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Judicial Opinion 128

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Abstract

Judicial Opinion 128 addresses nomenclatural issues related to the names of classes validly published under the International Code of Nomenclature of Prokaryotes. It is confirmed that the common ending *-proteobacteria* of some class names is not indicative of a joint taxonomic or phylogenetic placement; that the nomenclatural type of *Mollicutes* Edward and Freundt 1967 (Approved Lists 1980) is *Mycoplasmatales* Freundt 1955 (Approved Lists 1980); and that the placement of a name on the list of rejected names does not imply that another name with the same spelling but a distinct rank is also placed on that list. The names at the rank of class *Anoxyphotobacteria* (Gibbons and Murray 1978) Murray 1988, *Archaeobacteria* Murray 1988, *Bacteria* Haeckel 1894 (Approved Lists 1980), *Firmibacteria* Murray 1988, *Microtatobiotes* Philip 1956 (Approved Lists 1980), *Oxyphotobacteria* (ex Gibbons and Murray 1978) Murray 1988, *Photobacteria* Gibbons and Murray 1978 (Approved Lists 1980), *Proteobacteria* Stackebrandt *et al*. 1988, *Schizomycetes* Nägeli 1857 (Approved Lists 1980), *Scotobacteria* Gibbons and Murray 1978 (Approved Lists 1980) are placed on the list of rejected names. For three common nominative singular suffixes of genus names their genitive singular and nominative plural forms are confirmed: *-bacter* (*-bacteris*, *-bacteres*); *-fex* (*-ficis*, *-fices*); and *-genes* (*-genis*, *-genes*). The class names *Aquificae* Reysenbach 2002, *Chrysiogenetes* Garrity and Holt 2002, *Chthonomonadetes* Lee *et al*. 2011, *Gemmatimonadetes* Zhang *et al*. 2003, *Opitutae* Choo *et al*. 2007 and *Verrucomicrobiae* Hedlund *et al*. 1998 are orthographically corrected to *Aquificia*, *Chrysiogenia*, *Chthonomonadia*, *Gemmatimonadia*, *Opitutia* and *Verrucomicrobiia*, respectively.

INTRODUCTION

The Request for an Opinion by Göker [1] covers various issues of nomenclature related to names of classes validly published under the ICNP, the International Code of Nomenclature of Prokaryotes [2, 3]. Names of classes were already treated in recently published Judicial Opinions, namely Opinions 116 and 119 [4]. The author of the Request [1] submitted a further inquiry by referring to the more recent decision of the ICSP, the International Committee on Systematics of Prokaryotes [5], to make Rule 8 non-retroactive. Rule 8 indicates that the name of a class must be formed from the stem of the name of the type genus of the type order of the class, followed by the category-specific suffix *-ia*, but the Rule now enforces this scheme only for names validly published after 2011. Names not formed in that manner but validly published before 2012 can no longer be regarded as illegitimate for this reason. The implemented wording of the ICNP largely followed a suggestion by Tindall [6].

Göker [1] noted that while such older names of classes do not contravene Rule 8 anymore, they may contravene other Rules of the ICNP and thus may still be illegitimate. The Request for an Opinion also emphasized that the restored legitimacy

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Abbreviations: ICNP, International Code of Nomenclature of Prokaryotes; ICSP, International Committee on Systematics of Prokaryotes.

of a certain class name may cause the illegitimacy of another class name. Moreover, Göker [1] reiterated that the lack of a nomenclatural type of a class would mean that the name of the class is illegitimate and that the remaining uncertainties in this regard should be solved. The Request for an Opinion also called for a clarification regarding the taxonomic implications of some class names that might be considered to imply a certain taxonomic or phylogenetic placement. Perhaps more importantly, it was suggested to place some names of classes on the list of rejected names [1].

The other part of the Request for an Opinion [1] was devoted to the orthographical correctness of the names of classes validly published before 2012. The Request noted that Rule 8 does not provide much information for the orthography of these names. Principle 3, Rule 6 and Rule 8 of the ICNP [2, 3] imply that names of classes are to be treated as Latin while Rule 57a stipulates that their orthography should be correct. An ICSP decision in 2022 caused the last sentence of the Note to Rule 61 to be deleted, as proposed in 2016 [7]. The decision literally reversed an earlier ruling of the ICSP [8], which had the explicit purpose of more severely restricting corrections to defined cases. Now Rule 61 argues against an orthographical correction only 'if the change affects the first syllable and, above all, the first letter of the name or epithet'. This reiterates the need for determining the orthographically correct spelling of names of classes, which was already emphasized in Judicial Opinion 116 [4]. Göker [1] attempted to identify the scheme according to which most names of classes validly published before 2012 were formed and suggested to orthographically correct all names that deviate from that scheme.

The ten separate requests to the Judicial Commission made by Göker [1] comprise five devoted to orthographical correctness of class names and five devoted to the status of class names under the ICNP. The latter will be treated first.

LEGITIMACY AND REJECTION OF NAMES OF CLASSES

The Request for an Opinion [1] claimed that two validly published and legitimate names of classes became illegitimate when Rule 8 was made non-retroactive: *Actinomycetia* Salam *et al.* 2020 [9] and *Myxococcia* Waite *et al.* 2020 [10]; another name remained illegitimate: *Actinobacteria* Stackebrandt *et al.* 1997 [11]. The Judicial Commission agrees with this merely descriptive assessment. Comments on *Actinobacteria* and *Actinomycetia* were made in Opinion 119 [4].

Göker [1] further noted that this implies that *Deltaproteobacteria* may need to be treated as class within *Myxococcota* Waite *et al.* 2021 [12], depending on taxonomic opinion [10]. The Request for an Opinion [1] raised the question whether many users of taxon names may erroneously believe that the common ending *-proteobacteria* of the names *Alphaproteobacteria* Garrity *et al.* 2006 [13], *Betaproteobacteria* Garrity *et al.* 2006 [14], *Deltaproteobacteria* Kuever *et al.* 2006 [15], *Epsilonproteobacteria* Garrity *et al.* 2006 [16] and *Gammaproteobacteria* Garrity *et al.* 2005 [17] indicated a common taxonomic or phylogenetic placement of these classes. The Judicial Commission was thus requested to clarify that the names should not be treated as being indicative of a joint placement.

This conclusion can indeed by based on Principle 4, General Consideration 4, Principle 1(4) and Principle 1(1) of the ICNP [2, 3]. The Judicial Commission thus confirms that the common ending *-proteobacteria* of the names of the classes *Alphaproteobacteria* Garrity *et al.* 2006, *Betaproteobacteria* Garrity *et al.* 2006, *Deltaproteobacteria* Kuever *et al.* 2006, *Epsilonproteobacteria* Garrity *et al.* 2006 and *Gammaproteobacteria* Garrity *et al.* 2005 is not to be treated as being indicative of the taxonomic or phylogenetic placement of these classes. Eleven commissioners agreed with this result while one commissioner did not participate in the ballot.

The Judicial Commission was also requested [1] to confirm that the nomenclatural type of *Mollicutes* Edward and Freundt 1967 (Approved Lists 1980) is *Mycoplasmatales* Freundt 1955 (Approved Lists 1980). The Judicial Commission noted that the absence of a type would make the name illegitimate and that the information provided for *Mollicutes* Edward and Freundt 1967 (Approved Lists 1980) [18, 19] indicates that *Mycoplasmatales* Freundt 1955 (Approved Lists 1980) [19, 20] is the nomenclatural type by monotypy. Rule 22 [2, 3] stipulates that the type 'of a taxon higher than order is one of the contained orders, and if there is only one order this becomes the type.' At the time of valid publication of *Mollicutes* Edward and Freundt 1967 (Approved Lists 1980), only one order was contained in the class, which had a validly published name. Eleven commissioners agreed with confirming *Mycoplasmatales* Freundt 1955 (Approved Lists 1980) as the type of *Mollicutes* Edward and Freundt 1967 (Approved Lists 1980) while one commissioner did not participate in the ballot.

Göker [1] also requested the placement of a number of class names on the list of rejected names [2, 3]. The reasons given for rejecting these names [1] are summarized in Table 1.

In the case of a missing nomenclatural type, the Judicial Commission could assign one to each of these names based on Rule 22 [2, 3]. However, the Judicial Commission agrees with the Request [1] that this might cause other, better-known names of classes to become illegitimate according to Rules 51b and 55 or at least to become later heterotypic synonyms. In contrast, the class names listed in Table 1 were hardly in use. The lack of a nomenclatural type for some of these names renders them *nomina dubia* according to Rule 56a(2), i.e. names whose application is uncertain [2, 3]. The reasons for also regarding names as *nomina ambigua* according to Rule 56a(1) are provided in Table 1. The counterparts of *Bacteria* Haeckel 1894 (Approved Lists 1980)

Table 1. Names of classes requested to be placed on the list of rejected names [1] and potential reasons for doing so

The term 'misfitting megaclassification' is not used in the ICNP [2, 3] or in previous Judicial Opinions. The term refers to the supplement to Opinion 79 [25], which rejected names that were part of a comprehensive prokaryotic classification scheme which also contained names that contravened the ICNP [1].

Name	Problems	Rationale
Anoxyphotobacteria (Gibbons and Murray 1978) Murray 1988 [26, 30]	Rank elevation of not validly published name; part of problematic comprehensive classification scheme	Part of 'misfitting megaclassification' (supplement to Opinion 79) [25]
Archaeobacteria Murray 1988 [26, 30]	Reduction in rank of not validly published name; part of problematic comprehensive classification scheme	Part of 'misfitting megaclassification' (supplement to Opinion 79) [25]
Bacteria Haeckel 1894 (Approved Lists 1980) [19, 21]	No nomenclatural type; mostly used at rank of domain, which is not covered by the ICNP	*Nomen dubium et ambiguum* (Rule 56a) [2, 3]
Firmibacteria Murray 1988 [26, 30]	No intrinsic problems but part of problematic comprehensive classification scheme	Part of 'misfitting megaclassification' (supplement to Opinion 79) [25]
Microtatobiotes Philip 1956 (Approved Lists 1980) [19, 47]	No nomenclatural type; includes viruses	*Nomen dubium et ambiguum* (Rule 56a, General Consideration 5) [2, 3]
Oxyphotobacteria (*ex* Gibbons and Murray 1978) Murray 1988 [26, 30]	Name of nomenclatural type not validly published; rank elevation of not validly published name; replacement of *Photobacteria* Gibbons and Murray 1978 (Approved Lists 1980)	*Nomen dubium* (Rule 56a); part of 'misfitting megaclassification' (supplement to Opinion 79) [25]
Photobacteria Gibbons and Murray 1978 (Approved Lists 1980) [19, 29]	Subclass as nomenclatural type; name of nomenclatural type not validly published	*Nomen dubium* (Rule 56a) [2, 3]; part of 'misfitting megaclassification' (supplement to Opinion 79) [25]
Proteobacteria Stackebrandt *et al.* 1988 [22]	No nomenclatural type; mostly used at rank of phylum	*Nomen dubium et ambiguum* (Rule 56a) [2, 3]
Schizomycetes Nägeli 1857 (Approved Lists 1980) [19, 48]	No nomenclatural type; includes fungi	*Nomen dubium et ambiguum* (Rule 56a, General Consideration 5) [2, 3]
Scotobacteria Gibbons and Murray 1978 (Approved Lists 1980) [19, 29]	No nomenclatural type; *Schizomycetes* Nägeli 1857 [48] or *Bacteria* Haeckel 1894 [21] to be used instead	*Nomen dubium* (Rule 56a); part of 'misfitting megaclassification' (supplement to Opinion 79) [25]

[21] and *Proteobacteria* Stackebrandt *et al.* 1988 [22] at the ranks of domain and phylum, respectively, are not validly published [23, 24], but the usage of the two class names might well cause confusion.

The request to reject some of the names is based on the Supplement to Opinion 79 [25]. In addition to the issues listed in Table 1, another problem of Murray's 1984 classification [26] is that '*Thallobacteria*' did not also become validly published [1]. The Judicial Commission agrees with the interpretation of the Supplement to Opinion 79 [25] by Göker [1], i.e. that it also rejected names that were not intrinsically problematic in terms of nomenclature but were part of a comprehensive classification scheme covering all prokaryotes and including other names that contravened at least one Rule.

The Judicial Commission emphasizes that the rejection of those names was not due to conflicting taxonomic views. The ICNP does not rule on taxonomy [2, 3], and neither does the commission [4, 5, 27, 28]. For this reason, the probably reasonable assumption that most contemporary taxonomists would not agree with the classification proposed by Gibbons and Murray [29] or the one proposed by Murray [26] must not be used to argue for the rejection of the names included in these classifications. Likewise, the mere fact that some of those names are earlier synonyms of more widely known names of classes cannot be used as argument for their rejection.

However, practical problems related to names listed in Table 1 are related to more well-known but conflicting names, which contravene Rules 51b and 55 [1]:

- Instead of *Alphaproteobacteria* Garrity *et al.* 2006 [13], *Anoxyphotobacteria* Murray 1988 [26, 30] should have been used for the class including *Rhodospirillales*.
- Instead of *Bacilli* Ludwig *et al.* 2010 [31], *Firmibacteria* Murray 1988 [26, 30] should have been used; the names are homotypic synonyms with *Bacillales* as the type order.
- Instead of *Methanobacteria* Boone 2002 [32], *Archaeobacteria* Murray 1988 [26, 30] should have been used; the names are homotypic synonyms with *Methanobacteriales* as the type order.

Thus, the Judicial Commission agrees with the Request [1] that the rejection of the names listed in Table 1 would also remove a situation in which widely used names would need to be replaced by hardly known ones, although this cannot be a reason for rejection. The Judicial Commission agrees with the Request [1] that, in this particular case, conservation of the three names listed above over their counterparts could not be applied because of their illegitimacy. This holds although it is clear that the synonymy was not caused by actions of Murray but by oversights in some volumes of the second edition of Bergey's manual

Table 2. Selected words that occur as the last component of names of classes validly published under the ICNP before 2012 and either potentially in need of an orthographic correction or used for comparative purposes

Components only known as suffixes are indicated by a leading hyphen.

Nominative singular	Genitive singular	Stem	Nominative plural	Origin
-bacter	*-bacteris*	*-bacter-*	*-bacteres*	Stem fixed in Opinion 2 [38], plural fixed here
-fex	*-ficis*	*-fic-*	*-fices*	Stem in use, plural fixed here
-genes	*-genis*	*-gen-*	*-genes*	Stem in use, plural fixed here
microbium	*microbii*	*microbi-*	*microbia*	Stem and plural in use, second declension
monas	*monadis*	*monad-*	*monades*	Latin dictionaries
myces	*mycetis*	*mycet-*	*mycetes*	Greek dictionaries (here Latinized)
tutus	*tuti*	*tut-*	*tuti*	Latin dictionaries

[13, 31, 32]. Eleven commissioners agreed with the request to place the names listed in Table 1 on the list of rejected names while one commissioner did not participate in the ballot.

The Judicial Commission was also asked [1] to clarify whether the ICNP indicates that the rejection of a name at a certain rank also implies the rejection of a name at another rank solely because it has the same spelling. This is of relevance here because of the names *Bacteria* and *Proteobacteria* (Table 1). The Judicial Commission noted that Appendix 4 of the ICNP [2, 3], 'Conserved and Rejected Names of Prokaryotic Taxa', is composed of distinct lists of rejected (or conserved) names, assorted according to the category of the names. Moreover, should names with the same spelling but at distinct ranks be requested to be rejected, this could be requested separately for each rank. These considerations indicate that the ICNP does not intend that the placement of a name at a certain rank on the list of rejected names also yields the placement of a name at another rank on the list of rejected names just due to the identity of the spelling of the two names. Eleven commissioners agreed with this interpretation while one commissioner did not participate in the ballot.

ORTHOGRAPHY OF NAMES OF CLASSES

The Request for an Opinion [1] claimed that names of classes validly published before 2012 were formed in one of the following ways:

(1) As nominative plural of the (nominative singular) name of the type genus of the type order of the class (e.g., *Archaeoglobi* Garrity and Holt 2002 [33]).
(2) As nominative plural 'descriptive name', i.e. not derived from the name of a genus but using as last component a Latin or Neo-Latin nominative plural of a nominative singular which is in use as the last component of a genus name (e.g. *bacterium*, plural *bacteria*) or could at least be used as such (*cutis*, plural *cutes*).
(3) Composed of the stem of the name of the type genus of the type order of the class plus an explicitly given ending distinct from *-ia* (see below).
(4) Composed of the stem of the name of the type genus of the type order of the class plus the ending *-ia* as in the case of legitimate names of classes validly published after 2011 (e.g., *Erysipelotrichia* Ludwig *et al*. 2010 [34]).

The Judicial Commission agrees with this merely descriptive assessment although the Request for an Opinion [1] failed to consider two names of classes validly published before 2012, to which we will return below.

Göker [1] further requested the orthographic correction of incorrect plurals found in names formed according to scheme (1) or scheme (2). *Chthonomonadetes* Lee *et al*. 2011 [35] can be added here although it was not mentioned in the Request for an Opinion. The Judicial Commission concludes that Rule 8, in conjunction with Rules 57a and 61, stipulates that such names should indeed be orthographically corrected. This is also based on the understanding that the move to render Rule 8 non-retroactive regarding names of classes had the purpose to restore the legitimacy of class names but was neutral regarding orthography [6]. Judicial Opinion 116 [4] noted that names of taxa above genus rank are illegitimate if they deviate from the envisaged ending, if any. If otherwise they are not illegitimate for that reason but may need an orthographic correction, as in the case of an incorrectly formed stem [4]. These considerations did not rule out that there may be other reasons for orthographically correcting a name, whether or not the name is supposed to have a rank-specific ending.

The Request for an Opinion [1] also called for the orthographic correction of names formed according to scheme (3). This is difficult to justify based on the Rule 8 in conjunction with Rules 57a and 61. However, the Judicial Commission agrees with the author of the Request that scheme (3) was only applied to a minority of names, which exclusively used *-ae* as suffix, and that such

names can be confusing if they are used as templates for forming new names [1]. The latter kind of problem was also emphasized in Judicial Opinion 116 [4]. The implemented wording of Rule 8 for names of classes validly published before 2012 does not explicitly rule out that they are formed according to scheme (3) but the co-occurrence of schemes (3) and (4) is unfortunate. Moreover, the standardized endings of names of taxa above genus rank are exclusively derived from Latin (or Greek) adjectival suffixes under the ICNP; see pp. 307–310 in Stearn [36]. However, *-ae* is not among these adjectival suffixes, neither in the feminine gender nor in any other gender.

The final components of the names of the type genera of the type orders of the classes whose names were listed by Göker [1] as in need of an orthographic clarification are shown in Table 2 together with some other suffixes of interest; see also Stearn [36]. In case of *Deferribacteres* Huber and Stetter 2002 [37] the only action needed would be to sanction *-bacteres* as plural of *-bacter*. The Judicial Commission agrees with the Request for an Opinion [1] that the grammar of *-bacter* is not found in Latin dictionaries, which is why it had to be defined in Judicial Opinions 2 [38] and 3 [39]. Moreover, negative consequences of defining *-bacteres* as the nominative plural of *-bacter* and confirming that *-bacteris* is its genitive singular are not known. Eleven commissioners agreed with this definition while one commissioner did not participate in the ballot.

Based on the argumentation and the scheme provided in the Request [1] and by Stearn [36] and reiterated in Table 2, the Judicial Commission also confirms that *-ficis* is the genitive singular of *-fex* and that *-fices* is its nominative plural. Eleven commissioners agreed with this confirmation while one commissioner did not participate in the ballot. Moreover, the Judicial Commission confirms that *-genis* is the genitive singular of *-genes* and that *-genes* is its nominative plural. Eleven commissioners agreed with this confirmation while one commissioner did not participate in the ballot. In contrast to *myces* (Table 2), these suffixes do not have an augmented genitive, hence one must assume that the nominative plural is not augmented either [36].

Some of the names of classes validly published before 2012 already use scheme (4), including *Armatimonadia* Tamaki *et al.* 2011 [40], which was not listed in the Request [1]. Accordingly, if a name formed according to scheme (3) or incorrect variants of schemes (1) and (2) is orthographically corrected one could either use scheme (4) or the correct variant of scheme (1) or (2). The choice seems to be partially a matter of taste but one needs to consider that scheme (4) can be recognized more easily because it is the standard since 2012. Moreover, some nominative plurals are identical to the nominative singular (Table 2), hence their application could make the name of the class identical to the name of the type genus, which would be unfortunate.

The Judicial Commission decided to orthographically correct the incorrect plurals in the following names: *Chthonomonadetes* Lee *et al.* 2011 [35] is corrected to *Chthonomonadia* corrig. Lee *et al.* 2003; *Gemmatimonadetes* Zhang *et al.* 2003 [41] is corrected to *Gemmatimonadia* corrig. Zhang *et al.* 2003; *Chrysiogenetes* Garrity and Holt 2002 [42, 43] is corrected to *Chrysiogenia* corrig. Garrity and Holt 2002; *Aquificae* Reysenbach 2002 [44] is corrected to *Aquificia* corrig. Reysenbach 2002. Eleven commissioners agreed with conducting corrections while one commissioner did not participate in the ballot. Four commissioners preferred the old-style spelling (which would have yielded *Chthonomonades* corrig. Lee *et al.* 2003, *Gemmatimonades* corrig. Zhang *et al.* 2003, *Chrysiogenes* corrig. Garrity and Holt 2002, and *Aquifices* corrig. Reysenbach 2002, respectively) while seven commissioners opted for the new style and one commissioner did not participate in the ballot.

The Judicial Commission further decided to orthographically correct the explicitly given but misleading suffix *-ae* in the following names: *Verrucomicrobiae* Hedlund *et al.* 1998 [45] is corrected to *Verrucomicrobiia* corrig. Hedlund *et al.* 1998; *Opitutae* Choo *et al.* 2007 [46] is corrected to *Opitutia* corrig. Choo *et al.* 2007. Eleven commissioners agreed with conducting corrections while one commissioner did not participate in the ballot. Four commissioners preferred the old-style spelling (which would have yielded *Verrucomicrobia* corrig. Hedlund *et al.* 1998 and *Opituti* corrig. Choo *et al.* 2007, respectively) while seven commissioners opted for the new style and one commissioner did not participate in the ballot.

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Conflicts of interest
The authors declare that there are no conflicts of interest.

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