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Hedges, S. B. & Kumar, S. (Eds.) (2009): The Timetree of Life. – In: Oxford Biology. – XXI +551 pp., 172 figs. (164 in col.), 78 tables; Oxford, New York (Oxford University Press), 22 x 28 cm, hardbound, ISBN 978-0-19-953503-3; € 115,- (£ 100,-; US-$ 200,-).

Genetics appears to be somewhat far from the field of palaeontology and related to only the living things. Surprisingly, the present state-of-the-art techniques are able to apply our genetic knowledge in order to reveal past worlds even better than the classical palaeontology can. Tracing the evolution back from the living organisms to their ancestors has already become a reality. A large volume edited by HEDGES & KUMAR presents us a new picture of the organic evolution. The molecular clock study based on an evaluation of a time of divergence from earlier forms involves DNA and protein sequences analysis of living organisms. Finding the last common ancestor means reaching the very root of the lineage and, meantime, a complete constraint of its phylogeny. This sounds phantastic, but this method works with more or less uncertainties. The aim of the reviewing book was to gather all available information from the molecular clock analysis of the entire life and some particular biological groups. A lot of efforts were made to provide trustable divergence times because of differences of results. Some averaging was undertaken as the best possible resolution of this uncertainty.

The volume consists of two parts. The first one, *Introduction*, provides a theoretical background of molecular clocks. This part comprises 4 papers. HEDGES & KUMAR attempt to review the state and importance of available timetrees (evolutionary trees plotted against the geologic time scale). The curves calculated on the basis of 1610 family-level lineages indicate a significant radiation of life during the past 300 myr. They also confirm a reality of the Permian/Triassic catastrophic event. But they do not indicate both the Cambrian Explosion and the Cretaceous/Paleogene extinction. The authors tend to explain the Cambrian Explosion as an artefact linked to changes in the preservation degree since the beginning of the Phanerozoic. The reviewer remains curious whether an account of already extinct lineages would affect this conclusion. Additionally, the complicated models of the Cambrian Explosion (e.g., SHU, 2008) should also be compared with the molecular clock data. AVISE continues a discussion. He explains that controversies between cladistics and phenetics as well as misunderstandings of molecular clocks restricted a use of timetrees in the past decades. Then, he demonstrates an efficacy of the molecular clock method. Particularly, an application of the latter permits to hypothesize new relationships in the evolution of ants and angiosperm plants in the Late Cretaceous. The author formulates a very challenging proposal about the utility of timetrees for a development of universal biological classifications on the basis of "temporal banding". GRADSTEIN & OGG present a paper, which reviews the present-day chronostratigraphy and the International Stratigraphic Chart (Figs. 2, 3, pp. 32-33). The longest contribution to this part of the volume is made by BENTON *et al*. After description of some fundamental principles, they propose two kind of dates for 63 divergence events. The dates of the first kind are minimal ages registered with the available palaeontological record. The dates of the second kind are soft maximums, which can be interpreted as probable times expected also palaeontology. E.g., the caniform-feliform split occurred at 39.68 Ma as a minimum or at 65.8 Ma as a maximum. The reviewer recommends to open the relevant page in the second part of this volume and to learn that molecular clock estimates the time of divergence of feliformia and caniformia from the common ancestor as 52.9 Ma.

The second part of this volume, *Timetree*, is, in fact, a kind of encyclopaedia (the editors judged it so themselves). Similarly-designed short papers deal with particular taxonomically

high-ranked (families and above) groups of organisms. Each provides a figure of timetree (or alternative timetrees) and divergence times put into a special table. Everywhere, the text is somewhat supplementary to the timetree, but it provides some basic knowledge on biological state, classification, diversity, phylogeny, and evolution of a described group. Of course, molecular clock data are always discussed in the text. Each paper contains also a little, but very nice picture of the characterized organisms. It is important that not only family-level lineages are described. There are papers, which deal with, e.g., land plants or amniotes taken in the whole. The first paper is entitled simply - *Life*. One may read that the molecular clock analysis suggests the first divergence of life occurred somewhen in the Hadean, at about 4.2 Ga. The divergence from the last common ancestor of land plants is traced back to 600 Ma. Similarly, the vertebrates diverged since 608 Ma. The origin of first mammal clades is found in the Late Triassic (220.2 Ma). The last common ancestor of primates existed at 77.5 Ma, when a divergence began. Thus, our own ancestors lived yet in the Campanian! Well, one may choose a group of organisms, which he or she is interested in, and check for its radiation timing in this volume. Even the timetree of Archaebacteria (Archaea) is not omitted and analyzed with a precision! Generally, a lot of absolute ages are available in this book and it is very enriching to explore this huge dataset. Some interesting considerations based on molecular clock results are presented too. E.g., BLAIR emphasizes that Neoproterozoic environmental perturbations evidently affected the evolution of metazoans, which radiated since 1237 Ma and survived multiple divergences within 900-600 Ma. This echoes a hypothesis linking the Neoproterozoic glaciations with the rise of metazoans (RUBAN, 2007).

This book is a complete source of new information. It provides a lot of matter for further thoughts. It lacks just one major subject. The reviewer agrees with the editors that a detailed comparison of molecular clock data with the fossil record should be out of scope of the present volume. However, one moderate to lengthy chapter, which reviews the evolution of life constrained on the basis of direct palaeontological observations is strongly necessary. This would facilitate a further justification of our image of evolution with a use of this book. Not all potential readers may be aware of details of biotic changes through geologic time. This is especially important because this book may attract an attention of specialists from biology or philosophy, who may or may not have enough knowledge on the history of life. Fortunately, references to the fossil record exist in many particular chapters, and the paper by BENTON *et al*. provides some important palaeontological data. The reviewing book impresses by both its comprehensity and design. The style of writing is everywhere clear for non-specialists in particular group of organisms, and, at the same time, it avoids any simplifications and large caveats. This is a nice example of those well-thought editions, which continue to serve well even when information from them becomes outdated. Undoubtedly, the volume edited by HEDGES & KUMAR is an exciting gift to geoscientists now, at a time of the DARWIN's 200 anniversary. The reviewer recommends this book strongly for all palaeontologists, geologists, and all other specialists interested in the evolution of the life.

References

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