Taxonomic Note

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Rule 15 of the International Code of Nomenclature of Bacteria: a current source of confusion

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There is some degree of confusion surrounding Rule 15 of the International Code of Nomenclature of Bacteria and the fact that it appears to contradict the general principle of priority, which is central to codes of nomenclature. The present overview attempts to highlight the problem and also to provide a basis for discussion towards a solution.

The current wording of Rule 15 of the International Code of Nomenclature of Bacteria (to become the International Code of Nomenclature of Prokaryotes; the Code) reads (Lapage *et al.*, 1992):

‘A taxon consists of one or more elements. For each named taxon of the various taxonomic categories (listed below), there shall be designated a nomenclatural type. The nomenclatural type, referred to in this Code as ‘type’, is that element of the taxon with which the name is permanently associated. The nomenclatural type is not necessarily the most typical or representative element of the taxon. The types are dealt with in Rules 16–22.’

This wording has been taken to mean that the name of the type species of a genus is conserved over earlier synonyms at the same position and rank. While P. H. A. Sneath has indicated in a personal communication that the wording of this Rule had been left ambiguous, J. McNeill (personal communication) indicated that the wording was by no means ambiguous, although it may lack a degree of clarity. The issue of the problem of the wording of Rule 15 surfaced during the formulation of Opinion 80 (Judicial Commission, 2005) together with the accompanying interpretation (Tindall *et al.*, 2005) and is also the subject of a more limited Request for an Opinion dealing with nomenclature in the genus *Agrobacterium* (Young *et al.*, 2006).

In essence, the wording of Rule 15 seems to have caused confusion shortly after publication of the 1975 revision of the Code. This was evident in the publication regarding the nomenclature of the species *Yersinia pestis* and *Yersinia pseudotuberculosis* (Bercovier *et al.*, 1980), as well as in the Request for an Opinion (Farmer *et al.*, 1976) regarding the question of priority of *Edwardsiella anguillimortifera* over *Edwardsiella tarda* [a request that was eventually withdrawn (Judicial Commission, 1978), although the problem has not been solved, it has been ignored]. Similarly, Holmes & Roberts (1981) have interpreted the issue of the matter of priority with regard to the names *Agrobacterium tumefaciens* and *Agrobacterium radiobacter* in a similar fashion, as have Kersters & De Ley (1984).

The current interpretation of Rule 15 implies that the name of the type species of a genus at the same position and rank is conserved over any earlier synonyms at the same position and rank, implying that the principle of priority is overruled. However, this is far from the case, since the critical wording of Rule 15 only makes a statement regarding the fact that the nomenclatural type ‘is that element of the taxon with which the name is permanently associated’ and does not make any mention of the principle of priority or the fact that it may be treated as a later heterotypic synonym of another taxon.

Other rules of relevance include:

‘Rule 17. The type determines the application of the name of a taxon if the taxon is subsequently divided or united with another taxon.’

The appropriate Rules in the Code determine which name has priority, and this wording would not exclude the possibility that the name of the type species of a genus could be a later heterotypic synonym.

‘Rule 38. When two or more taxa of the same rank are united, then the name of the taxon under which they are united (and therefore the type of the taxon) is chosen by the rule of priority of publication.’

In the case of the name of the type species of a genus, if it is a heterotypic synonym, the current interpretation of the Code would be in conflict with this Rule.

‘Rule 42. In the case of subspecies, species, subgenera, and genera, if two or more of those taxa of the same rank are united, the oldest legitimate name or epithet is retained.

If priority of the names or epithets cannot be determined unambiguously (see Rule 24b), the author who first unites the taxa has the right to choose one of them, and his choice must be followed.’

In the case of the name of the type species of a genus, if it is a heterotypic synonym, the current interpretation of the Code would be in conflict with this Rule.

If one wishes to remove this apparent contradiction from the Code, the following wording of Rule 15 would be appropriate:

‘A taxon consists of one or more elements. For each named taxon of the various taxonomic categories (listed below), there shall be designated a nomenclatural type. The nomenclatural type, referred to in this Code as ‘type’, is that element of the taxon with which the name is permanently associated, **whether as a correct name or as a synonym**. The nomenclatural type is not necessarily the most typical or representative element of the taxon. The types are dealt with in Rules 16–22.’

It should be noted that, when the principle of priority is applied, a number of corrections in interpretation have to be made.

There are a number of examples where the type of a genus has been shown to be a later homotypic or heterotypic synonym, and some examples are illustrated below.

Synonymy of *Edwardsiella tarda* Ewing and McWhorter 1965 (type species of the genus) (type strain ATCC 15947) and *Edwardsiella anguillimortifera* (Hoshina 1962) Sakazaki and Tamura 1975 (type strain ATCC 15947)

If we simply follow the rules of priority:

The epithet *anguillimortifera* in *Edwardsiella anguillimortifera* (Hoshina 1962) Sakazaki and Tamura 1975 is the earlier legitimate epithet and has priority over the epithet *tarda* in *Edwardsiella tarda* Ewing and McWhorter 1965.

The correct name in the genus *Edwardsiella* is *Edwardsiella anguillimortifera* (Hoshina 1962) Sakazaki and Tamura 1975 (type strain ATCC 15947) if the two names are considered to be synonymous.

The type strain of the type species remains ATCC 15947.

The type species of the genus remains *Edwardsiella tarda* Ewing and McWhorter 1965, although it may be a synonym and might not appear as a correct name. The names *Edwardsiella tarda* Ewing and McWhorter 1965 and *Edwardsiella anguillimortifera* (Hoshina 1962) Sakazaki and Tamura 1975 are homotypic synonyms, which may have further implications.

Synonymy of *Marinobacter hydrocarbonoclasticus* Gauthier et al. 1992 (type species of the genus) (type strain SP.17) and *Pseudomonas nautica* Baumann et al. 1972 (type strain ATCC 27132)

If we simply follow the rules of priority:

The epithet *nautica* in *Pseudomonas nautica* Baumann et al. 1972 is the earlier legitimate epithet and has priority over the epithet *hydrocarbonoclasticus* in *Marinobacter hydrocarbonoclasticus* Gauthier et al. 1992.

The correct name in the genus *Marinobacter* is *Marinobacter nauticus* (Baumann et al. 1972) with synonymy being asserted by Spröer et al. 1998 (type strain ATCC 27132) if the two names are considered to be synonymous.

The type strain of the type species remains SP.17.

The type species of the genus remains *Marinobacter hydrocarbonoclasticus* Gauthier et al. 1992, although it may be a synonym and might not appear as a correct name.

Synonymy of *Deleya aesta* (Baumann et al. 1972) Baumann et al. 1983 (type species of the genus) (type strain 134), *Deleya aquamarina* (ZoBell and Upham 1944) Akagawa and Yamasato 1989 (type strain ZoBell and Upham 558), *Halomonas aquamarina* (ZoBell and Upham 1944) Dobson and Franzmann 1996 (type strain ZoBell and Upham 558) and *Alcaligenes faecalis* subsp. *homari* Austin et al. 1981 (type strain L1)

If we simply follow the rules of priority:

In the genus *Deleya*:

The epithet *aquamarina* in *Deleya aquamarina* (ZoBell and Upham 1944) Akagawa and Yamasato 1989 is the earlier legitimate epithet and has priority over the epithet *aesta* in *Deleya aesta* (Baumann et al. 1972) Baumann et al. 1983, as well as the subspecific epithet *homari* in *Alcaligenes faecalis* subsp. *homari* Austin et al. 1981.

The correct name in the genus *Deleya* is *Deleya aquamarina* (ZoBell and Upham 1944) Akagawa and Yamasato 1989 (type strain ZoBell and Upham 558) if these four names are considered to be synonymous.

The type strain of the type species remains strain 134.

The type species of the genus *Deleya* remains *Deleya aesta* (Baumann et al. 1972) Baumann et al. 1983, although it may be a synonym and might not appear as a correct name.

In the genus *Halomonas*:

Halomonas aquamarina (ZoBell and Upham 1944) Dobson and Franzmann 1996 is a homotypic synonym of *Deleya aquamarina* (ZoBell and Upham 1944) Akagawa and Yamasato 1989, a heterotypic synonym of *Deleya aesta* (Baumann et al. 1972) Baumann et al. 1983 and a heterotypic synonym of *Alcaligenes faecalis* subsp. *homari* Austin et al. 1981.

The correct name in the genus *Halomonas* is *Halomonas aquamarina* (ZoBell and Upham 1944) Dobson and Franzmann 1996 (type strain ZoBell and Upham 558) if these four names are considered to be synonymous.

The type of the genus *Halomonas* is *Halomonas elongata*.

Synonymy of *Cupriavidus necator* Makkar and Casida 1987 (type species of the genus) (type strain N-1), *Alcaligenes eutrophus* Davis 1969 (Approved Lists 1980) (type strain ATCC 17697), *Ralstonia eutropha* (Davis 1969) Yabuuchi *et al.* 1996 (type strain ATCC 17697) and *Wautersia eutropha* (Davis 1969) Vaneechoutte *et al.* 2004 (type strain ATCC 17697)

If we simply follow the rules of priority:

The epithet *eutrophus* in *Alcaligenes eutrophus* Davis 1969 (Approved Lists 1980) is the earlier legitimate epithet and has priority over the epithet *necator* in *Cupriavidus necator* Makkar and Casida 1987.

The correct name in the genus *Cupriavidus* is *Cupriavidus eutrophus* (Davis 1969), with synonymy asserted by Vandamme and Coeyne 2004 (type strain ATCC 17697), if the names *Cupriavidus necator* and *Alcaligenes eutrophus* are considered to be synonymous.

The type strain of the type species remains N-1.

The type species of the genus remains *Cupriavidus necator* Makkar and Casida 1987, although it may be a synonym and might not appear as a correct name.

Synonymy of *Microvirgula aerodenitrificans* Patureau *et al.* 1998 (type species of the genus) (type strain SGLY2) and *Aquaspirillum dispar* Hylemon *et al.* 1973 (type strain ATCC 27510)

If we simply follow the rules of priority:

The epithet *dispar* in *Aquaspirillum dispar* Hylemon *et al.* 1973 is the earlier legitimate epithet and has priority over the epithet *aerodenitrificans* in *Microvirgula aerodenitrificans* Patureau *et al.* 1998.

The correct name in the genus *Microvirgula* is *Microvirgula dispar* (Hylemon *et al.* 1973), with synonymy asserted by Cleenwerck *et al.* 2003 (type strain ATCC 27510), if the two names are considered to be synonymous.

The type strain of the type species remains SGLY2.

The type species of the genus remains *Microvirgula aerodenitrificans* Patureau *et al.* 1998, although it may be a synonym and might not appear as a correct name.

Synonymy of *Agrobacterium tumefaciens* (Smith and Townsend 1907) Conn 1942 (type species of the genus) (type strain ATCC 23308) and *Agrobacterium radiobacter* (Beijerinck and van Delden 1902) Conn 1942 (type strain ATCC 19358)

If we simply follow the rules of priority:

The epithet *radiobacter* in *Agrobacterium radiobacter* (Beijerinck and van Delden 1902) Conn 1942 is the earlier legitimate epithet and has priority over the epithet

tumefaciens in *Agrobacterium tumefaciens* (Smith and Townsend 1907) Conn 1942.

The correct name in the genus *Agrobacterium* is *Agrobacterium radiobacter* (Beijerinck and van Delden 1902) Conn 1942 (type strain ATCC 19358) if the two names are considered to be synonymous.

The type strain of the type species remains ATCC 23308.

The type species of the genus remains *Agrobacterium tumefaciens* (Smith and Townsend 1907) Conn 1942, although it may be a synonym and might not appear as a correct name.

It should be noted that some combinations proposed in the IJSEM, where the type of a genus at the same position and rank is a later heterotypic synonym, do not follow the principle of priority (Principle 6; Lapage *et al.*, 1992), and corrections would be needed to bring the nomenclature of these names in line with the proposed new wording of Rule 15.

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