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Review

J. David Archibald, *Aristotle's Ladder, Darwin's Tree: The Evolution of Visual Metaphors for Biological Order*, 2014, University Press; New York, Columbia, 256 pages, US\$60.00 hardcover.

Heather Winlow

Bath Spa University, UK

Readers interested in the history of science and the use of visual metaphors to represent scientific theories will find this book illuminating. Archibald provides a comprehensive overview of the origins and uses of ladder and tree diagrams as metaphors for life. It has cross-disciplinary appeal, but will be more digestible to readers with prior knowledge of evolutionary theories. The author draws on examples crossing a wide time span and a range of representational modes, including architecture, artwork, unpublished and published written materials and hand-drawn and computer generated diagrams.

The opening chapters provide pre-nineteenth-century context to the evolution and use of ladders and trees, setting the scene for later chapters. Chapter 1 traces the use of the ladder metaphor to Aristotle, whose surviving writings indicate that he perceived a continuous scale of ascent from inanimate objects, through plants and animals. The chapter considers the use of religious and non-religious ladders. Religious ladders included representations of the Great Chain of Being, such as the one in Diego Valadés *Rhetorica Christiana* (1579) – which includes representations of hell and heaven linked by a chain with six intermediate levels depicting flora and fauna. Chapter 2 traces the history of the tree diagram during the Roman and medieval periods. Archibald compares the use of the Acanthus motif in pre-Christian Roman architecture and medieval Christian architecture. As a Roman symbol, the branching Acanthus represented nature's cycle of birth-death-rebirth, symbolism which later featured in churches, sometimes taking a tree-like form. These discussions conclude with an examination of a twelfth-century floor mosaic in the Cathedral of Otranto, Italy, featuring a tree running the full length of the nave. The chapter concludes with an overview of a range of other tree images, including those used to indicate family descent – a practise common among elite groups from the Roman period onwards.

Chapter 3 outlines some major nineteenth-century developments and considers how the tree became dominant in representing biological diversity. The chapter also explores other forms of ordering biological data, such as tables and listed classifications. The first known evolutionary tree from Lamarck's *Philosophie zoologique* (1809) is discussed as are his classificatory tables. The diagrams of key thinkers such as William Carpenter, Robert Chambers, Louis Agassiz, Edward Hitchcock and Anna Maria Redfield are included, demonstrating how the tree metaphor began to dominate the work of evolutionists and non-evolutionists alike. An analysis of the origins and meanings of Darwin's tree diagrams, considering both published and unpublished sources, is the focus of chapter 4. Archibald argues that Darwin used the tree metaphor to demonstrate the theoretical relationship between species, only occasionally using trees to show specific links **beenbetween** species. Darwin's most well-known diagrams are explored, including the branching figure from notebook B (the 'I think' diagram), the diagram published in *On the Origin of Species* and a number of less well known tree diagrams. Together these are used to demonstrate how Darwin's ideas about evolution and its visual representation changed over time.

After the publication of Darwin's *Origin* trees of life became common. Chapter 5 examines diagrams produced by Darwinian scientists, including biologist St George Jackson Mivart; palaeontologists Jean Albert Gaudry, Franz Hilgendorf and Vladimir Kovalevsky; and zoologist Ernst Haeckel, well known for his prodigious production of tree imagery. Haeckel's 'Great Oak' or Genealogical Tree of Humans (1874) has been widely interpreted as progressionist and anti-Darwinian. Archibald asserts that this diagram was not necessarily representative of Haeckel's scientific views, but an interpretation of evolution designed for use by the general public – who could handle Darwin's evolution as long as humans crowned the tree of life. Several of Haeckel's other diagrams are also explored, including a world map on which was superimposed a tree-like form, showing the origin and radiation of humans from a hypothetical point in the Indian ocean – a map not dissimilar to recent world genetic maps.

Later chapters focus on twentieth- and twenty-first-century developments. Chapter 6 explores the use of tree diagrams by Neo-Lamarckians, following the turn of the last century. Archibald argues that American palaeontologists Edward Drinker Cope, Henry Fairfield Osborn and William King Gregory, produced diagrams which reinforced older ideas about *scala naturae* alongside the concept of evolution. The chapter also explores the work of Darwinian Gaylord Simpson who used phylogenetic trees to represent evolutionary processes and contributed to the 'modern synthesis' of evolutionary theory (combining natural selection and genetics). Chapter 7 stresses the importance of late twentieth and twenty-first century developments in mapping evolutionary change, including the development of polymerase chain reaction and increased computing power. Archibald notes that tree diagrams proliferated in the 1960s about 10 years after the discovery of DNA and discusses recent tree diagrams based on molecular data that attempt to represent most of the species on earth. The current wave of diagrams vary from trees to circles to webs and use anatomical data, molecular data, or both. One example, an almost full-circle super-tree published by Olaf Buninda-Edmond and colleagues in 2007 was constructed by clustering a series of smaller trees using various data-sets and contains 4510 of the 4554 extant species. Archibald observes that some major questions remain unanswered – firstly about the timings of major evolutionary events in pre-history and secondly, whether the tree, now the dominant metaphor for the history of life, is a reasonable metaphor for the portrayal of biological complexity. In chapter 8 Archibald reconsiders the position of modern humans noting that 'our understanding of our place in nature has expanded in the past two thousand years almost beyond comprehension, to the point that we now realise that we constitute but a miniscule part of life on Earth' (p. 200).

This book is wide-ranging in historical coverage but it is also specialised in its focus on biological ladders and trees. It is interesting to see how versatile and influential **the** these metaphors for life have been and continue to be – representations which are important not only to scientific understandings of the origins and diversity of life, but to wider public and societal understandings.