Morris, Simon Conway. Ed. *The Deep Structure of Biology: Is Convergence Sufficiently Ubiquitous to Give a Directional Signal?* Templeton Foundation Press. West Conshohocken, PA. 2008. paperback. ISBN-13: 978-1-59947-138-9 / ISBN-10: 1-59947-138-8. Includes list of contributors, bibliography and index. Pages: vii-x, 232. List price: US$ 29.95

Book review by Jitse M. Van der Meer.

Since the 1940s the Darwinian theory of evolution is generally taken to have been superseded by the neo-Darwinian or Synthetic Theory of Evolution. It was called synthetic because it integrated heredity and evolution. But it was not really synthetic because the study of embryonic development was left out. It took more than half a century of learning about the genetic control of embryonic development before that gap could begin to be addressed. Developmental biologists are now proposing explanations for the development of the overall animal body pattern that are being integrated in evolutionary theory. The book to be reviewed is an edited collection of studies of convergence from this integrated perspective.

Convergence is the phenomenon that problems of adaptation have similar solutions in different organisms (13, 30). The solutions may be molecular, genetic, morphological, mental and social. The thesis of the book is that there are "aspects of evolution that appear to be constrained, if not predictable." (vii). The ground for this thesis is the independent convergence of evolutionary paths on the same evolutionary solutions. The classical example of such a solution is the camera eye which occurs in jellyfish, snails, octopus and whales. Their common ancestor lived before the first appearance of the camera eye. Hence it must have developed independently several times over and this is taken as a hint, but no more than a hint, that there may be an undiscovered deeper order of life. Further, convergence requires natural selection in order to eliminate divergent evolutionary trajectories. The contributors describe examples of convergence and explore possible metaphysical implications of an ordering of evolutionary processes beyond what is accepted within the neo-Darwinian paradigm. The editor hopes that convergence points to a theory of biological organization that succeeds where the synthetic theory of evolution fails. This is not the first time that the explanation of the organization and the evolution of organisms is seen as mutually exclusive. Georges Cuvier (1769-1832) held this view and the introduction appropriately places the book in that historical context.

Since this is an edited volume, I highlight common themes that run through the chapters. Richard Lenski opens with the question how one might include directionality in an evolutionary process that is characterized by the interplay of randomness and necessity (Ch. 1). He sees this interplay between the randomness of mutation and the necessity of natural selection as well as between the contingency of events in the history of life and the repeatability of convergence. Random events are directed by necessary ones. Empirical approaches to testing such interplay are possible, Lenski argues, and he reviews an example from his own research. George McGhee argues that it is possible to predict existing as well as non-existing morphologies given known constraints imposed by the laws of physics and geometry as well as by the biological requirements of organisms (Ch. 2). Karl Niklas describes convergent directionality in plant evolution resulting from extrinsic and intrinsic constraints. Among extrinsic constraints, the law of diffusion governs the relation between body volume and surface area across prokaryotes as well as unicellular and

multicellular eukaryotes. Likewise, the laws of mechanics govern the relation between girth and height in trees with a certain tissue type. Intrinsic constraints come with the demands of photosynthesis and immobility on plant structure. Engineering theory allows only a few plant body plans that satisfy both intrinsic and extrinsic requirements, and these 'solutions' are the ones repeated independently in phylogeny (Ch. 3). In Ch. 4 Simon Conway Morris notes that directionality as such does not allow one to make specific predictions about the outcome of evolution. How could one predict the outcome of one evolutionary pathway when experiments show that the same outcome can be reached via different pathways? How might one predict which solution to the problem of oxygen transport obtains when there are three options (hemoglobin, hemocyanin, and hemerythrin)?

Three chapters are devoted to the evolution of intelligence in plants (Ch. 5), insects (Ch. 6) as well as crows and primates (Ch. 7). Each author argues that intelligence evolved multiple times independently. Ironically, the three chapters together implicitly invalidate this argument because each defines intelligence differently. Convergence, however, presupposes similarity much of which is lost when intelligence is variously defined as controlled flow of information in a network of interacting constituents (Ch. 5: 79), the ability to solve problems (Ch. 6: 112) and the ability to think, reason, and solve novel problems (Ch. 7: 128). Hal Whitehead proposes (Ch. 8) that convergence of heritable social attributes in whales, elephants and humans are caused by social learning and group selection. This is in line with the general pattern of explanation for similarity as the result of similar environmental demands rather than common ancestry.

The last four chapters deal with the question of purpose in evolution. As is well-known, Ernst Mayer believed that one could acknowledge the existence of purpose in organisms objectively in science without getting nervous about its possible metaphysical implications. He called it teleonomy as distinct from teleology. Yet Foley insists in Ch. 9 on purpose being illusory. Clearly, this is a metaphysical if not religious position masquerading under the guise of science. As John Haught observes in Ch. 12, "... the naturalistic enshrinement of either chance or necessity can survive only in an illusory and imaginative world of ideas quite cut off from the actual narrative flow of nature and of life itself." (230). Michael Ruse (Ch. 10) sees no trouble for the Darwinian who acknowledges purpose in organisms. But, he emphasizes, one cannot read God's intentions from them. As a Christian, one should interpret them in terms of God's intentions, but this is another matter." As a scientist, one strives methodologically, "to be an atheist, even if he or she accepts a fuller and more meaningful metaphysical picture of ultimate reality." (183). Celia Deane-Drummond argues (Ch. 11) "that the concept of natural law provides one way of understanding in theological terms what evolutionary science is hinting at through notions of convergence and evolutionary 'purpose'". (214). One wishes she had placed this thesis at the beginning rather than at the end of her chapter which suffers from a lack of focus and unsupported assertions. John Haught has the final chapter. He defines purpose as an overall aim to bring about a goal that is self-evidently worthwhile or good. This applies to the actions of people, but, he asks, is there purpose in the wider universe? Following Teilhard de Chardin, Haught proposes that subjectivity and purpose are cosmic realities. Scientists may exclude subjectivity *methodologically*, "as long as they remain aware that they have left something real off of their maps of nature for the sake of focusing on certain objectifiable and quantifiable aspects."

EVALUATIVE NOTES

This book is a work of responsible scientific speculation and must be appreciated as such. The editor notes that “biology like any science can only progress if the ideas are adventurous, ...” I enjoyed sharing the exploration and I recommend it to others who want to stay informed about cutting-edge thinking in biology.

One of the chapters attributes intelligence to plants. This prompts me to say something about the role of abstraction in defining convergence. Abstraction is a cognitive process that constructs similarity by ignoring differences. So, when intelligence is described or defined in birds, whales and people or when agriculture is attributed to both ants and humans (164), is the similarity constructed by abstraction or does it have ontological reality? Without ontological reality the concept of convergence falls apart into particularities that undermine the suggestion that there might be something lawful in convergence. This problem is not addressed.

Is it possible to attribute similarity between organisms to common ancestry or convergence unambiguously? Convergence has been taken to invalidate common ancestry as an explanation of similarity from the molecular to the morphological level. Morris draws attention to work suggesting that similarity between genetic control networks for body pattern construction during embryonic development may be due to convergence rather than common ancestry (54). Other convergences such as tool use in crows, octopus, chimpanzees and humans raises the same challenge. I believe convergence and common ancestry can be distinguished, but it would have been helpful if the book had included examples of how this can be done.

Finally, I appreciate Haught’s attempt to counter the metaphysics of materialism in science by making subjectivity and purpose part of the fabric of cosmic reality. What we have here, in my view, is two ways of characterizing reality that are mutually exclusive. But it did not become clear to me how viewing nature as a story that is being told contributes to understanding subjectivity and purpose as cosmic realities. I take it that the answer is to be found in “theological conjecture at its own appropriate level of understanding.”