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BOOK REVIEW

Soltis D.E. & Soltis P.S. (2019)
The Great Tree of Life

xiv + 170 pp., illustrated.
London & Oxford (UK), San Diego & Cambridge (USA), Academic Press (Elsevier)
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When I received the invitation to review the above book, the ToL web project evidently came into my mind, and I looked forward to reading its history written down by two famous American botanists, Douglas Soltis and Pamela Soltis. Having the book in hands, it was obvious at first glance that this treatment of the Tree of Life is much Greater, as the title suggests. The "Tree of Life" stands as a metaphor for the relationships between organisms, and rather one can characterize the book as a thorough essay on the history, nature, development and importance of systematic and phylogenetic botany, with emphasis on trends from the last decades. Indeed, the generation of the Soltis's, to which I also belong, participated in the dramatic shift of an authoritative discipline towards a repeatable and testable scientific approach.

The book starts, after an Introduction, with a first chapter giving an historical survey of genealogical trees in ancient culture and art. Already in the Assyrian culture (6000 BP) Trees of Life are often stylistically depicted with a trunk and a crown connecting all life and mankind to heavens and underworld. The book discusses such trees in ancient Egypt and the Middle East, and focuses on the relationship of these trees with the Tree of Knowledge of Good and Evil from the bible. Trees of Life also play a role in myths elsewhere in the world, and the authors refer to the Norse Ygdrassill world tree as well as to sacred trees of native American peoples. Authors then turn to the ancient Greeks, who were at the beginning of our constructions of biological classification. They stress that the Greeks started to use a type of linear hierarchy and this way led the foundation of Linnean classification. This was given with ladder-like representations, such as Aristotle's *Scala Naturae*, with our species at the top.

Chapter 2 sketches the "history of the modern concept of the Tree of Life", starting from Darwin, Augier, Haeckel and Bessey to the Hennigian revolution. These pages explain in a simple way some principles of phylogenetic thinking, such as parsimony, but treatments of common methods (Maximum Likelihood, Bayesian Inference, Neighbor Joining) are considered to be beyond the scope of the book. I would have liked to see these topics treated in the attractive and clear language of the rest of the book. Chapter 3 continues about building the Tree of Life through a second revolution, the use of DNA sequence data, which rendered phylogeny "extremely challenging computationally." Just to quote one example of the legible and perspicacious expression, the authors here use Felsenstein's calculations demonstrating that when building a tree for 22 taxa, the number of trees approximates Avogadro's number (6.02×10^{23}): "with mere 22 taxa, there are roughly a mole of possible trees." This chapter also deals with moving from trees to graphs, and the problems of genetic material exchange by hybridization and lateral gene transfer, resulting in the need of net-like representations of phylogenetic relationships.

In the next chapters, the book turns into other aspects, first how many living species exist (chapter 4)? It tells the reader why the estimate of 2.3 million described species is only approximate: there are undiscovered synonymies, different views on species delimitations, bias on terrestrial ecosystems ... This rough number also strongly underrates the facts, and the authors here deal with "the iceberg of cryptic species" and the bacterial world, so immense that it cannot fit in our system of Linnean binomina. Challenges are discussed here. Fairly steady, around 14,000 new species are described yearly. At that rhythm, it will take at least 900 years "just to name what we think is here at our planet," and that is in strong contrast with the rapid tempo of extinction. This links with the next chapters, 5 (The value of the Tree of Life) and especially 6 (Fate of the Tree of Life).

Chapter 5 starts with quoting Dobzhansky: "Nothing makes sense except in the light of evolution." The authors survey here the importance of understanding phylogenetic relationships, and start with enumerating the unanticipated spin off of the human genome sequencing project, such as better comprehending many diseases or past human migration, as well as generating advances in DNA sequencing. Authors argue that in the same way "reconstructing the entire Tree of Life ... will ... fuel fundamental research" and allow to develop "tools to sustain biological diversity and enhance the quality of human life." Medical applications, struggling diseases, underpinning nature conservation, response to climate change, crop improvement, forensics and ecosystem services are all at the issue. Moral and ethical aspects too are

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included, such as the spiritual value of nature, and our responsibility towards biodiversity in the developing countries which have "the most to lose." That last aspect is developed in the next chapter 6 – the demise of many species, the sixth mass extinction, the immense impact of climate change on biodiversity.

Teaching the Tree (dealt with in the final chapter 7) is nowadays the common focus for instructing students about biodiversity and relationships. But it also brings the message of the connectivity of humans to nature – alike the stylistic trees in ancient cultures. Documenting and explaining the Tree of Life is, however, not easy because of its huge size and numerous branches, hard to study on a page or computer screen. Museums use solutions such as expanding by zooming on groups of interest, with addition of images of organisms to branches; fig. 7.3 shows an example at the Marston Library, University of Florida, home of the authors. OneZoom of the Tree of Life Explorer is an easily used and attractive navigation application. Other products are also discussed, e.g. Tree Tender, an animated movie, and cell phone apps such as Map of Life. With this ends a truly complete and vast survey of what biological systematics represents today and can offer to the society, in a nutshell of less than 200 pages.

Each chapter has its own extensive list of references, some with also suggestions for further reading, making the book an even more complete introduction. The two authors have a firm reputation in the world of natural history, and both have over 400 publications and wrote many books. A synthesis from their hand could only be wide and mature as in this book. Every novice in systematic biology should read this book at least three times, and every biologist should have it on his book shelf. School teachers, even at the basic school, can find here manifold inspiration to innovate their biology teaching and link it with present-day issues. But I also hope with the authors "that this book will impact not only the scientific community, but also, more importantly, the public and policy makers." The language is fluent and easy to read, and accompanied with numerous well chosen colour illustrations. This makes the content approachable to a wide audience, and one may wish indeed that the strong message of the book will even have influence on deniers of evolution or climate change.

Reading this work overwhelmingly causes a sense of urgency. But the book also is optimistic by referring to the human capacity for collaboration (p. 112): "by working together, the enormous challenges to protecting the Tree of Life can be solved. There is hope."

According to the web page of Elsevier, the published date is 19th November 2018. But the copyright mention in the printed book and on the website is dated 2019. For a paperback of some 180 pages the booklet is expensive, 42 euro with a 25% discount announced when I visited the website. Curiously the eBook version is even more expensive (with discount 48 euro). The book aims at a general audience and should therefore be better affordable.

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