

The new system of “phyletic states” of groups of organisms: the situation is a bit interesting and complicated than it seems

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Abstract

The current system of “phyletic states” (holo-/monophyly, paraphyly, and polyphyly as they are currently defined) is not adapted for the impossibility of classifying unknown organisms (unknown ancestors included). There are longstanding confusion and controversy regarding the “phyletic states”. Here was published the introductory part on the new phyletic terminology, which is used in my larger work in preparation. In this part, the explanations of the new system of phyletic states and the corresponding system of phyletic terms are given. The intersection of four basic “phyly” (*enophyly*, *merophyly*, *kollitophyly*, and *schizophyly*) results in the unambiguous triad of *holophyly*, *paraphyly*, and *schizophyly*. The definitions of the terms in this triad are believed to be unambiguous unlike the widespread definitions of holo-(mono-), para- and “polyphyly”. Here, many terms were defined using others in order not to make the definitions too cumbersome. Nevertheless, it is not only a possible application of these terms. The “primary” phyly seem not less useful in phylogenetic discussions than the phyly of the triad. So also is the terms *inprestor*, *rendestor*, *ancessure*, *drade* and *skade* as well as the more precisely defined term *clade*. A review on already existing systems was not the purpose of this work and, probably, such a review could confuse the reader regarding the terms and their definitions.

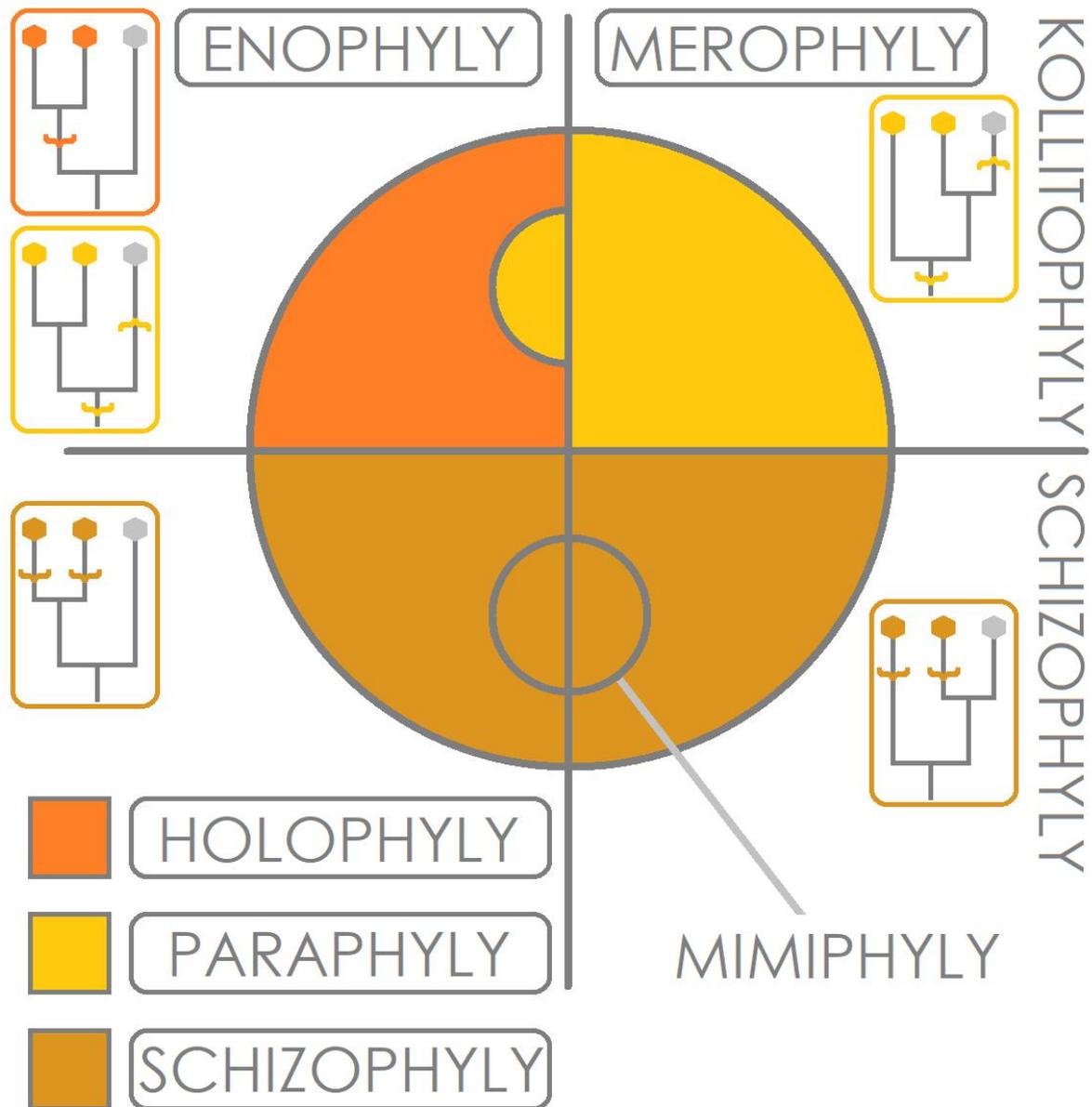
Keywords: *systematics; phylogenetics; taxonomy; rendestor; ancessure; enophyletic; merophyletic; kollitophyletic; schizophyletic; holophyletic; paraphyletic; drade; clade; skade; cladism.*

Introduction

In natural sciences, the key criterion for proving the existence of an object (like a subatomic particle of a previously unknown kind or an atom of a previously unknown element in physics; an organism of a previously unknown species in biology) is its empirical observation and/or observation of traces of the existence of this object (radiation, remains of vital activity, paw prints, *etc.*). Only objects that meet this criterion can be classified (*e.g.* entered in the periodic table of elements or described as a species).

A remarkable feature of biological systematics and phylogenetics is that known descendants inevitably imply the existence of their ancestors, even if the latter are unknown. But this is not enough to “establish the identity” of each of unknown ancestors. This can be compared to the following situation. If the existence of some secret illegal organisation with a leadership management system is proven, then it certainly has a leader. However, this data is not enough to bring any person to trial. Despite all this, non-classification of unknown organisms contradicts the current system of phyletic states and creates confusions in it.

Hennig (1950; 1966) was probably aware that only known organisms could be classified. At the same time, he considered the probability of finding an ancestor of any group so low that he did not stipulate the ancestors in any way in his definitions of phyletic terms. For example, his monophyletic group was defined as “all descendants of one ancestor”. The ancestor *de facto* is excluded from the group. This theoretical inaccuracy led to the rapid inclusion of the common ancestor by other authors in the definitions of the three phyly, the direct and unconditional inclusion. This lack of distinction between known and unknown organisms has led to confusion among taxonomists (see Podani, 2010 for review). Probably, both of the main types of the vision of phylogenetic trees shown by Podani (2010) are not completely correct (compare Fig. 1 in Podani, 2010 and Fig. 1 here) and the consensus seems possible and necessary. Here, the differentiation regarding known and



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FIGURE 2. The diagram of the relationships of “phyly” among themselves. Coloured hexagons represent known group members. Grey hexagons represent the known organisms outside the group. The groups: on all three trees on the left are enophyletic; on all two trees on the right are merophyletic; on all three trees above are kollitophyletic; on all two trees below are schizophyletic. The colour of the hexagons and borders around each tree matches the colour of the segment of the vertical half of the diagram.

The main part

PHYLA (/ˈfaɪlə/; from Greek *φῦλον* [*phylon*] - tribe) — the ancestor plus all its descendants, or the group of a sole member having no descendants.

ENOPHYLETIC group (/ɛnə(ʊ)faɪ'letɪk/; from Greek *ενότητα* [*enótita*] - unity) — a set of known organisms, for which at least one phyla exists, all known members of which they are.

MEROPHYLETIC group (/mɪrə(ʊ)faɪ'letɪk/; from Greek *μέρος* [*méros*] - part, portion) — a set of known organisms, which have at least one common ancestor, and for which no phyla exists, all known members of which they are.

POLYPHYLETIC group (/pɒlɪfaɪ'letɪk/; from Greek *πολύς* [*polús*] - many, much) — a set of known organisms, which have no common ancestor; descendants of different ancestors (an exclusively theoretical concept in the present state of knowledge of life in the universe).

INPRESTOR of the group (/ɪnpɹɛstə/ from *in*; Greek *πρώτα* [*próta*] - first; and *ancestor*) — the first in history common ancestor of all known members of the group, which [the ancestor] is able to be included (or is included) in the given group.

Note 1. There is the logical issue with the word “progenitor” without adding “of the known members”. The progenitor of the group can not be a member of the group. Therefore, it also should *be unable to be included* in the group. The phrase “My granny is the progenitor of my granny, my mother and me” is not correct.

The inprestor is not always the same thing as the:

RENDESTOR of the group (/rɒndɛstə/; portmanteau from Fr. *rendezvous* - a meeting at an agreed time and place - and Eng. *ancestor*) — last common ancestor of all known members of the group except this ancestor itself if this ancestor is known.

Note 2. There is the logical issue with the wording “last common ancestor” without adding “of the known members”. The ancestor of the group can not be a member of the group. Therefore, it also should *be unable to be included* in the group. The phrase “My granny is the ancestor of my granny, my mother and me” is not correct. The last common ancestor of Eukaryotes can not have a nucleus. Otherwise, it will be one of the eukaryotes but not their ancestor. The same is with the terms “concestor” (simple contraction from “common ancestor” coined by Nicky Warren and popularised by Dawkins (2004); see p. 7 in *op. cit.*) and “cenancestor” (originally coined by Fitch & Upper (1987) for universal rendestor). This issue and the cumbersomeness of the wording “the last common ancestor of the known members of the [X]” as well as un-pronounceability of possible abbreviation LCAKM were the reasons for the more short term.

As the reader could see, the basic criterion, which gives us eno- and merophyly, are not dealing with unknown organisms, including unknown ancestors. The latter are matter that cannot be completely divided into discrete units (*e.g.* could not be divided into a number of species). Although inside it some members can be distinguished (such as the rendestor, the inprestor of a feature-based group (*e.g.* apomorphy-gainer), the inprestor of a max-clade). As in other cases the lineages of unknown ancestors can not be divided into discrete units and in each given moment of the time appear to humanity as solid functional units with the rendestor/inprestor, the common term seems highly suitable.

ANCESSURE (/ansɛs'ʃʊə/; portmanteau from *ancestor* and *commisure*) — the inprestor of the given set of organisms (the group) plus all inprestor's descendants, which also are ancestors of known members of the given group.

Note 3. The word “commisure” was not used directly because, for example, the ancessure plus all members of the drade (see below) do not always represent the minimum clade, *i.e.* it can contain “a tail” to the inprestor when the group have a definition other than that of min-clade or simple listing of the members (see Fig. 2). An *ancessure* is about both known and/or unknown organisms.

Using the term *ancessure*, it is possible to define the second basic dichotomy of the phyletic states.

KOLLITOPHYLETIC group (/kəlɪtə(ʊ)faɪ'letɪk/; from Greek κολλητός [*kollitós*] - glued)— a group of known organisms, which is able to include all members of its ancessure (according to the definition of the group).

SCHIZOPHYLETIC group (/skɪtsə(ʊ)faɪ'letɪk/; from Greek σχίζω [*skhízō*] - splitted) — a group of known organisms, which is unable to include all members of its ancessure (according to the definition of the group).

Note 4. Kollitophyletic groups are always able to include the rendestor (as it is always the part of ancessure) and have an inprestor. Schizophyletic groups are unable to include the rendestor and have no single inprestor, although their parts have their own inprestors.

Having the two basic phyletic dichotomies it is finally possible to define the diade of phyletic variants emerging at the intersection of eno-/merophyly and kollitophyly (see Fig. 2). It is holophyly and paraphyly:

HOLOPHYLETIC group (/hɒlə(ʊ)faɪ'letɪk/ from Greek ὅλος [*hólos*] - whole)— an enophyletic and at the same time kollitophyletic group, the ancessure of which did not give rise to any known organism outside the group.

PARAPHYLETIC group (/pɛɪə(ʊ)faɪ'letɪk/; from Greek παρά [*pará*] - beside, near, alongside) — a kollitophyletic group, the ancessure of which gave rise to a known organism(s) outside the group.

Note 5. The term *holophyly* was preferred here, because of the large number of meanings of the term *monophyly*, both definitional and etymological. Evolutionary taxonomists used it in the same sense as kollitophyly. Phylogenetic taxonomists used it in the stricter sense, the same as holophyly. As there was no differentiation between known and unknown organisms relatively to the phyletic terms before, the additional confusion arose. This confusion allows the term *monophyly* to be treated as a synonym of enophyly or to cover both eno- and merophyly. It is quite attractive to treat monophyly in the latter sense (“descendants of one ancestor”) as opposite to polyphyly, although it extremely reduces the term’s usefulness. Haeckel (1866), who introduced the terms *monophyly* and *polyphyly*, also used them as antonyms and, notably, did not reject the possibility of multiple origins of life (see Dayrat, 2003 for review). In such views the terms *polyphyly*, as it was defined here, and *monophyly* as its antonym were applicable.

The distinct entities of enophyletic and holophyletic groups raise the question of to what kind of groups the term *clade* should be ascribed. Although merophyletic groups now are not generally considered clades, there are still three options left of what the clade can be considered: 1) enophyletic groups, 2) para-enophyletic groups or 3) holophyletic groups (see Fig. 2). As the etymology of the term *clade* (from Greek κλάδος [*kládos*] - shoot, branch) minds the inclusion of the ancessure, here the term *clade* was applied only to holophyletic groups as they were defined here.

Such an interpretation of the term *clade* borrows the issue with the groups formed by a simple listing of their members or subgroups. Such groups are unable to include their ancessures. For example, the wordings “Sar+Telonemia clade” or “Telonemia formed the clade with Sar” or “TSAR clade” will not be correct since the ancessure is not fully included here (see Strassert *et al.*, 2019 for phylogeny). For such purposes, the short term for “*enophyletic group*” seems needed.

DRADE /dɹeɪd/— an enophyletic group (from the two first letters of the semantic core in *L. polydrupa* - the type of fruit to which raspberries belong, bramble fruit; the type of aggregate fruit easily separable from the receptacle) and the ending *-ade*, like in the terms grade and clade).

CLADE /kleɪd/— a holophyletic group (from Greek κλάδος [*kládos*] - shoot, branch).

Note 6. Clade definitions that do not use the separation of known and unknown organisms do not allow the clade to be completely divided into subclades—at least the rendestor will remain. This has been emphasised, for example, by Cavalier-Smith (1998 p. 211). Such definitions of the clade contradict the very essence of cladistic systematics. Cladistic systematics is the drive to constantly reduce non-holophyletic groups to only unknown organisms. However, such a definition of the clade (like the one given here for the phyla) is widespread and adopted, for example, by the *PhyloCode*

(Article 2.1). Regardless of how acceptable we think paraphyletic groups are, cladism is possible in the views adopted here (and possibly only in these) and paraphyletic groups can be reduced to cases with known ancestors.

The short term for paraphyletic groups also seems necessary there. The term [evolutionary] *grade* does not mean “a paraphyletic group”. Grades can be holophyletic and schizophyletic as these terms were defined here (see Huxley, 1957; 1958; 1959).

SKADE /skeid/— a paraphyletic group (from Greek *σκαλών* [*skalón*] - flight of stairs).

Origins of the terms

The number of terms used here was introduced by other authors with the different definitions and/ or application.

The terms *monophyly/monophyletic* and *polyphyly/polyphyletic* are originated from Haeckel (1866).

The terms *paraphyly/paraphyletic* are originated from Hennig (1950; 1966).

The terms *holophyly/holophyletic* are originated from Ashlock (1971).

The terms *merophyly/merophyletic* are originated from Bernardi (1981).

The term *clade* is originated from Cuénot (1940).

The terms *enophyly/enophyletic*, *kollitophyly/kollitophyletic*, *schizophyly/schizophyletic*, *drade*, *skade*, *inprestor*, *rendestor*, and *ancessure* are believed by me to be new.

References

- HENNIG, W. (1950). *Grundzüge einer Theorie der Phylogenetischen Systematik*. Deutscher Zentralverlag, Berlin.
- HENNIG, W. (1966). *Phylogenetic systematics*. University of Illinois Press, Urbana.
- PODANI, J. (2010). Monophyly and paraphyly: A discourse without end? *Taxon* **59** (4), 1011–1015.
- DAWKINS, R. (2004). *The Ancestor's Tale: A Pilgrimage to the Dawn of Life*. Boston: Houghton Mifflin.
- FITCH, W. M. & UPPER, K. (1987). The phylogeny of tRNA sequences provides evidence for ambiguity reduction in the origin of the genetic code. *Cold Spring Harbor Symposia on Quantitative Biology* **52**, 759–767.
- HAECKEL, E. (1866). *Generelle Morphologie der Organismen: Allgemeine Grundzüge der organischen Formen-Wissenschaft, mechanisch begründet durch die von Charles Darwin reformirte Descendenz-Theorie*. Verlag von G. Reimer, Berlin.
- DAYRAT, B. (2003). The roots of phylogeny: How did Haeckel build his trees? *Systematic Biology* **52**, 515–527.
- STRASSERT, J. F. H., JAMY, M., MYLNIKOV, A. P., TIKHONENKOV, D. V. & BURKI, F. (2019). New Phylogenomic Analysis of the Enigmatic Phylum Telonemia Further Resolves the Eukaryote Tree of Life. *Molecular Biology & Evolution* **36** (4), 757–765.
- CAVALIER-SMITH, T. (1998). A revised six-kingdom system of life. *Biological Reviews* **73**, 203–266.
- DE QUEIROZ, K. & CANTINO, P. D. (2020). *International Code of Phylogenetic Nomenclature (PhyloCode)*. CRS Press.
- HUXLEY, J. S. (1957). The three types of evolutionary process. *Nature* **180**, 454–455.
- HUXLEY, J. S. (1958). *Evolutionary processes and taxonomy with special reference to grades*. pp. 21–39, in O. Hedberg (ed). *Systematics Today*. Uppsala Universitets Arsskrift, Sweden.
- HUXLEY, J. S. (1959). *Clades and grades*. pp. 21–22, in A.J. Cain (ed). *Function and Taxonomic Importance*. The Systematics Association, London.
- ASHLOCK, P. D. (1971). Monophyly and Associated Terms, *Systematic Biology* **20** (1), 63–69.
- BERNARDI, N. (1981). Parentesco filogenético, grupo monofilético e conceitos correlatos: novas definições. *Revista Brasileira de Entomologia* **25** (4), 323–326.
- CUÉNOT, L. (1940). Remarques sur un essai d'arbre généalogique du règne animal. *Comptes rendus hebdomadaires des séances de l'Académie des sciences* **210**, 23–27.