrate Archetype’, *Isis*, Vol. 84, No. 2 (Jun., 1993), 231-251.

Teich, M., Porter, R., Gustafsson, B. (Eds.), *Nature and Society in Historical Context* (Cambridge: Cambridge University Press, 1997).