

Biological Nomenclature in Perspective: Prospects for the *PhyloCode*

Review of *The Advent of PhyloCode. The Continuing Evolution of Biological Nomenclature.*

Michel Laurin. 2024. CRC Press, Taylor & Francis Group, Boca Raton, Florida, USA

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Michel Laurin has authored an excellent book on the ongoing evolution of biological nomenclature, with an emphasis on explaining phylogenetic nomenclature (PN), how the *PhyloCode* works, and how it compares with rank-based nomenclature (RN). Anyone the least bit interested in this topic—and I assume this includes everyone reading this review—should buy this book, read it, and use it as a refresher on all of the issues at the heart of the debates over how best to name taxa.

The book is unapologetically written by a proponent of phylogenetic nomenclature, with the goal of convincing people that the *PhyloCode* is preferable to the several rank-based codes that have long dominated biological nomenclature. The tone isn't emotional or dismissive or combative in the ways that some attacks on phylogenetic nomenclature have most certainly been. Instead, to Laurin's great credit, he is steadfastly level-headed and polite as he lays out compelling arguments against RN and in favor of PN.

Most importantly, Laurin does a fine job of comparing and contrasting RN and PN, repeatedly making these key distinctions:

(1) The major RN codes have considered it a virtue *not* to be tethered in any way to evolution; the idea is that, instead, they should somehow be “theory-free.” Very importantly, the taxa named under these codes have no necessary connection to the tree of life and therefore aren't necessarily monophyletic. In stark contrast, PN and the *PhyloCode* are deliberately tied to the tree of life and the rules were developed specifically for the naming of hypothesized clades.

(2) RN “aims at not delimiting taxa precisely” (p. xi), whereas PN is specifically designed for the precise delimitation of clades using several forms of phylogenetic definitions. These use “specifiers” (particular species or specimens) to variously attach names to minimum (node-based), maximum (branch-based), and apomorphy-based clades.

(3) The RN codes link the form/spelling of taxonomic names to particular hierarchical ranks, whereas in PN the spelling of names is not linked to ranks. A related set of arguments is that assigning ranks is subjective and arbitrary in every imaginable dimension. As Laurin argues, taxa of the same rank could conceivably be rendered comparable if the evolutionary process conformed to certain models. If phylogenetic trees were completely symmetrical then monophyletic taxa assigned to the same rank could be made comparable with respect to the number of included lineages. If rates of phenotypic divergence were basically even across the tree, then they could be made comparable in terms of the degree of phenotypic similarity. And, if cladogenesis took place more or less simultaneously at several distinct time periods during the evolution of particular clades, then rank assignments might be rendered comparable based on absolute age of origin (as proposed, in fact, by Hennig, 1966). As evidenced by the vast phylogenetic literature of the past several decades, the first two models don't seem to hold in real trees. There might be more hope for age of origin as a ranking criterion, at least in some groups during some time periods. But age inferences in many groups (which are themselves often problematical) show only limited clumping in times of origin, and more continuous variation may simply require too many ranks to be tenable.

Laurin goes on to link each of these differences to their downstream consequences. Thus, for example, tying names to ranks has led frequently to name changes (sometimes a cascade of name changes) without any underly-

ing change in what we understand about relationships, but instead just because taxonomists differ in the ranks they wish to assign. Creating the large number of new ranks that would be necessary to adequately classify the entire tree of life would only lead to more rank reshuffling and arbitrary name changes. And, with respect to the study of biodiversity, ranks have encouraged a variety of misuses: for example, tallying up taxa of the same rank as though they are equivalent, when they clearly are not.

These arguments will be very familiar to those who have followed debates over the best approach to nomenclature. However, it is really helpful to have them clearly articulated in one place and repeated in slightly different forms and contexts in nearly every chapter of the book. In the end, there's simply no way that readers can miss the huge and highly consequential differences between RN and PN.

One of the hallmarks of this book is its deep scholarship. Laurin has read and digested an enormous literature—some of it quite obscure and legalistic. Throughout the text he quotes extensively from the primary literature, sometimes reproducing long passages just to be sure to properly capture the context of a statement. Historical analyses abound in every chapter, but especially in his coverage of the centuries leading up to the development of the RN codes. I especially enjoyed the extended discussions of Aristotle and his followers, the renaissance period, Linnaeus and his contemporaries, and the critical role that Lamarck played in early evolutionary thinking.

Laurin also does a very thorough job of describing and comparing the key elements of the several RN codes that are currently used by different communities: the zoological code, the botanical code (which also covers algae and fungi), the code for cultivated plants, the prokaryotic code, and the code for viruses, and even the abandoned Draft *BioCode* that aimed to develop a universal set of RN rules. Most systematists will be reasonably familiar with one of these codes, but almost none of us are conversant with all of them. Therefore, it is so valuable to have the history of each one of these codes described, and to have their similarities, differences, and special attributes clearly explained.

Laurin's scholarship is also on display in his deep dive into folk taxonomies. Anthropologist Brent Berlin and colleagues argued that hierarchy and categorical ranks may be universal features of the independently developed taxonomic systems of indigenous peoples around the globe. Laurin argues that folk taxonomies are highly variable and difficult to interpret, and that strict hierarchy and ranks may not be ubiquitous after all.

Laurin explores in considerable detail the sorts of nomenclatural systems that have been developed in other disciplines, such as stratigraphy, geography, chemistry, and physics. Being unfamiliar with these systems, I found this section dense but fascinating. In the end, though, as with folk taxonomies, there is not a great deal that can be gained from such comparisons, although Laurin does glean the following: “. . . RN appears to be fairly isolated in being designed to deliberately not delimit taxa. The emergence of PN appears to reflect the general trend observed in other fields of human knowledge . . . toward more precise delimitation over time.” (p. 167).

Having highlighted some of the great strengths of this book, I turn now to a few friendly criticisms. The first of these concerns the intended audience. Laurin states at the outset that his book “is aimed at university students who have had at least one year of biology instruction, graduate students and practicing biologists” (p. ix). I fear that in quite a few places he has greatly overestimated the knowledge of his readers. For example, what am I, as a botanist, to make of passages like this one: “Osborn . . . included in *Synapsida* the cotylosaurs (diadectomorphs, which are currently considered the sister group of amniotes, along with procolophonoids and pareiasaurs, now considered parareptiles), “Anomodontia” in which he placed taxa now considered to be therapsids (cynodonts and dicynodonts), turtles and sauropterygians (placodonts and plesiosaurs).” (p. 144). Of all of those names, the only ones I recognize are “amniotes” and “turtles”. This problem might have been remedied by including more tree diagrams or illustrations of organisms and focal traits (which are both rather few and far between). And, more examples from outside of vertebrate biology (Laurin's expertise) would help to engage a broader audience.

Although the book is about “how biologists name taxonomic groups of organisms and the codes that regulate how to form and use these names” (p. ix), Laurin spends considerable time explaining aspects of evolutionary (including systematic) biology. While evolution is surely relevant, I felt a bit of mission-creep here, with too much detail on certain topics that have occupied the systematics community but are not highly relevant to the RN-PN comparison (e.g., whether to order multistate characters). In the end I felt that Laurin's somewhat idiosyncratic synopsis of phylogenetics could have been cut way back with a statement and references along the lines of “let us take for granted that we are getting better and better at confidently inferring phylogenetic relationships.”

There is also an issue of balance in some spots. For example, in my opinion Laurin pays too much attention to rather inconsequential proposals, such as the “Duplostensional Nomenclatural System”, and too little attention to

some of the important details of the harsh criticisms that have been leveled at PN. For example, I was disappointed that Laurin did not consider in sufficient detail the arguments made by Norman Platnick about the information content of classifications (e.g., Platnick, 2009, 2012). To my mind, these were some of the most credible and potentially devastating arguments against PN. Detailed responses to Platnick were published not long after they appeared (e.g., de Queiroz and Donoghue, 2011, 2013), but most of the counterarguments are barely mentioned by Laurin.

There were some other missed opportunities. For example, with phylogenetic definitions computers can communicate with one another about, for example, how changes in knowledge of relationships influence the hypothesized composition of the clade designated by a phylogenetically defined name. In turn, this opens the possibility (mentioned only in passing) for the automated updating of classifications as additional species are included in analyses. And, despite the fact that the mandatory registration of names is a big difference between the *PhyloCode* and some of the major RN codes, the RegNum database (<https://www.phyloregnum.org>) is barely mentioned. Likewise, although Laurin highlights that life may be more of a web than a tree in some major groups of organisms (e.g., bacteria), he provides no worked examples of how reticulation could be handled under PN. As a botanist, I think the book would have benefited from more attention to this critical topic.

The very short final chapter of the book concerns the future, and ends with this question: “Will PN prevail, and if so, how long will it take to become the mainstream biological nomenclature?” (p. 199). Laurin is clearly optimistic that the arguments against RN and in favor of PN are so strong that PN will eventually prevail. While I agree absolutely about the quality of the arguments (PN is a clear winner from a logical standpoint), I think Laurin is too sanguine in his projection. In science, I think the truth inevitably wins out, although this can take a very long time. But nomenclature is in large part a political issue (though, as noted above, not entirely; i.e., fundamental decisions do have to be made about whether/how nomenclature relates to evolution), and in politics there is no guarantee that good ideas will prevail (even democracy, it now appears!). This is especially true in the case of nomenclature, where there has been so much investment in the RN codes and consequently there is so much inertia.

However, there is another problem in this case, and it is one that I think Laurin glosses over. There was a long lag-time between the initial development of PN starting in 1990 (de Queiroz and Gauthier, 1990), the emergence of the first draft of the *PhyloCode* in 2000, and the 2020 publication of both the *PhyloCode* (Cantino and de Queiroz, 2020) and the accompanying *Phylonyms* (de Queiroz *et al.*, 2020). My sense is that over those several decades some of the initial positive energy surrounding PN has dissipated. Of course, as Laurin’s historical analysis of the RN codes makes clear, it takes a long time to develop a comprehensive code of nomenclature, and an even longer time for it to be embraced by the taxonomic community. And, in our particular era it might be expected to take even longer as interest and training in nomenclature has clearly waned, perhaps especially so in the critical phylogenetics community. It was a very good idea to start formal phylogenetic nomenclature with a set of carefully-vetted names, and the monumental *Phylonyms* volume was a huge step forward, especially as its 285 contributions engaged a large number of systematists with expertise scattered across the tree of life. In some research communities PN has definitely caught on, especially in Laurin’s field of vertebrate paleontology. But, overall, the uptake has been spotty.

Looking to the future, we need to find ways to spread the word about the logic and benefits of PN and to build back the momentum. One idea would be to promote phylogenetic name-athons (cf. hackathons in software development circles) at the annual meetings of our various taxon-focused scientific societies. We also need to continue to streamline the naming process, making it as easy as possible to publish and to officially register names as we stare down the biodiversity crisis. In this effort, it doesn’t help that by now many of the initial proponents of PN are retired or approaching retirement. Younger systematists need to see that PN is alive and well and to experience for themselves the power of phylogenetic nomenclature. Laurin’s book provides a wonderful starting point for that engagement, but it is clear that we still have a long way to go before PN prevails.

In the end, despite my minor quibbles, we owe a huge debt of gratitude to Michel Laurin for the tremendous effort he put into this project, and for the great light that he has shed on these truly fundamental issues.

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