Taxonomic Note

Correspondence

J. M. Young
youngj@clear.net.nz

Legitimacy is an essential concept of the International Code of Nomenclature of Prokaryotes – a major revision of the Code is called for

J. M. Young

Landcare Research, Private Bag 92170, Auckland, New Zealand

Tindall [*Int J Syst Evol Microbiol* **58** (2008), 1979–1986] claimed that the *International Code of Nomenclature of Prokaryotes* (the Code) creates a paradox in the application of the term 'legitimate' in relation to valid publication, that the term is dispensable and that the paradox would be resolved by revising the Code to avoid its use. Although it is not clearly explained in the Code, the concept of legitimacy is central to the proposal of names. Discarding the concept would fundamentally alter the conceptual structure of the Code and obscure significant distinctions in formal nomenclature. The text of the Code itself is not clear and a careful reading suggests that it would be enhanced by a critical overview involving textual revision and restructuring of some sections. The Judicial Commission is asked not to accept Tindall's suggested revision and it is proposed that the Editorial Board of the International Committee on Systematics of Prokaryotes re-examine the Code from first principles and make such revisions as will avoid in future the confusion, ambiguities and uncertainties indicated here.

Recently, Tindall (2008b) proposed that the terms 'legitimate' and 'illegitimate' as used in the *International Code of Nomenclature of Prokaryotes* ('the Code' – hitherto the *International Code of Nomenclature of Bacteria*; Lapage *et al.*, 1992) are redundant and that the Code should be revised to dispense with them. The proposal was discussed briefly by the Judicial Commission of the International Committee on Systematics of Prokaryotes (ICSP) at the 12th International Congress of Bacteriology and Applied Microbiology (Istanbul, Turkey, 5–9 August 2008) and a decision was deferred until the next Congress in 2011 (D. P. Labeda, Minutes Secretary to the Judicial Commission, personal communication).

It will be argued here that the proposed changes are the result of a misinterpretation of the Code but that this is because of a general lack of clarity in the Code itself. What follows is an extension of Young (2008) that aims specifically to clarify the relevant Sections and Rules in order to show the significance of the concept of legitimacy, to note elements of the structure of the Code that are sources of confusion and to consider the implications of Tindall's changes in this light. It will be proposed that Tindall's revision should not be adopted by the Judicial Commission. Finally, it will be proposed that the Rules should not be modified by further ad hoc amendment but be reconsidered in a general revision of the Code.

The primary objectives of the Code

The structure of the 1976 revision of the Code (Lapage *et al.*, 1975) was strongly shaped by the need to emphasize

the importance of the Approved Lists of Bacterial Names ('the Approved Lists'; Skerman *et al.*, 1980) as well as the process of valid publication. Both are unique to bacterial nomenclature, and form the basis for establishing the priority of names (Young, 2008). This structure was carried over without significant amendment in the 1992 revision (Lapage *et al.*, 1992). In giving emphasis to these central issues, the authors' attention was perhaps diverted from other important aspects of the Code, because the structure of the published revisions, even though they have been the subject of ongoing amendment, obscures certain essential nomenclatural relationships.

One of the most important objectives of the Code is to regulate the publication of names proposed in accord with the Rules (legitimate names) and their listing as validly published names, in order to simplify the process of determining the priority of synonyms and hence the identification of correct names. A correct name is the one that '... must be adopted for a particular taxon under the Rules' (Rule 23a).

(i) The first step is the proposal of a legitimate name (or combination). Unfortunately, the Code is written in a way that obscures what constitutes a legitimate name, noting only (Rule 23a *Note* 5) that names and epithets should be 'in accordance with the Rules'. Considered in isolation, this definition is a tautology, providing little or no elaboration for the term. However, in this position, the context is clear; a legitimate name is one in accordance with the Rules *that are relevant to the proposal of names*. It refers to the Rules

that specify the information required for the proposal of a legitimate name. This information comprises the explicit proposal of the name, together with its orthography and derivation, the description of the taxon and the designation of a type. The term 'protologue' usefully encapsulates this information. This term is not defined in the Code but it is now used routinely (Tindall *et al.*, 2006). In the first instance, it is the responsibility of its authorship to ensure that a proposed name fulfils the Rules and therefore is legitimate.

The name also must be effectively published in a suitable medium (Rule 25a). In this second instance, it is the responsibility of the reviewers and editors of the publication in which the name is effectively published to confirm that the name meets the criteria governing legitimacy.

(ii) To have *standing in nomenclature*, an effectively published name must be included in a Validation List in the *International Journal of Systematic and Evolutionary Microbiology* (IJSEM) (Rule 27). The proposal of names published directly in IJSEM also constitutes valid publication. It must be emphasized that such publication does not ipso facto 'validate' or 'legitimize' names in any nomenclatural sense. This point was made explicitly by Skerman *et al.* (1980, 1989) in relation to the Approved Lists, and it applies with equal force to the lists of validly published names. The requirement that names be so listed is to provide a single compendium or 'register' (Tindall *et al.*, 2006) in IJSEM of names that have standing in nomenclature to obviate searches for effectively published names in the wider scientific literature when determining priority. This is the sole function of the Validation Lists. Since the publication of the Approved Lists, a total of approximately 9500 names of new species and new combinations have been validly published, of which about 7000 were published directly in IJSEM. Its editors oversee the presentation of proposals of all names, whether as effective publications for inclusion in Validation Lists or as direct publications in IJSEM.

(iii) The order of publication in IJSEM determines the priority of synonyms (Rule 24b).

(iv) All validly published synonyms of names have standing in nomenclature, but only one can take priority as the correct name of a taxon in a given classification scheme (Rule 23a).

In summary, the four distinct processes in the creation and determination of correct names are: (i) proposal of a legitimate, effectively published name, (ii) listing of the name in IJSEM in order to record it as a validly published name, (iii) determination of the priority of synonyms and (iv) identification of the correct name. Properly, the correct name is the earliest, legitimate, validly published synonym with a given circumscription, position and rank. Names proposed in IJSEM are effectively and validly published in a single step, but the legitimate proposal, valid publication and determination of priority are distinct

processes. These processes involve concepts that are entirely different in character and cannot be equated one with another.

Ambiguities and uncertainties in the Code

A careful reading of the Code shows that a number of Rules are not clearly written and the order in which they are recorded in the Code leads to confusion. Central to the discussion of this paper is the objection that the Code does not clearly state the requirements for the proposal of properly formed, legitimate names in an orderly way and is ambiguous and uncertain in various other places. A major source of confusion is that the Rules governing the formal proposal of names are not found under a single heading at the beginning of Section 5, *Priority and Publication of Names*, and referring to the proposal of legitimate names, but are dispersed under subheadings associated with *Priority* (Rule 23a) and *Publication* (Rules 25a, 27, 28, 30, 31 and 32). Most of these Rules refer to valid publication in IJSEM rather than, as they should do, to names effectively published in any suitable journal. An amendment to Rule 27 (De Vos & Trüper, 2000) includes the requirements for legitimate names (the explicit proposal of the name, together with its orthography and derivation, the description of the taxon and the designation of a type), but they are referred directly to the valid publication of names in IJSEM. They should, in the first instance, specify the requirements for the proposal of legitimate names, because they refer to all proposals of names wherever they are published. Furthermore, subsequent amendments (De Vos *et al.*, 2005; Tindall *et al.*, 2008) have worked to support this misleading structure. Misconstruction of the Code at this point is probably the source of the greatest misunderstanding.

The Code would be clearer if Section 5 was given a new title such as *Establishment of Correct Names*. Under separate subheadings, such as *Proposal of Legitimate Names*, *Effective Publication of Names*, *Valid Publication of Names* and *Priority*, the rules relevant to these separate matters would make clear the sequence of events in determining correct names. Also obscured in the present Code is the fact that, although 'illegitimate', as the antithesis of 'legitimate', is referred to in Rule 23a *Note 5*, the specific relevant rules are reported in Section 8, Rule 51a. These might be better included in Section 5, to explain the prohibitions associated with the proposal of legitimate names.

There are a number of other instances in which the Code is unclear or ambiguous. The following are only the most striking examples.

The wording of Rule 15 has caused confusion over the priority of types (Tindall, 2008a).

Rule 24a includes much introductory text that explains the role of the Approved Lists in establishing the new starting point for bacterial nomenclature. This explanation is

essential in the Code, but should now be recorded elsewhere, perhaps as a historical note.

Rules 26a and 26b apply to effective publication and are not relevant to the publication of names with standing in nomenclature, which is covered by Rules 27, 28a and 28b. They appear to be an atavistic reference to the determination of priority of legitimate names published before 1980 being considered for validation by publication in the Approved Lists.

Tindall & Garrity (2008) have noted the problem that arises when a novel subspecies is proposed by the division of a species. Such proposals automatically create another subspecies that includes the type strain of the species and whose name, therefore, is that of the species. The Code only requires such proposals to include a description of the novel subspecies, without considering whether there should be an obligation to provide an emended description of the subspecies with the basonym. Tindall & Garrity (2008) note that 'it is important that authors take into consideration both that the species description may have to be emended and that all subspecies names, whether created automatically or not, must meet the requirements of Rule 27 ...'. Perhaps it is true that the species description may need emendation in these cases, but it is more likely that the description of the subspecies based on the basonym will require emendation, because at least some characters associated with the new subspecies should be excluded from it. However, this conclusion, that the description of the basonymic subspecies may require emendation, is also true whenever taxa at any taxonomic level are subdivided, whether into separate subspecies, separate species or separate genera (Rules 39a and 40a). Division of a taxon into two should require emendation of the description of the basonymic taxon. The Code should have some comment on this point.

The Code does not make explicit in Rule 41a, as it should, the requirement that, if a new combination is proposed then, as with the proposal of novel taxa, type strains must be included in the study to exclude the possibility of creating a heterotypic synonym. Otherwise, the proposal is based on the claim of the authors that their reference populations comprise authentic members of taxa, which is too often not the case.

The Code does not clearly describe the different nomenclatural consequences resulting when taxa are united. At first sight, these consequences seem to be indicated by Rule 24a *Note* 3, which describes heterotypic synonyms, and by Rules 42 and 44. However, collectively, these rules do not take account of Rules 51b(1) and 51b(2). These latter rules make it clear that the name of a novel taxon is illegitimate when proposed if it contains the type of an earlier legitimate name or if there was an earlier name that should have been used. The name is illegitimate because it refers to a later synonym with the same circumscription, position and rank as the earlier synonym. Does this not create a conundrum when two legitimate and validly

published names are subsequently shown to be heterotypic synonyms? For example, the genus *Sinorhizobium* Chen *et al.* 1988 was shown to be the later heterotypic synonym of *Ensifer* Casida 1982 (Willems *et al.*, 2003). Under such circumstances, does the later heterotypic synonym with the same circumscription, position and rank not become illegitimate 'by discovery' if there is to be consistency with Rules 51b(1) and 51b(2)? The legal status of synonyms demonstrated under these circumstances is not adequately defined. The section in Rule 24a describing heterotypic synonyms and Rules 42, 44, 51b(1) and 51b(2) should collectively be revised to take account of their shared impact on the legitimacy of synonyms – to make clear the distinction between those new combinations that are synonyms according to a particular taxonomic opinion, which permit a choice of synonym, and those that share an identical circumscription, which do not.

Rule 56a, in Section 8 (*Illegitimate Names and Epithets*), describes the identification and status of *nomina rejicienda* (rejected names). Names may only be declared to be rejected names by the Judicial Commission if they are considered to be ambiguous, doubtful, confusing, perplexing or perilous. Rejected names are clearly different from other categories described in this Section in that they are proposed in due form as legitimate names, are validly published and therefore have standing in nomenclature; no Rule was broken in their formation, nor are they illegitimate 'by discovery'. Rejected names are confused as illegitimate names because they are in a Section entitled *Illegitimate Names and Epithets*. They should be referred to under some other heading. Young (2008) accepted rejected names as kinds of illegitimate names but, according to the interpretation here, was mistaken.

It is not surprising that mistakes in proposals have occasionally been overlooked, resulting in the publication of illegitimate names in the lists of validly published names. Under some circumstances, a correction may be made by the IJSEM List Editor after publication. For instance, the new combination *Thalassobius gelatinovorius* was proposed (Arahal *et al.*, 2005) without listing the type strain, and therefore was illegitimate. A correction was published in Validation List No. 107 (Arahal *et al.*, 2006) providing the missing data, and the name was included in a Notification List (List Editor, 2006), but citing Arahal *et al.* (2005) as the validating publication. In other cases, the Judicial Commission of the ICSP may be required to make a determination based on a Request for an Opinion (Appendix 8). For example, more than 70 names were proposed with the deposition of the type strain in only one culture collection, and were listed as validly published, after the Code (Rule 30) had been amended to require the deposition of isolates of the type strain in at least two publicly accessible collections in different countries. In these examples, the names were illegitimate because the proposals were incomplete, but they were identified (Euzéby & Tindall, 2004), and a retrospective correction of those names for which type strains had been found in

additional collections was duly made (Judicial Commission, 2008). In the following example, the proposals of *Burkholderia caryophylli* and *Burkholderia gladioli* (Yabuuchi *et al.*, 1992) as new combinations were validly published (Yabuuchi *et al.*, 1993) before it was noticed that their type strains had not been included in the study, and therefore the combinations might not be legitimate. A Request for an Opinion has yet to be made to test their legitimacy. According to the interpretation given above, they are not. In the meantime, *B. caryophylli* and *B. gladioli* are treated as if they were validly published. It should be obvious that all effectively and validly published names are treated as legitimate unless a defect is discovered.

It is not claimed that this critique is complete or that its analysis is correct in every respect. But it is contended that it shows that the Code is not written with clarity and that this has led to errors of interpretation and mistakes in nomenclatural proposals. The extent of such errors and mistakes is unclear, but it seems to have led to the misunderstanding of the Code described below.

Legitimacy

In a very brief introduction, Tindall (2008b) claimed that a paradox results when validly published names are subsequently shown to have been proposed illegitimately, stating that ‘the problem then arises that it would appear that an illegitimate name may be validly published, but at the same time such a name cannot be used as a correct name’. Tindall concluded that ‘in the majority of cases, the situation would be clarified if only names that are in accordance with the Rules can be validly published, thus making the terms legitimate and illegitimate superfluous’. He proposed that the Code should be simplified by replacing the terms ‘legitimate’ and ‘illegitimate’ throughout the Code with the phrases ‘in accord with the Rules’ and ‘not in accord with the Rules’, or with ‘validly published’ or ‘not validly published’, respectively. Tindall did not discuss in detail the application of the terms ‘legitimate’, reported in Principle 6 or in Section 5, Rule 23a, *Note 5*, nor ‘illegitimate’ as reported in Section 8, Rules 51 and 56. Most of his paper was devoted to the rewording of the Code to avoid reference to these terms.

Central to of Tindall’s argument is his claim that ‘... an illegitimate name may be validly published, but at the same time such a name cannot be used as a correct name’, which he then claims creates ‘... the paradox that there are instances where a taxon is given a validly published name but, because it is illegitimate, that name cannot be used’.

Tindall’s use of ‘cannot’ is mistaken because, as noted above, names that do not conform to the Rules (are illegitimate) can be and are listed as validly published names and serve in practice as correct names. Inevitably, illegitimate names proposed in IJSEM or listed in IJSEM as validly published will be treated as validly published until

relevant information is reported that demonstrates a mistake and the need for correction. This is the only way they *can* be treated. The mistake in Tindall’s argument, and one accepted by a number of experienced bacterial taxonomists in personal communications, is that a sensible distinction *can* be made between legitimate names listed as validly published names and illegitimate names also listed as validly published names. This would require reconfirmation of the legitimacy and effective publication of names on Validation Lists by any individual intent on nomenclatural accuracy, and this is exactly what the publication of effectively published names in Validation Lists (and the Approved Lists) is intended to obviate.

Presumably, by ‘paradox’, Tindall means that an internal contradiction is created in the proposition. Carefully examined, however, it is clear that there is no paradox if the Rules are interpreted in the way described here. There can be no formulation, as Tindall proposes, that can prevent illegitimate names, those contrary to the Code, from being listed as validly published names and used as correct names, and the Code is neither contradictory nor paradoxical in the present application of Rules governing the proposal of names. A mistaken proposal does not create a nomenclatural paradox. However, a paradox *is* created by Tindall’s suggested revision in which he proposes that validly published names ‘... *must* [my italics] be in accordance with the Rules. Names contrary to the Rules *cannot* [my italics] be validly published’. This leads to the contradiction that a name can be proposed in a form that is ‘not in accord with the Rules’ (creating an illegitimate name) but, following valid publication, is ‘in accord with the Rules’ (because it is validly published).

Tindall not only has simplified the terminology of the Code by discarding the use of ‘legitimate’, but has also changed the intention of ‘valid publication’. As noted, in introducing the concept of ‘valid publication’, the authors of the 1976 revision aimed to do no more than provide a single compendium of names with standing in nomenclature from which correct names are chosen. Tindall’s suggested revision gives the lists of validly published names a nomenclatural authority such that inclusion of a name renders it ipso facto ‘in accord with the Rules’ (legitimate), overriding inadequacies of its original proposal. Tindall’s mistake may have arisen following a linguistic slide from ‘valid publication’, intended as a listing of names with standing in nomenclature, via ‘registration’ (Tindall *et al.*, 2006), to ‘validation’, in the mistaken sense that valid publication implies nomenclatural authentication. Although the Code states that the correct name is the one that *must* be used in a given classification scheme, this can mean no more than that the correct name is the earliest of the validly published synonyms of the taxon, according to a particular taxonomic opinion, that have standing in nomenclature (i.e. are validly published). Tindall’s conclusion that correct names *must* be in accordance with the Rules does not follow, and creates a contradiction where he tries to avoid one.

Apart from being 'paradoxical', introducing an internal contradiction, and therefore being confusing, the effect of Tindall's revision is to leave unclear the question as to whether illegitimate names that have been listed as validly published can, or should, be corrected. At present, mistakes in the proposal of legitimate names that have been validly published can be, and are, corrected. The consequence of the revision, the confirmation of uncorrected names and removal of the basis for correction (except by revoking the Rules – see below), would be the progressive erosion of the quality of names in Validation Lists and therefore of correct names.

Additional reasons why a name may be illegitimate are detailed in Rule 51b: in 51b(1) the proposed taxon includes the type strain of a validly published name that the authors should therefore have applied; in 51b(2) a name is chosen that is not the earliest validly published synonym available with its particular circumscription, position and rank; and 51b(4) the proposed name is already recognized in other biological nomenclature. If Tindall intends that his revision is applied to these forms of illegitimacy, such that, because they are listed as validly published then they are in accord with the Rules *ipso facto* and cannot be declared illegitimate, then the revision will lead to conflict with 51b(1) and 51b(2) and involve the overthrow of the principle of priority, and with 51b(4) to conflict with Principle 2. His solution is to invoke Rule 3, which is to allow 'the Judicial Commission [to] set aside the Rules of the Code and make exceptions'. But such interventions, involving the setting aside of the Rules, are only necessary if his changes are adopted. Tindall seems not to give consideration to the likelihood, indeed the probability, that names will continue to be illegitimately proposed in future, resulting in the routine setting aside of the Rules by the Judicial Commission. This cannot be desirable. Properly interpreted and suitably clarified, the Code can now take account of the examples that he gives, and solutions in general are already covered by the Rules. As noted, the Judicial Commission already has the authority to rectify nomenclatural mistakes where appropriate.

Based upon these arguments it is proposed to the Judicial Commission that the revision of the Code proposed by Tindall (2008b) not be accepted.

Proposal to revise the Code

At this distance (the Code was written more than 30 years ago), the revolutionary nature of the 1976 revision and the intellectual leap made by the authors in introducing the two novel elements to the Code at that time, the new nomenclatural start and valid publication (Sneath, 2005), is less clear. It is not surprising that the attention of the Code's authors was diverted from other elements of the text and that some sections and individual rules are perplexing and uncertain in application. Viewed in a modern light, it is clear that the Code could be refined considerably by attention to the structure, grouping and

textual revision of Rules. It is proposed that the Chairman of the ICSP establish a process thorough its Editorial Board (Article 11a) to reconsider the Code from first principles to avoid in future the kinds of ambiguity indicated here. The fact that increasing numbers of bacteriologists, some still unfamiliar with the principles of nomenclature, are now engaging in taxonomic activity makes this revision all the more necessary and urgent.

Acknowledgements

Thanks to S. R. Pennycook and S. J. Wagstaff, Landcare Research, and especially to D. R. W. Watson, Plant Diseases Division, Department of Scientific and Industrial Research (retired) for critically reading the manuscript, and to A. Austin for editorial assistance.

References

- Arahal, D. R., Macián, M. C., Garay, E. & Pujalte, M. J. (2005). *Thalassobius mediterraneus* gen. nov., sp. nov., and reclassification of *Ruegeria gelatinovorans* as *Thalassobius gelatinovorus* comb. nov. *Int J Syst Evol Microbiol* **55**, 2371–2376.
- Arahal, D. R., Macián, M. C., Garay, E. & Pujalte, M. J. (2006). *Thalassobius gelatinovorus* comb. nov. In *List of New Names and New Combinations Previously Effectively, but not Validly, Published*. Validation List no. 107. *Int J Syst Evol Microbiol* **56**, 1–6.
- De Vos, P. & Trüper, H. G. (2000). Judicial Commission of the International Committee on Systematic Bacteriology. IXth International (IUMS) Congress of Bacteriology and Applied Microbiology. Minutes of the meetings, 14, 15 and 18 August 1999, Sydney, Australia. *Int J Syst Evol Microbiol* **50**, 2239–2244.
- De Vos, P., Trüper, H. G. & Tindall, B. J. (2005). Judicial Commission of the International Committee on Systematics of Prokaryotes. Xth International (IUMS) Congress of Bacteriology and Applied Microbiology. Minutes of the meetings, 28, 29 and 31 July and 1 August 2002, Paris, France. *Int J Syst Evol Microbiol* **55**, 525–532.
- Euzéby, J. P. & Tindall, B. J. (2004). Status of strains that contravene Rules 27(3) and 30 of the Bacteriological Code. Request for an Opinion. *Int J Syst Evol Microbiol* **54**, 293–301.
- Judicial Commission (2008). Status of strains that contravene Rules 27 (3) and 30 of the International Code of Nomenclature of Bacteria. Opinion 81. *Int J Syst Evol Microbiol* **58**, 1755–1763.
- Lapage, S. P., Sneath, P. H. A., Lessel, E. F., Skerman, V. B. D., Seeliger, H. P. R. & Clark, W. A. (editors) (1975). *International Code of Nomenclature of Bacteria (1976 Revision)*. Washington, DC: American Society for Microbiology.
- Lapage, S. P., Sneath, P. H. A., Lessel, E. F., Skerman, V. B. D., Seeliger, H. P. R. & Clark, W. A. (editors) (1992). *International Code of Nomenclature of Bacteria (1990 Revision)*. Bacteriological Code. Washington, DC: American Society for Microbiology.
- List Editor (2006). Notification that new names and new combinations have appeared in volume 55, part 6, of the IJSEM. *Int J Syst Evol Microbiol* **56**, 319–321.
- Skerman, V. B. D., McGowan, V. & Sneath, P. H. A. (editors) (1980). Approved lists of bacterial names. *Int J Syst Bacteriol* **30**, 225–420.
- Skerman, V. B. D., McGowan, V. & Sneath, P. H. A. (editors) (1989). *Approved Lists of Bacterial Names (Amended Edition)*. Washington, DC: American Society for Microbiology.

- Sneath, P. H. A. (2005).** The preparation of the Approved Lists of Bacterial Names. *Int J Syst Evol Microbiol* **55**, 2247–2249.
- Tindall, B. J. (2008a).** Rule 15 of the International Code of Nomenclature of Bacteria: a current source of confusion. *Int J Syst Evol Microbiol* **58**, 1775–1778.
- Tindall, B. J. (2008b).** Are the concepts of legitimate and illegitimate names necessary under the current International Code of Nomenclature of Bacteria? A proposal to make changes to the Code. *Int J Syst Evol Microbiol* **58**, 1979–1986.
- Tindall, B. J. & Garrity, G. M. (2008).** Should we alter the way that authorship of a subspecies name that is automatically created under Rule 40d of the Bacteriological Code is cited? *Int J Syst Evol Microbiol* **58**, 1991–1992.
- Tindall, B. J., Kämpfer, P., Euzéby, J. P. & Oren, A. (2006).** Valid publication of names of prokaryotes according to the rules of nomenclature: past history and current practice. *Int J Syst Evol Microbiol* **56**, 2715–2720.
- Tindall, B. J., De Vos, P. & Trüper, H. G. (2008).** Judicial Commission of the International Committee on Systematics of Prokaryotes. XIth International (IUMS) Congress of Bacteriology and Applied Microbiology. Minutes of the meetings, 23, 24 and 27 July 2005, San Francisco, CA, USA. *Int J Syst Evol Microbiol* **58**, 1737–1745.
- Willems, A., Fernández-López, M., Muñoz-Adelantado, E., Goris, J., De Vos, P., Martínez-Romero, E., Toro, N. & Gillis, M. (2003).** Description of new *Ensifer* strains from nodules and proposal to transfer *Ensifer adhaerens* Casida 1982 to *Sinorhizobium* as *Sinorhizobium adhaerens* comb. nov. Request for an Opinion. *Int J Syst Evol Microbiol* **53**, 1207–1217.
- Yabuuchi, E., Kosako, Y., Oyaizu, H., Yano, I., Hotta, H., Hashimoto, Y., Ezaki, T. & Arakawa, M. (1992).** Proposal of *Burkholderia* gen. nov. and transfer of seven species of the genus *Pseudomonas* homology group II to the new genus, with the type species *Burkholderia cepacia* (Palleroni and Holmes 1981) comb. nov. *Microbiol Immunol* **36**, 1251–1275.
- Yabuuchi, E., Kosako, Y., Oyaizu, H., Yano, I., Hotta, H., Hashimoto, Y., Ezaki, T. & Arakawa, M. (1993).** *Burkholderia* gen. nov. In *Validation of the Publication of New Names and New Combinations Previously Effectively Published Outside the IJSB*, List no. 45. *Int J Syst Bacteriol* **43**, 398–399.
- Young, J. M. (2008).** An overview of bacterial nomenclature with special reference to plant pathogens. *Syst Appl Microbiol* **31**, 405–424.