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Notes on the use of Greek word roots in genus and species names of prokaryotes

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This paper provides a survey of the ways in which Greek words and word roots have been used in the nomenclature of prokaryotes and explores the extent to which the different uses agree with the wording of the International Code of Nomenclature of Prokaryotes. We here give recommendations on how to use Greek words and word roots in new genus names and specific epithets so that the resulting names are in agreement both with the rules of Greek grammar and with Principle 3 of the Code.

> If I told you I understood Greek, I'd be lying. But those who understood him smiled at one another and shook their heads. As for myself, it was Greek to me.
>
> (William Shakespeare, Julius Caesar, Act 1, Scene 2)

The special position of Greek in the nomenclature of prokaryotes

'The scientific names of all taxa are Latin or latinized words treated as Latin regardless of their origin.' Thus reads the first sentence of Principle 3 of the International Code of Nomenclature of Prokaryotes (ICNP) (Parker *et al.*, 2016). Latin is thus the basis of all prokaryote nomenclature. Use of words and word elements derived from other languages is strongly discouraged, except when such words are from Greek. Principle 3 continues, 'They are usually taken from Latin or Greek…', and Recommendation 6(3) states: 'Words from languages other than Latin or Greek should be avoided as long as equivalents exist in Latin or Greek or can be constructed by combining word elements from these two languages. …' (Parker *et al.*, 2016). Appendix 9 provides further information on the way Greek word elements are used in compound names for genera and species: 'The connecting vowel is *-o-* when the preceding word element is of Greek origin, … Greek is more flexible than Latin about the connecting vowel, and other connecting vowels than *-o-* may be used if a precedent is found in Greek. Example: *Corynebacterium*.'

The authors dedicate this paper to the memory of Prof. Dr. Hans Georg Trüper, an expert in microbial taxonomy and in Greek and Latin nomenclature, who passed away on March 9, 2016.

Abbreviation: ICNP, International Code of Nomenclature of Prokaryotes.

The botanical and the zoological codes of nomenclature do not reserve a special position for Greek. The International Code of Nomenclature for algae, fungi, and plants (McNeill *et al.*, 2012) states:

> Article 20.1. The name of a genus… may be taken from any source whatever, and may even be composed in an absolutely arbitrary manner, …
>
> Recommendation 20A.1. (a). Use Latin terminations insofar as possible.
>
> Article 23.2. The epithet in the name of a species may be taken from any source whatever, and may even be composed arbitrarily.
>
> Recommendation 23A.3. In forming specific epithets, authors should comply also with the following: (a) Use Latin terminations insofar as possible.
>
> Recommendation 60A.1. When a name of a new taxon …, or its epithet, is to be derived from Greek, the transcription to Latin should conform to classical usage.
>
> Recommendation 60G.1. A name or epithet that combines elements derived from two or more Greek or Latin words should be formed, as far as practicable, in accordance with classical usage. This may be stated as follows…: (a) In a regular compound, a noun or adjective in non-final position appears as a compounding form generally obtained by (1) removing the case ending of the genitive singular (…; transcribed Greek *-ou*, *-os*, *-es*, *-as*, *-ous* and its equivalent *-eos*) and (2) before a consonant, adding a connecting vowel (…, *-o-* for Greek elements).

The Zoological Code (International Commission on Zoological Nomenclature, 1999) states:

Table 1. Transliteration of selected letters and letter combinations from Greek into Latin, as recommended by MacAdoo (1993)

Greek	Transliteration	Greek	Transliteration
α	*a*	ν	*n*
αι, ᾳ	*ae*	ξ	*x*
αυ	*au*	ο	*o*
β	*b*	οι	*oe*
γ	*g*	ου	*u*, rarely *ou*
δ	*d*	π	*p*
ε	*e*	ρ	*r*
ει	*e*	ῥ	*rh*
ευ	*eu* (*ev* before vowels)	ῤῥ	*rrh*
ζ	*z*	σ, ς	*s*
η	*e*	τ	*t*
ηι, ῃ	*i*	υ	*y*
ηυ	*eu* (*ev*)	υι	*yi*
θ	*th*	φ	*ph*
ι	*i, j*	χ	*ch*
κ	*c**	ψ	*ps*
λ	*l*	ω	*o*
μ	*m*	ωι, ῳ	*oe* (rare)

*Recommendation 6(7) to the Code (Parker *et al.*, 2016) recommends transliteration of κ to k. See further information in the text.

> Article 11.3. … a name may be a word in or derived from Latin, Greek or any other language…, or be formed from such a word. …
>
> 30.1.2. A genus-group name that is or ends in a Greek word transliterated into Latin without other changes takes the gender given for that word in standard Greek dictionaries.
>
> 30.1.3. A genus-group name that is a Greek word latinized with change of ending, …, takes the gender normally appropriate to the changed ending or the Latin suffix.
>
> Examples. Names with the Latin gender ending *-us*, Latinized from the Greek endings *-os* (masculine or feminine), *-e* (feminine), *-a* (neuter) or *-on* (neuter), are masculine: e.g. *-cephalus* (kephale), *-cheilus* and *-chilus* (cheilos), *-crinus* (krinon), *-echinus* (echinos), *-gnathus* (gnathos), *-rhamphus* (rhamphos), *-rhynchus* (rhynchos), *-somus* (soma), *-stethus* (stethos), and *-stomus* (stoma). Names ending in the Latin gender ending *-a*, latinized from the Greek ending *-on* are feminine, e.g. *-metopa* (metopon). Names derived from the Greek *-keras* (neuter) may have the ending *-cerus* (masculine) or *-cera* (feminine), although simple transliteration of the Greek ending as *-ceras* retains the neuter gender; …

Practical information in the literature on how to use Greek roots in new names of prokaryote genera and species

The number of microbiologists with a sufficiently in-depth understanding of Latin is decreasing (Oren *et al.*, 2015), and for classical Greek the situation is even worse. Most novel species are now described by research groups from Asian countries where Latin and Greek are not part of the curriculum of students who pursue a career in biological sciences. Thus, in the period January 2012–July 2013, 25.9 % of all papers submitted to the International Journal of Systematic and Evolutionary Microbiology came from China, 16.4 % from South Korea and 8.0 % from Japan (Oren & Garrity, 2014). For 2014 these numbers were 31.2 %, 14.8 % and 6.4 %, respectively.

Table 2. Examples of noun endings in Greek and their Latin transliteration (based on MacAdoo, 1993)

	Gender	Nominative singular	Genitive singular	Genitive plural
First declension	Feminine	χωρα = *chora* (land)	χωρας = *chorae*	χωρων = *chorarum*
		κωμη = *coma* (hair)	κωμης = *comae*	κωμων = *comarum*
	Masculine	νεανιας = *neania* (young man)	νεανιου = *neaniae*	νεανιων = *neaniarum*
		μαθητης = *matheta* (leaner)	μαθητου = *mathetae*	μαθητων = *mathetarum*
Second declension	Feminine	νοσος = *nosus* (disease)	νοσου = *nosi*	νοσων = *nosorum*
	Masculine	λαιος = *laeus* (thrush)	λαιου = *laei*	λαιων = *laeorum*
		λαγως = *lagus* (hare)	λαγω = *lagi*	λαγων = *lagorum*
	Neuter	συκον = *sycum* (fig)	συκου = *syci*	συκων = *sycorum*
Third declension	Feminine	φλεψ = *phleps* (vein)	φλεβος = *phlebis*	φλεβων = *phlebum*
		θριξ = *thrix* (hair)	τριχος = *trichis*	τριχων = *trichum*
		ὀρνις = *ornis* (bird)	ὀρνιθος = *ornithis*	ὀρνιθων = *ornithum*
	Masculine	γιγας = *gigas* (giant)	γιγαντος = *gigantis*	γιγανθων = *gigantum*
		ποιμην = *poemen* (shepherd)	ποιμενος = *poemenis*	ποιμενων = *poemenum*
		ἡγεμων = *hegemo* (leader)	ἡγεμονος = *hegemonis*	ἡγεμονων = *hegemonum*
	Neuter	σωμα = *soma* (body)	σωματος = *somatis*	σωμαθων = *somatum*
		ἡπαρ = *hepar* (liver)	ἡπατος = *hepatis*	ἡπατων = *hepatum*

Table 3. Selected names of prokaryote genera in which the last part of the name is derived from Greek

The etymology is given as found in LPSN (www.bacterio.net). Therefore, transliteration e.g. of '*υ*' to '*y*' or to '*u*' is inconsistent.

Genus name	Etymology	Comments
Abiotrophia	Gr. prefix *a-* negative (un-); Gr. n. *bios* life; Gr. n. *trophe* nutrition; N.L. fem. n. *Abiotrophia* life-nutrition-deficiency	The Latin-derived ending *–ia* was added to form a Neo-Latin noun; *Abiotropha* would have been in agreement with Table 2
Actinoalloteichus	Gr. n. *actis actinos* ray (used to refer to actinomycetes); Gr. adj. *allos* another, the other; Gr. masc. n. *teichos* wall; N.L. masc. n. *Actinoalloteichus* actinomycete with a different wall	The Greek ending –ος was transliterated to *–us* in accordance with Table 2
Actinomyces	Gr. n. *aktis aktinos* ray; Gr. masc. n. *mukês* fungus; N.L. masc. n. *Actinomyces* ray fungus, referring to the radial arrangement of filaments in *Actinomyces bovis* sulfur granules	No attempt was made here to give a Latin ending, and –ης was transliterated to *–es; Actinomyca* would have been in agreement with Table 2
Actinopolymorpha	Gr. n. *actis actinos* a ray; Gr. adj. *polumorphos* multiform, manifold; N.L. fem. n. (N.L. fem. adj. used as a substantive) *Actinopolymorpha* actinomycete of many shapes	The Greek ending –η was transliterated to *–a* in accordance with Table 2
Arsenophonus	Gr. n. *arsên* a male; Gr. masc. n. *phonos* murder, slaughter; N.L. masc. n. *Arsenophonus* male-killer	The Greek ending –ος was transliterated to *–us* in accordance with Table 2
Brochothrix	Gr. n. *brochos* a slip-knot, a loop; Gr. fem. n. *thrix* a thread; N.L. fem. n. *Brochothrix* loop(ed) thread	The Greek ending –ιξ was transliterated to *–ix* in accordance with Table 2
Carboxydibrachium	N.L. n. *carboxydum* carbon monoxide; N.L. neut. n. *brachium* (from Gr. neut. n. *brachiôn*) arm, branch; N.L. neut. n. *Carboxydobrachium* CO branch, i.e. CO-utilizing, branching bacterium	The Greek ending –ων was transliterated to *–um. brachium* or *bracchium* also exists in classical Latin
Caryophanon	Gr. n. *karyon* nut, kernel, nucleus; Gr. adj. *phaneros* bright, conspicuous; N.L. neut. n. *Caryophanon* that which has a conspicuous nucleus	The authors preferred a Greek ending rather than the Latin transliteration as *Caryophanum*, and for unclear reasons some of the letters of the Greek root were deleted. See the text for further information
Chlamydia	Gr. n. *chlamus -udos* a cloak, short mantle; N.L. fem. n. *Chlamydia* a cloak	The Latin-derived ending *–ia* was added to form a Neo-Latin noun
Chloroherpeton	Gr. adj. *chlôros* greenish-yellow, pale green; Gr. neut. n. *herpeton* a creeping thing, reptile; N.L. neut. n. *Chloroherpeton* green creeping organism	Based on Table 2, the preferred transliteration of the neuter ending –ον is *–um*, but the authors preferred the Greek ending
Desulfatirhabdium	L. pref. *de-* from; N.L. n. *sulfas -atis* sulfate; Gr. neut. n. *rhabdium* a little rod; N.L. neut. n. *Desulfatirhabdium* a sulfate-reducing small rod	The neuter Greek ending –ον was transliterated to the Latin neuter ending *–um*
Desulfoplanes	L. n. *sulfur* sulfur; Gr. n. *planes* a wanderer, roamer; N.L. masc. n. *Desulfoplanes* a sulfate-reducing wanderer, pertaining to a motile sulfate reducer	Based on Table 2, the suggested transliteration is *Desulfoplana*, but the authors preferred the Greek ending
Enhygromyxa	Gr. adj. *enugros* in the water, aquatic; Gr. fem. n. *muxa* mucus, slime; N.L. fem. n. *Enhygromyxa* slime of wet or moist habitat; intended to mean aquatic myxobacteria	The feminine ending –α was transliterated to *-a* in accordance with Table 2
Enterorhabdus	Gr. n. *enteron* intestine; Gr. fem. n. *rhabdos* a rod; N.L. fem. n. *Enterorhabdus* a rod isolated from the intestine	The Greek ending –ος was transliterated to *–us* in accordance with Table 2
Herpetosiphon	Gr. n. *herpeton* gliding animal, reptile; Gr. masc. n. *siphôn* tube, pipe; N.L. masc. n. *Herpetosiphon* gliding tube	Based on Table 2, the suggested transliteration of the masculine Greek ending –ων is *–o*; however, the authors preferred to keep the Greek ending *–on*
Holophaga	Gr. adj. *holos* entire; Gr. v. *phagein* to eat; N.L. fem. n. *Holophaga* eating all	The Latin-derived ending *–a* was added to form a Neo-Latin noun
Hyperthermus	Gr. prep. *hyper* above; Gr. adj. *thermos* hot; N.L. masc. n. *Hyperthermus* an organism existing in a very hot environment	The Greek ending –ος was transliterated to *–us* in accordance with Table 2
Lyticum	N.L. adj. *lyticus -a -um* (from Gr. adj. *lutikos -ê -on*) able to loosen, able to dissolve; N.L. neut. n. *Lyticum* dissolver	The neuter Greek ending –ον was transliterated to the Latin neuter ending *–um*

Table 3. cont.

Genus name	Etymology	Comments
Methanopyrus	N.L. n. *methanum* [from French n. *méth(yle)* and chemical suffix *-ane*] methane; N.L. pref. *methano-* pertaining to methane; Gr. neut. n. *pur* fire; N.L. masc. n. *Methanopyrus* the 'methane fire' (the hyperthermophilic methanogen)	The Latin-derived ending *–us* was added to the Greek noun πυρ to form a Neo-Latin noun
Methylogaea	N.L. n. *methylum* (from French *méthyle*, back-formation from French *méthylène*, coined from Gr. n. *methu* wine and Gr. n. *hulê* wood) the methyl group; N.L. pref. *methylo-* pertaining to the methyl radical; N.L. fem. n. *Gaea* the mother goddess of the earth in Greek mythology; N.L. fem. n. *Methylogaea* referring to the terrestrial origin of a methyl-using bacterium	The Greek –αι was transliterated to *–ae* in accordance with Table 1
Prosthecochloris	Gr. n. *prosthece* appendage; Gr. adj. *chlôros* greenish-yellow, pale green; N.L. fem. n. *Prosthecochloris* green (organism) with appendages	Based on Table 2, the preferred transliteration of feminine Greek ending –ος is *–us* and not *–is*
Rapidithrix	L. adj. *rapidus* rapid; Gr. n. *thrix* hair; N.L. fem. n. *Rapidithrix* rapidly moving hair	The Greek ending –ιξ was transliterated to *–ix* in accordance with Table 2
Rhizorhapis	Gr. n. *rhiza* root; Gr. fem. n. *rhapis* rod; N.L. fem. n. *Rhizorhapis* a rod associated with roots	The Greek ending –ις was transliterated to *–is* in accordance with Table 2
Rhodoplanes	Gr. n. *rhodon* the rose; Gr. masc. n. *planos* a vagabond, a wanderer; N.L. masc. n. *Rhodoplanes* a red wanderer	Based on Table 2, the suggested transliteration is *Rhodoplana*, but the authors preferred the Greek ending
Roseateles	L. adj. *roseus* rose-coloured, pink; Gr. adj. *ateles* defective, incomplete; N.L. masc. n. *Roseateles* the rose-coloured incomplete (photosynthetic bacterium)	Based on Table 2, the suggested transliteration of the masculine Greek ending –ης is *–a*; however, the authors preferred to keep the Greek ending *–es*
Symbiotes	N.L. masc. n. *Symbiotes* (from Gr. n. *sumbiotes*) one who lives with a companion, a partner	Based on Table 2, the suggested transliteration of the masculine Greek ending –ης is *–a*; however, the authors preferred to keep the Greek ending *–es*
Thiopedia	Gr. n. *theion* (Latin transliteration *thium*) sulfur; Gr. neut. n. *pedion* a plain, a flat area; N.L. fem. n. *Thiopedia* (*sic*) sulfur plain	Instead of transliterating the neuter ending –ον to *–um*, the authors decided to use the feminine gender for the genus name
Thioploca	Gr. n. *theion* (Latin transliteration *thium*) sulfur; Gr. fem. n. *plokê* a twist, anything twisted, a braid; N.L. fem. n. *Thioploca* sulfur braid	The Greek ending –η was transliterated to *–a* in accordance with Table 2
Tropheryma	Gr. n. *trophê* nourishment, food; Gr. neut. n. *eruma* fence, a defence against, barrier; N.L. fem. (*sic*) n. *Tropheryma* barrier to nourishment, so named because it causes malabsorption	The Greek ending –μα was transliterated to *–ma* in accordance with Table 2, but for unclear reasons the authors changed the gender of the Neo-Latin genus name from neuter to feminine

Practical guidance to authors on how to correctly form names of new taxa of prokaryotes can be found in a review article and a book chapter (Trüper, 1999; Oren, 2011a). These papers mainly focus on the formation of new names using Latin roots, and very little information is given on how to use Greek word elements in new names. The most detailed source of such information is found in the essay on 'Nomenclatural literacy' by Thomas MacAdoo (1993), a book chapter that is unfortunately little known within the community of taxonomists who publish newly proposed names. MacAdoo provided useful tables showing the way Greek letters, letter combinations and endings of nouns in the three declensions of Greek grammar are transliterated into (nomenclature) (Neo)-Latin. Selected information is copied in Tables 1 and 2.

Many Greek words have entered the classical Latin language, and many more Greek words may have been used by the Romans and were never recorded in writing and therefore are not found in our dictionaries. MacAdoo (1993) provided the following interesting comments that may be relevant when using Greek words and word elements in prokaryote nomenclature:

> The ancient Romans were by no means consistent in latinizing Greek endings. Learned authors, in particular, were likely to retain Greek forms, changing only the letters, presumably to demonstrate the excellence of their knowledge of Greek… Now I can hardly forbid a taxonomist to use a formation that is well attested in classical Latin, even though it does not fit into a normal Latin declension, but anyone who does will not only

Table 4. Selected species epithets of prokaryote genera formed as adjectives [Rule 12c(2)] in which the last part of the name is derived from Greek

The etymology is given as found in LPSN (www.bacterio.net).

Epithet	Species	Etymology	Comments
actinosclerus	*Hymenobacter actinosclerus*	Gr. n. *actis actinos* ray, beam; Gr. adj. *sklêros* hard; N. L. masc. adj. *actinosclerus* hard against rays	The Greek ending –ος was transliterated to *–us*
apista	*Pandoraea apista*	N.L. fem. adj. *apista* (from. Gr. adj. *apistos*) disloyal, unfaithful, treacherous	The feminine form ἀπιστη was transliterated to *apista* in accordance with Table 2
brachy	*Eubacterium brachy*	N.L. neut. adj. *brachy* (from Gr. neut. adj. *brachu*) short, referring to the length of the cells	The authors transliterated the Greek ending –υ to –y. See the text for further comments
chlorus, chlora	*Streptomyces chlorus*/, *Actinomycetospora chlora*	N.L. masc. adj. *chlorus*/N.L. fem. adj. *chlora* (from Gr. adj. *khloros -ê -on*) greenish-yellow	The Greek endings –ος and –α were transliterated to *–us* and *–a* in accordance with Table 2. The feminine form of the adjective in Greek is χλωρα and not χλωρη as suggested by the authors
coccoides	*Clostridium coccoides*	N.L. masc. n. *coccus* (from Gr. masc. n. *kokkos* grain, seed) coccus; L. suff. *-oides* (from Gr. suff. *-eides* from Gr. n. *eidos* that which is seen, form, shape, figure) resembling, similar; N.L. neut. adj. *coccoides* berry-shaped	The ending *–oides* is found in genus names as well as specific epithets. Further comments on such names will be published elsewhere (Oren & Schink, 2016)
crossotus	*Butyrivibrio crossotus*	N.L. masc. adj. *crossotus* (from Gr. masc. adj. *krossôtos*) tasseled	The Greek ending –ος was transliterated to *–us*
cryophilis	*Saccharothrix cryophilis*	Gr. n. *kruos* icy cold, frost; N.L. adj. *philus -a -um* (from Gr. adj. *philos -ê -on*) friend, loving; N.L. fem. adj. *cryophilis* (*sic*) cold-loving	Instead of transliterating the Greek ending –ος to *–us* as customary, the authors selected an ending that is neither Greek nor Latin
crystallopoietes	*Arthrobacter crystallopoietes*	L. n. *crystallus* a crystal, Gr. v. *poieo* to make, to produce, to form; N.L. masc. adj. *crystallopoietes* crystal forming	Instead of transliterating the Greek ποιητης (maker, creator) to *poietus* the authors kept the Greek ending
diaphoros/ diaphorus	*Dokdonia diaphoros/ Krokinobacter diaphorus*	N.L. masc. adj. *diaphorus*/N.L. fem. adj. *diaphoros* (from Gr. fem. adj. *diaphoros*) different, unlike	In the second case the Greek ending –ος was transliterated to *–us* as customary, in first case the Greek ending was kept
dimorpha	*Mycoplana dimorpha*	Gr. fem. adj. *dimorpha*, two-formed	*dimorpha* is the Neo-Latin transliteration of the Greek feminine adjective διμορφη
eikastus/eikasta	*Krokinobacter eikastus/Dokdonia eikasta*	N.L. masc. adj. *eikastus* (from Gr. masc. adj. *eikastos*)/N.L. fem. adj. *eikasta* (from Gr. fem. adj. *eikasta*) similar, comparable	The Greek endings –ος and –η were transliterated to *–us* and *–a* for the masculine and feminine forms. The feminine form of the adjective in Greek is εικαστη and not εικαστα as suggested by the authors
encheleia	*Aeromonas encheleia*	Gr. n. *egchelus* (Latin transliteration *enchelys*) eel; N.L. fem. adj. *encheleia* from eels	How the Greek ἐγχελυς is transliterated to enchelys is not clear. The adjective was formed by adding the Latin ending *–a* to form a feminine Neo-Latin adjective
enhydra/ enhydrum	*Vasilyevaea enhydra/ Prosthecomicrobium enhydrum*	N.L. fem. adj. *enhydra*/N.L. neut. adj. *enhydrum* (from Gr. neut. adj. *enudron* living in or by water) living in water, aquatic	*enhydra* is the Neo-Latin transliteration of the Greek feminine adjective ἐνυδρη
enoeca	*Prevotella enoeca*	Gr. n. *enoikos* inhabitant, dweller in a place; N.L. fem. adj. *enoeca* inhabiting (the gingival crevice)	*enoica* is the Neo-Latin transliteration of the Greek feminine adjective ἐνοικη
erythra	*Legionella erythra*	N.L. fem. adj. *erythra* (from Gr. fem. adj. *erythre*) red	*erythra* is the Neo-Latin transliteration of the Greek feminine adjective ἐρυθρη. The adjective *erythraeus* derived from the Greek ἐρυθραιος is found in classical Latin
eurytherma	*Amycolatopsis eurytherma/ Thalassomonas eurytherma*	Gr. adj. *eurys* wide; Gr. adj. *thermos* hot; N.L. fem. adj. *eurytherma* able to tolerate a wide range of temperatures	*therma* is the Neo-Latin transliteration of the Greek feminine adjective θερμη
eutropha	*Ralstonia eutropha/ Alcaligenes eutrophus*	Gr. prep. *eu* good; Gr. n. *trophos* feeder; N.L. fem. adj. *eutropha* well nourished	The Greek endings –ος was transliterated to *–us*
genikus/genika	*Krokinobacter genikus/ Dokdonia genika*	N.L. masc. adj. *genikus*/N.L. fem. adj. *genika* (from Gr. masc. adj. *genikos*/Gr. fem. adj. *genika*) principal, typical	The Greek endings –ος and –α were transliterated to *–us* an *–a* as customary
hadrum	*Eubacterium hadrum*	N.L. neut. adj. *hadrum* (from Gr. neut. adj. *hadron*) thick, bulky	The Greek ending –ον was transliterated to *–um*
halochares	*Bacillus halochares*	Gr. n. *hals halos* salt; N.L. part. adj. *chares* (from Gr. v. *chairo* to rejoice at, to delight in) delighting in; N.L. part. adj. *halochares* finding pleasure in salt	If *chares* is formed as a present participle, it is not clear why the authors did not use the *–ens* ending
hypermegas	*Bacteroides hypermegas*	Gr. pref. *huper* very, excessive; Gr. adj. *megas* great, big; N.L. masc. adj. *hypermegas* excessively great	The Greek ending –ας was transliterated to *–as* (compare also Table 2)
halochloris	Halorhodospira halochloris/ *Ectothiorhodospira halochloris*	Gr. n. *hals halos* salt; Gr. adj. *chlôros* green; N.L. fem. adj. *halochloris* green-colored and from salt lakes	The feminine form of χλωρος is χλωρα, and therefore it is not clear why the authors preferred *halochloris* over *halochlora*

Table 4. cont.

Epithet	Species	Etymology	Comments
haloplanktis	*Alteromonas haloplanktis*/ *Pseudoalteromonas haloplanktis*	Gr. n. *hals halos* sea; Gr. adj. *planktos -ê -on* wandering, roaming; N.L. fem. adj. *haloplanktis* sea-wandering	The preferred transliteration of the feminine form πλανκτη is *plankta* or *plancta* and not *planktis*
heliothermus	*Antarctobacter heliothermus*	Gr. n. *hêlios* sun; Gr. adj. *thermos* hot; N.L. masc. adj. *heliothermus* heated by the sun	The ending –ος was transliterated to *–us* as customary
hippikon	*Acholeplasma hippikon*	Gr. neut. adj. *hippikon* pertaining to the horse	The customary way of transliterating the neuter ending –ον is *–um*
hypermegale	*Megamonas hypermegale*	Gr. pref. *hyper* over, more than; Gr. adj. *megas megale mega* big; N.L. fem. adj. *hypermegale* very big	A more consistent way of transliterating the feminine ending –η is to *–a* instead of *-e*
limnaea	*Gillisia limnaea*	Gr. adj. *limnaios* of or from the marsh; N.L. fem. adj. *limnaea* living in the water	*limnaea* is the correct way of transliterating the feminine form λιμναια
micros/*micra*	*Peptostreptococcus micros*/*Parvimonas micra*	Gr. adj. *mikros -ê -on* small, little; N.L. masc. adj. *micros*/N.L. fem. adj. *micra* small, little	The feminine form is μικρα and not μικρη. The consistent way of transliterating μικρος is *micrus*
miotherma	*Petrotoga miotherma*	N.L. fem. adj. *miotherma* (from Gr. adj. *meiôn* less; and Gr. adj. *thermos* hot) less hot	*therma* is the Neo-Latin transliteration of the Greek feminine adjective θερμη
monachus	*Labrys monachus*	N.L. adj. *monachus* (from Gr. adj. *monachos*) unique, single	The Greek ending –ος was transliterated to *–us* as customary
oxytoca	*Klebsiella oxytoca*	Gr. *oxus* sour, acid; Gr. suff. *-tokos* producing; N.L. fem. adj. *oxytoca* acid-producing	τοκος is a masculine noun ('a bringing forth'), here used in a combination as Neo-Latin feminine adjective
pectinoschiza	*Lachnospira pectinoschiza*	N.L. n. *pectinum* pectin; Gr. v. *schizô* to split, cleave; N.L. fem. adj. *pectinoschiza* pectin-splitting	Formed by adding the Latin feminine ending *–a* to the Greek word
perideroedes	*Meganema perideroedes*	N.L. neut. adj. *perideroedes* (from Gr. neut. adj. *perideroedes*) necklace-like	From περιδερις a necklace
phaeum	*Pelodictyon phaeum*/ *Thermacetogenium phaeum*	Gr. neut. adj. *phaion* dark, brown; N.L. neut. adj. *phaeum* brown	Based on the adjective φαιος φαια φαιον
pleiomorpha	*Acrocarpospora pleiomorpha*/ *Sphaerochaeta pleomorpha*	Gr. adj. *pleios* full; Gr. n. *morphê* form, shape; N.L. fem. adj. *pleiomorpha* pleiomorphic, in various shapes	The Greek ending –η was transliterated to *–a* as customary
pneumosintes	*Bacteroides pneumosintes*/ *Dialister pneumosintes*	Gr. n. *pneuma* wind, breathed air; Gr. n. *sintes* a spoiler, thief; N.L. masc. adj. *pneumosintes* breath destroying	According to Table 2, the masculine 1st declension nominative σιντης must be transliterated as *sinta*
pnomenusa	*Pandoraea pnomenusa*	Gr. n. *pnoê* breath, breathing; Gr. v. *menô* to stay, wait; N.L. fem. adj. *pnomenusa* referring to the lung as the niche of these bacteria	Derived from the Greek noun πνοη and the verb μενω; the ending –ουσα, transliterated *–ousa*, is the feminine form of the present participle
polypragmatus	*Bacteroides polypragmatus*	Gr. *polypragmâtos* busy about many things; N.L. masc. adj. *polypragmatus* versatile	The Greek ending –ος was transliterated to *–us*
pycnus	*Rummeliibacillus pycnus*	Gr adj. *puknos* thick; N.L. masc. adj. *pycnus* thick	The Greek ending –ος was transliterated to *–us*
rhodochrous	*Rhodococcus rhodochrous*	N.L. masc. adj. *rhodochrous* rose colored	Derived from the Greek noun χρως, gen. χρωτος; the source of the ending *–us* of the epithet is unclear
rhodophaea	*Nocardiopsis rhodophaea*	Gr. n. *rhodos* the rose; Gr. adj. *phaeos* brown; N.L. fem. adj. *rhodophaea* rose-brown	Based on the adjective φαιος, φαια, φαιον
rhodos	*Pseudomonas rhodos*	Gr. n. *rhodon* the rose; N.L. fem. adj. *rhodos* (*sic*) rose coloured	*rhodos* is not a feminine form for a Latin adjective, and the epithet is malformed; the name of the organism was later changed to *Methylobacterium rhodinum,* derived from the Greek neuter adjective ῥοδινον
stenostrepta/ *stenostreptum*	*Spirochaeta stenostrepta*/ *Treponema stenostreptum*	Gr. adj. *stenos -ê -on* narrow; Gr. adj. *streptos* pliant, bent; N.L. fem. adj. *stenostrepta* tightly coiled	The Greek endings –η and –ον were transliterated to *–a* and *–um*, respectively
thereius	*Arcobacter thereius*	N.L. masc. adj. *thereius* (from Gr. adj. *thêreios*) pertaining to an animal	The Greek ending –ος was transliterated to *–us*
thermosphacta	*Brochothrix thermosphacta*	Gr. n. *thermê* heat; Gr. adj. *sphaktos* slain; N.L. fem. adj. *thermosphacta* killed by heat	The Greek σφακτη was transliterated to *sphacta*
trichodes	*Lactobacillus trichodes*	N.L. masc. adj. *trichoides* (from Gr. masc. adj. *trichoeidês*) like hair	The etymology gives the correctly formed name *trichoides*, but for unclear reasons the second 'i' was deleted in the published name
trota	*Aeromonas trota*	N.L. fem. adj. *trota* (from Gr. fem. adj. *trotê*) vulnerable	τρωτη was transliterated to *trota*

Table 5. Selected species epithets of prokaryote genera formed as adjectives [Rule 12c(3)] in which the last part of the name is derived from Greek and the Neo-Latin word was formed by adding a Latin ending

The etymology is given as found in LPSN (www.bacterio.net).

Epithet	Species	Etymology	Greek source - comments
aphoticum	*Photobacterium aphoticum*	Gr. pref. *a* not; Gr. n. *phos photos* light; L. neut. suff. *-icum* suffix used with the sense of pertaining to; N.L. neut. adj. *aphoticum* referring to the non-luminescent character of the species	The Neo-Latin adjective was formed by means of the neuter ending *–icum*
choerinum	*Bifidobacterium choerinum*	N.L. neut. adj. *choerinum* (from Gr. adj. *khoireos*) pertaining to a pig	The Neo-Latin adjective was formed by means of the neuter ending *–inum* to the Greek adjective χοιρεος, –α, –ον. *choerium* may have been the preferred Neo-Latin transliteration
dichotomicum	*Thermoflavimicrobium dichotomicum*	Gr. adj. *dichotomos* cut in two; N.L. neut. adj. *dichotomicum* dichotomous	The Neo-Latin adjective was formed by means of the neuter ending *–icum*
edaphicus	*Paenibacillus edaphicus*	Gr. n. *edaphos* ground; L. masc. suff. *-icus*, adjectival suffix used with the sense of belonging to; N.L. masc. adj. *edaphicus* living in soil	The Neo-Latin adjective was formed by means of the masculine ending *–icus*
endolithica	*Barrientosiimonas endolithica*	Gr. pref. *endo-* inside; Gr. n. *lithos* rock; N.L. fem. adj. *endolithica* endolithic	The Neo-Latin adjective was formed by means of the feminine ending *–ica*
enterica	*Salmonella enterica*	Gr. n. *enteron* gut; L. suff. *-icus -a -um* suffix used with the sense of belonging to; N.L. fem. adj. *enterica* pertaining to the gut	The Neo-Latin adjective was formed by means of the feminine ending *–ica*
hadalis	*Psychromonas hadalis*	N.L. fem. adj. *hadalis* (from Greek *Haides*) hadal, of or relating to the deepest regions of the ocean	Formed by adding the Latin adjective ending *–alis* to the Greek word
halophobica	*Pseudoamycolata halophobica/ Pseudonocardia halophobica*	Gr. n. *hals halos* salt, the sea; Gr. n. *phobos* fear, dread; L. fem. suff. *-ica* suffix used with the sense of pertaining to; N.L. fem. adj. *halophobica* salt-fearing	The Neo-Latin adjective was formed by means of the feminine ending *–ica*
hyicus	*Staphylococcus hyicus*	Gr. n. *hus huos* hog, pig; N.L. masc. adj. *hyicus* pertaining to a pig	The Neo-Latin adjective was formed by means of the masculine ending *–icus*
ichthiosmia	*Aeromonas ichthiosmia*	Gr. n. *ichtus* fish; Gr. n. *osmê* smell, odour; N.L. fem. adj. *ichthiosmia* fishy smelling	Formed by adding the Latin adjective ending *–ia* to the Greek word
melaninogenicus	*Bacteroides melaninogenicus*	N.L. n. *melaninum* melanin; N.L. adj. *genicus -a -um* producing (probably derived from Gr. n. *genetês* a begetter); N.L. masc. adj. *melaninogenicus* melanin producing	Formed by adding the Latin masculine adjective ending *–icus* to the Greek word
merycicum	*Bifidobacterium merycicum*	Gr. n. *meryx* (implied by verb *merykazo*) rumen; N.L. adj. *merycicum* pertaining to the rumen	Derived from the Greek verb μηρυκιζω – to ruminate. μηρυξ is given by Liddell & Scott (1882) only for a ruminating fish. The epithet was formed by addition of the neuter Latin ending *–icum*
splanchnicus	*Odoribacter splanchnicus*	Gr. pl. n. *splanchna* the 'innards"; L. masc. suff. *-icus* suffix used with the sense of pertaining to; N.L. masc. adj. *splanchnicus* pertaining to the internal organs	A Neo-Latin adjective was formed by addition of the masculine Latin ending *–icus*
synergistica	*Butyricimonas synergistica*	N.L. fem. adj. *synergistica* (from Gr. *sunergês* working with, co-operating) synergistic	A Neo-Latin adjective was formed by addition of the feminine Latin ending *–ica*
syntrophicum	*Sporotomaculum syntrophicum*	Gr. adj. *suntrophos* having grown up with one; L. neut. suff. *-icum* suffix used with the sense of pertaining to; N.L. neut. adj. *syntrophicum* pertaining to syntrophic substrate utilization	A Neo-Latin adjective was formed by addition of the neuter Latin ending *–icum*

Table 5. cont.

Epithet	Species	Etymology	Greek source - comments
tetraedrale	*Angulomicrobium tetraedrale*	Gr. adj. *tetraedros* having four faces: N.L. neut. adj. *tetraedrale* tetrahedral	A Neo-Latin adjective was formed by addition of the Latin neuter ending *–ale*
typhlonius	*Helicobacter typhlonius*	Gr. n. *tuphlôn* caecum; L. masc. suff. *-ius* suffix used with the sense of belonging to; N.L. masc. adj. *typhlonius* belonging to the caecum	A Neo-Latin adjective was formed by addition of the masculine Latin ending *–ius*

cause confusion, but will very likely provoke controversy! If, for example, a researcher decides to name a new genus *Crambe*, because it looks like a cabbage, or if he offers us *E. crambes* because it is an *Erwinia* that produces a disease in cabbage, instead of using the normal Latin *Cramba* or *crambae*, he will certainly raise eyebrows, and will probably have initiated a long and unproductive correspondence. (In this particular example, anything one does is likely to provoke a rebuke from some purist whose investigation of Lewis & Short (1907) has turned up the fact that *crambe* and *crambes* are the only forms of this word known to have been used in classical Latin. Full normalization can, however, be defended on the ground that not every form of every word appears in writing that has come down to us, and not every word that was used in speech was necessarily every written down. The average Roman farmer may well have said *cramba* for this particular type of cabbage, while the learned scholar was carefully writing *crambe*.

MacAdoo further made the following statement, important for all who try to incorporate Greek words or word elements in new species and genus names:

> In their relationship to Latin, the Greek adjectives are sufficiently complicated that one needs to be an expert in both languages to put the Greek properly into Latin form, unless, of course, the ancient Romans have already done it, so that the desired word can be found also in Lewis & Short (1907), a thing that happens more frequently than one would expect.

Below are a few examples found in the prokaryote nomenclature:

> *Meiothermus hypogaeus*. (Gr. adj. ὑπογαιος; L. masc. adj. *hypogaeus* underground. Note that the epithet is misspelled in *Thermogutta hypogea* and in *Isoptericola hypogeus* as the 'α' in ὑπογαιος must be transliterated to 'a').
>
> *Streptomyces erythraeus*, *Actinopolyspora erythraea*. (Gr. adj. ἐρυθρος red; L. adj. *erythraeus* reddish).
>
> *Tepidibacter thalassicus*. (Gr. adj. θαλασσιος; L. adj. *thalassicus* of or like the sea).
>
> *Micromonospora chersina*. (Gr. adj. χερσαιος living in dry land; L. fem. adj. *chersina* living upon dry land).
>
> *Streptomyces chryseus*. (Gr. adj. χρυσους (χρυσεος), χρυση, χρυσουν golden; L. adj. *chryseus* golden).
>
> *Meniscus glaucopis*. (L. fem. n. *glaucopis* owl-eyed) [from Gr. fem. n. γλαυκωπις gleaming-eyed (an epithet of the goddess *Athena*)].
>
> *Prosthecomicrobium pneumaticum*. (Gr. adj. πνευματικος; L. adj. *pneumaticus* of or belonging to air and wind).
>
> *Methanosarcina spelaei*. (Gr. n. σπηλαιον a cave; L. gen. n. *spelaei* from a cavern.)
>
> *Bacillus halmapalus*. (Gr. n. ἁλμη brine; Gr. adj. ὁπαλος = L. adj. *hapalus* soft).

A Greek adjective of two terminations may require three terminations in Latin, or it may require only one; those of three terminations in Greek regularly require three in Latin. A few examples are given in the table below, derived from MacAdoo (1993). In adjectives of two endings, the first is masculine or feminine, the second neuter.

Greek	Latin
ἀλογος, ἀλογον (irrational)	*alogus, aloga, alogum*
ἀληθής, ἀληθες (true)	*alethes*
καλος, καλη, καλον (beautiful)	*calus, cala, calum*
γλυκυς, γλυκεια, γλυκυ (sweet)	[*glycys*], *glycia*, [*glycy*]*

MacAdoo added the following footnote: '*I do not know any precedent for the use of the bracketed forms in Latin. Avoid them.' However, there already was a precedent for the use of such a form in *Eubacterium brachy*, a name suggested by Thomas MacAdoo himself in 1980 as apparent from the acknowledgment given in Holdeman *et al.* (1980). Such an epithet is grammatically correct Greek, but one may wonder whether it is in agreement with Principle 3 of the Code.

A survey of the use of Greek words and roots in prokaryotic genus and species names

Tables 3–7 present representative examples of the ways Greek words have been used in prokaryotic genus names (Table 3), in specific epithets formed as adjectives based on

Rule 12c(1) of the Code (Tables 4 and 5), in epithets formed as nouns in the nominative case 'in apposition' [Rule 12c (2)] (Table 6), and nouns in the genitive case [Rule 12c(3)] (Table 7). Some of the entries in these tables may be basonyms or synonyms of other names. Further information can be found at www.bacterio.net. In these tables the etymologies are often abridged, and the transliteration from Greek is given as in the original articles. The tables do not include names derived from names of plants or animals that are based on Greek. Also not included are the many names of cyanobacterial genera and species published under the provisions of the International Code of Nomenclature for algae, fungi, and plants. Nomenclature of cyanobacteria is dominated by Greek rather than by Latin roots (Oren, 2011b).

Genus names have always been formed as nouns in the nominative case, even if the Code does not explicitly state that the nominative case is obligatory, but a proposal to modify Rules 6, 10a and 12c of the Code accordingly has been submitted (Oren, 2014). Most cases of genus names based on one or more Greek roots are simple and straightforward, and the current convention is that by default the connecting vowel is *-o-* as stated in Appendix 9 of the Code. In most cases the endings of the genus names have been formed based on

Table 6. Selected species epithets of prokaryote genera in which the last part of the name is derived from Greek and the Neo-Latin word was formed as a noun 'in apposition' in the nominative case [Rule 12c(2)]

The etymology is given as found in LPSN (www.bacterio.net).

Epithet	Species	Etymology	Greek source/comments
chlororaphis	*Pseudomonas chlororaphis*	Gr. adj. *chloros* green; Gr. n. *raphis* a needle; N.L. n. *chlororaphis* a green needle	Correctly formed, based on the examples in Table 2
chroococcum	*Azotobacter chroococcum*	Gr. n. *chroa* colour; N.L. masc. n. *coccus* (from Gr. masc. n. *kokkos* grain, seed) coccus; N.L. neut. n. *chroococcum* coloured coccus	*chroococcus* would have been the preferred form
erythromyxa	*Kocuria erythromyxa*	Gr. adj. *eruthros* red; Gr. n. *muxa* mucus, slime; N.L. n. *erythomyxa* the red slime	Correctly formed, based on the examples in Table 2
erythropolis	*Rhodococcus erythropolis*	Gr. adj. *eruthros* red: Gr. n. *polis* a city; N.L. n. *erythropolis* red city	Correctly formed, based on the examples in Table 2
gephyra	*Archangium gephyra*	N.L. fem. n. *gephyra* (from Gr. fem. n. *gephura*) bridge	Correctly formed, based on the examples in Table 2
macrocephala	*Acrocarpospora macrocephala*	Gr. adj. *makrokephalos* long-headed; N.L. fem. n. *macrocephala* large head	Correctly formed, based on the examples in Table 2
megaterium	*Aquimarina megaterium*/ *Bacillus megaterium*	Gr. adj. *megas* large; Gr. n. *therion* monster, beast; N.L. neut. n. *megaterium* big beast	*megatherium* would have been more consistent based on Table 1; Opinion 1 of the Judicial Commission decided otherwise
metoecus	*Vibrio metoecus*	N.L. masc. n. *metoecus* (from Gr. n. *metoikos*) non-resident, stranger	Correctly formed, based on the examples in Tables 1 and 2
netropsis	*Streptomyces netropsis* *Streptoverticillium netropsis*	Gr. n. *netron* spindle; Gr. fem. n. *opsis* aspect, appearance; N.L. *netropsis* spindle-like	The authors did not explicitly state that the epithet is a noun in apposition
obeum	*Ruminococcus obeum*	Gr. n. *obeum* egg.	ὠβεον was transliterated to obeum in accordance with the examples in Table 2
platyhelix	*Spiroplasma platyhelix*	Gr. adj. *platus* flat, broad; Gr. n. *helix* a coil or spiral; N.L. n. *platyhelix* flat coil	Correctly formed, based on the examples in Table 2
polychroma	*Nonomuraea polychroma*	Gr. adj. *polus* many; Gr. n. *chroma* colour; N.L. n. *polychroma* intended to mean that the bacterium produces many colours	Correctly formed, based on the examples in Table 2
polymachus	*Bacillus polymachus*/ *Streptomyces polymachus*	N.L. n. *polymachus* from Gr. *polymachos* 'fighting many', referring to the production of metabolites against many other organisms	A Neo-Latin noun in apposition formed correctly from a Greek adjective based on the examples in Table 2
profundinema	*Desmospora profundinema*	L. n. *profundum* the depths of the sea; Gr. neut. n. *nema* a filament; N.L. neut. n. *profundinema* a filament from the depths of the sea	Correctly formed, based on the examples in Table 2
thetaiotaomicron	*Bacteroides thetaiotaomicron*	N.L. n. *thetaiotaomicron* a combination of the Greek letters *theta*, *iota* and *omicron* (relating to the morphology of vacuolated forms)	An arbitrary name, given as an example of such a name in Rule 12c of the Code

Table 7. Selected species epithets of prokaryote genera in which the last part of the name is derived from Greek and the Neo-Latin word was formed as a noun in the genitive case [Rule 12c(3)]

The etymology is given as found in LPSN (www.bacterio.net).

Epithet	Species	Etymology	Greek source/comments
acnes	*Propionibacterium acnes*	Gr. n. *acme* a point; incorrectly transliterated as N.L. n. *acne* acne; N.L. gen. n. *acnes* of acne	Based on Table 2, the preferential transliteration of the feminine genitive ending –ης is *–ae*
akari	*Rickettsia akari*	Gr. n. *akari* a mite; N.L. gen. n. *akari* of a mite	Except for the fact that the neuter noun ἀκαρι exists in Greek, no information about the conjugation of the word could be found. It is not clear on what basis *akari* was chosen as the genitive form of a Neo-Latin word
alocis	*Filifactor alocis*	Gr. n. *alox -okos* a furrow; N.L. gen. n. *alocis* of a furrow, referring to its isolation from a crevice of the gums	The genitive ending –ος was transliterated to *–is* according to Table 2
amarae	*Gordonia amarae*	Gr. n. *amara* trench, conduit, channel; here a sewage duct; N.L. gen. n. *amarae* of a sewage duct	Based on Table 2, *amarae* is the correct transliteration of ἀμαρης, the genitive form of ἀμαρη
anthropi	*Chryseobacterium anthropi*/ *Jonquetella anthropi*/ *Luteibacter anthropi*/ *Ochrobactrum anthropi*/ *Pseudocitrobacter anthropi*	Gr. n. *anthropos* a human being; N.L. gen. n. *anthropi* of a human being	Based on Table 2, *anthropi* is the correct transliteration of the genitive ἀνθρωπου
boreopolis	*Pseudomonas boreopolis*	Gr. n. *boreas* the north; Gr. n. *polis* a city; N.L. gen. n. *boreopolis* of North City	As the genitive of πολις is πολεως or πολεος, the preferred transliteration based on the examples in Table 2 is *poleis*
chelonae	*Mycobacterium chelonae*	Gr. n. *khelone* a tortoise; N.L. gen. n. *chelonae* of a tortoise	*chelonae* is the correct transliteration of the genitive form χελωνης based on Table 2
columbipharyngis	*Riemerella columbipharyngis*	L. n. *columbus -i* a pigeon; N.L. n. *pharynx –yngis* (from Gr. n. *pharugx pharuggos*) throat; N.L. gen. n. *columbipharyngis* of the throat of a pigeon	The genitive ending –ος was transliterated to *–is* according to Table 2
copri	*Prevotella copri*	N.L. gen. n. *copri* (from Gr. n. *kopros -on*) of/from faeces	*copri* was formed correctly based on Table 2 for the genitive of a 2nd declension feminine noun
cynodegmi	*Capnocytophaga cynodegmi*	Gr. *kuôn kynos* dog; Gr. n. *dêgmos* a bite; N.L. gen. n. *cynodegmi* of a dog bite	As δηγμα is 3rd declension neuter, *degmatis* is the correct transliteration of the genitive
dagmatis	*Pasteurella dagmatis*	Gr. n. *dagma -atos* bite; N.L. gen. n. *dagmatis* of/from a bite	*dagmatis* was formed correctly based on Table 2 for the genitive of a 3rd declension neuter noun
epidermidis	*Staphylococcus epidermidis*	Gr. n. *epiderma* the outer skin; N.L. gen. n. *epidermidis* of the epidermis	The genititve ἐπιδερμιδος was transliterated to *epidermidis* in accordance with Table 2
equirhinis	*Mycoplasma equirhinis*	L. n. *equus -i* a horse; Gr. n. *rhis rhinos* nose; N.L. gen. n. *equirhinis* of the nose of a horse	The genititve ῥινος was transliterated to *rhinis* in accordance with Table 2
gyiorum	*Kerstersia gyiorum*	Gr. n. *gyion* limb; N.L. gen. n. *gyiorum* from the limbs	The genitive plural γυιων was transliterated as *gyiorum* in accordance with Table 2
hippocoleae	*Arcanobacterium hippocoleae*	Gr. n. *hippos* a horse, mare; Gr. n. *koleos* sheath, vagina; N.L. gen. n. *hippocoleae* of the horse vagina	Based on the examples in Table 2, the preferred way to transliterate the genitive feminine κολεου is *colei*
ichthyoenteri	*Flaviramulus ichthyoenteri*	Gr. n. *ichthys* fish; Gr. n. *enteron* gut; N.L. gen. n. *ichthyoenteri* of fish gut	*enteri* was formed correctly based on Table 2 for the genitive of a 2nd declension masculine noun
necropolis	*Virgibacillus necropolis*	N.L. masc. adj. *necropolis* of the necropolis, referring to the mural paintings of the necropolis of Carmona, Spain, from where the type strain was isolated	As the genitive of πολις is πολεως or πολεος, the preferred transliteration based on the examples in Table 2 is *poleis*
oeni	*Leuconostoc oeni*/ *Oenococcus oeni*	Gr. n. *oinos* wine; N.L. gen. n. *oeni* of wine	*oini* was formed correctly based on Table 2 for the genitive of a 2nd declension noun
okeanokoites	*Planomicrobium okeanokoites*	Gr. masc. n. *okeanos* the ocean; Gr. fem. n. *choite* bed; N.L. fem. gen. n. *okeanokoites* of the ocean bed	Based on Table 2, the genitive form of κοιτος, κοιτους, should have been transliterated as *…koiti* instead of *…koites*
oulorum	*Bacteroides oulorum*/ *Prevotella oulorum*	Gr. n. *oulon* the gums; N.L. gen. pl. n. *oulorum* of the gums	The genitive plural οὐλων was transliterated as *oulorum* in accordance with Table 2. Based on Table 1, *ulorum* is possible as well
phymatum	*Burkholderia phymatum*	Gr. n. *phuma* tumour, tubercle; N.L. gen. pl. n. *phymatum* of nodules	The genitive plural φυμαθων was transliterated as *phymatum* in accordance with Table 2
ptyseos	*Tatumella ptyseos*	N.L. gen. n. *ptyseos* (from. Gr. n. *ptusis -eôs*, spitting) of/from a spitting	The preferred way to transliterate πτυσεος is *ptyseis* based on the examples in Table 2
rhizae	*Sporomusa rhizae*	N.L. gen. n. *rhizae* (from Gr. n. *rhiza*, root) of the root	The genititve ῥιζης was transliterated to *rhizae* in accordance with Table 2
rhizomae	*Marinomonas rhizomae*	N.L. n. *rhizoma* (from Gr. n. *rhizôma*) a rhizome; N.L. gen. n. *rhizomae* of a rhizome	Based on Table 2, the correct form derived from the genitive of the neuter noun ῥιζωμα is *rhizomatis*

Table 7. cont.

Epithet	Species	Etymology	Greek source/comments
rhusiopathiae	*Erysipelothrix rhusiopathiae*	Gr. adj. *rhousios* reddish; Gr. n. *pathos* accident, misfortune, calamity; N.L. gen. n. *rhusiopathiae* of red disease	Based on the examples in Table 2, the correct transliteration of the genitive noun παθεος is probably *patheis*
stomatis	*Pasteurella stomatis*/ *Peptostreptococcus stomatis*	Gr. n. *stoma stomatos* mouth; N.L. gen. n. *stomatis* of the mouth, throat	*stomatis* was correctly formed based on Table 2 for the genitive of a 3rd declension neuter noun
thalassae	*Vibrio thalassae*	Gr. fem. n. *thalassa* the sea	The genititve θαλασσης was transliterated to *thalassae* in accordance with Table 2
trogontum	*Helicobacter trogontum*	Gr. part. adj. *trogon trogontos* (from Gr. v. *trôgô* to gnaw) gnawing; N.L. gen. pl. n. *trogontum* of gnawing animals	Correctly formed, based on the examples in Table 2 for genitive plural 3rd declension words
udeis	*Burkholderia udeis*	N.L. gen. n. *udeis* (from Gr. gen. n. *oudeos*) from ground	Derived from the neuter noun οὐδας, the transliteration of the genitive is correct based on Table 2
uli	*Lactobacillus uli*/ *Olsenella uli*	Gr. n. *oulon* the gums; N.L. gen. n. *uli* of the gum	*uli* was formed correctly based on the examples in Tables 1 and 2
xyli	*Clavibacter xyli*/ *Leifsonia xyli*	Gr. n. *xulon* wood; N.L. gen. n. *xyli* of wood	*xyli* was formed correctly based on the examples in Table 2
zoodegmatis	*Neisseria zoodegmatis*	Gr. n. *zoon* an animal; Gr. n. *degma* a bite; N.L. gen. n. *zoodegmatis* of an animal's bite	As δηγμα is 3rd declension neuter, *degmatis* is the correct transliteration of the genitive
zoohelcum	*Bergeyella zoohelcum*/ *Weeksella zoohelcum*	Gr. n *zoon* an animal; Gr. neut. n. *helkos* a wound; N.L. gen. pl. n. *zoohelcum* of animal wounds	The genitive plural of ἑλκος, genitive ἑλκεος, is ἑλκεων, to be transliterated as *helkeum* or *helceum* based on the examples in Table 2
zymae	*Lactobacillus*	N.L. n. *zyma* (from Gr. n. *zumè*) leaven, sourdough; N.L. gen. n. *zymae* of sourdough	*zymae* was formed correctly based on the examples in Table 2

Table 2. For example, for names that end on ῥαβδος the ending *-rhabdus* is used. However, there are exceptions. *Caryophanon*, a genus name published in 1939 and included in the 1980 Approved Lists of Bacterial Names (Skerman *et al.*, 1980), should read *Caryophanum* based on the currently accepted transliteration. A Request for an Opinion to change the genus name *Rhodoligotrophos* (Fukuda *et al.*, 2012) to *Rhodoligotrophus* is currently awaiting to be discussed by the Judicial Commission of the International Committee on Systematics of Prokaryotes (Oren *et al.*, 2013).

Table 4 shows representative examples of specific epithets formed as adjectives based on Rule 12c(1) of the Code, with annotations about the way Greek words and endings were transliterated. The number of different endings of Latin adjectives is limited; the common ones being *–us*, *–a*, *–um* (1st and 2nd declension), *–is*, *–e* and a number of additional possibilities (3rd declension), and *–ans* and *–ens* (present participles used as adjectives). These endings can be adopted for Greek roots to form adjectives that comply with Rule 3 of the Code. A common way to form adjectives from Greek roots is by means of the Latin ending *–icus* (masc.) *–ica* (fem.) *–icum* (neut), e.g. in combined words such as *endophyticus –a –um*. A few examples of such names are given in Table 5. This is a simple way of using Greek word elements while complying with Rule 3 of the Code. Other options, used in many epithets, involve endings such as *–philus –a –um* (from Gr. adj. φιλος –η –ον) friend, loving, *–lyticus –a –um* (from λυτικος –η –ον) dissolving, and *trophus –a –um* (from Gr. adj. τροφος –η –ον) feeder.

Representative epithets formed as nouns in the nominative case 'in apposition', as based on Rule 12c(2) of the Code, are found in Table 6. Few special problems are encountered here: except for *Azotobacter chroococcum* where *chroococcus* would have made more sense, the transliteration suggestions in Table 2 were always followed.

Comments on the transliteration of the Greek κ in genus and species names

Inspection of the examples given in Tables 3–7 shows that the transliteration of the Greek κ has been highly inconsistent. MacAdoo (1993; see also Table 1) recommended '*c*', and he commented: 'Bacteriology allows the use of *k*… only in names and epithets formed from modern languages, never from Greek.' Thus we have genus names and specific epithets such as *Caryophanon, actinosclerus, micros, thermosphacta, zoohelcum*, etc. On the other hand, Recommendation 6(7) of the ICNP states that the Greek K… should be maintained to avoid confusion, and gives as example: *Akinetobacter* instead of *Acinetobacter* (even if the latter is the validly published name!). Examples of the '*k*' spelling in specific epithets are *eikastus, genikus, hippikon, akari* and *okeanokoites*. The mode of transliteration of Greek κ was not addressed in Appendix 9 – Orthography to the Code (Trüper & Euzéby, 2009; Parker *et al.*, 2016), and Recommendation 6(7) is not a Rule. Therefore authors are free to adopt or to disregard this recommendation.

Final comments and recommendations

The annotated examples of the use of Greek roots in the prokaryote nomenclature, as given in Tables 3–7, provide much information about the ways elements derived from

Greek have been incorporated in the nomenclature in the past. This was not always done in a consistent way. Notably, there are cases in which the requirements of the Greek grammar were met, but that are against Principle 3 of the ICNP which requires that the scientific names of all taxa be treated as Latin. Obvious examples are the genus name *Rhodoligotrophos* and the epithets in *Eubacterium brachy*, *Acholeplasma hippikon* and *Peptostreptococcus micros*. More examples can be found in the tables.

Taxonomists who give names to newly described prokaryotes tend to be more familiar with the rules of Latin grammar than with those of Greek. The correct formation of names based on Greek is often less straightforward than for Latin, as the examples in Tables 3–7 show. We hope that the guidelines given above will be useful when authors decide to base newly formed names on Greek, so that the resulting names will be both grammatically correct, consistent with the way Greek endings are transliterated to Latin (Table 2), and also meet the requirements of Principle 3, Rule 6, Rule 10a and the other provisions of the ICNP.

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