

Table to accompany Sutcliffe et al. (2022) ICSP response to Lloyd and Tahon "Science depends on nomenclature, but nomenclature is not science" Nature Reviews Microbiology, <https://www.nature.com/articles/s41579-022-00706-z>.

The comment by K.G. Lloyd and G. Tahon (2022) Nat Rev Microbiol (<https://doi.org/10.1038/s41579-022-00684-2>) contains multiple errors and misconceptions about the work of the ICSP that require correction or clarification as detailed below.

Statement	Corrections and clarifications
"The International Committee on Systematics of Prokaryotes (ICSP) has recently altered long-standing phylum names"	Incorrect: the new names were proposed by Oren & Garrity (authors of reference #1), not ICSP. The opportunity to propose the new names was created by the ICSP, when it approved the revision of the International Code of Nomenclature of Prokaryotes (ICNP) <sup>1</sup> to introduce the rank of phylum <sup>2</sup> , but the action of proposing the names was taken by independent researchers <sup>3</sup> .
"given no guidance for taxonomy of uncultured or imperfectly cultured archaea and bacteria"	It is not the role of the ICSP to provide guidance on taxonomy: its role is in the governance of prokaryotic nomenclature as described in our Statutes <sup>4</sup> . The nomenclature of as-yet-uncultured taxa is provided for by the <i>Candidatus</i> status described in Appendix 11 of the ICNP <sup>1</sup> .
"Official names of bacteria and archaea are determined by the International Committee on Systematics of Prokaryotes"	Incorrect: there is no such thing as an 'official' name, nor are names determined by the ICSP. Names are given by authors who describe taxa. The authors likely mean 'validly published names' or 'legitimate names', terms which are defined in relation to their compliance with the Rules of the ICNP <sup>1</sup> . The same error is reflected in the use of "published officially" later in the article. The word 'official' appears only once in the ICNP, in a different context.
"Recently, ICSP reversed its long-standing policy of not assigning phylum names"	Incorrect: this was never a "policy" to be reversed. Instead, the ICSP corrected the historic oversight that, until 2021, the rank of phylum was not recognised in the ICNP (meaning no phyla could be given validly published names). Note also that the reference cited to support this statement is the personal work of Oren & Garrity <sup>3</sup> , not an ICSP publication: the ICSP does not "assign names", only provides governance for the formation and use of names.

<p>“This decision should be viewed in the context of the fact that ICSP has not assumed responsibility for naming bacteria and archaea that are not readily cultured.”</p>	<p>Whilst both are important, it is unclear why the authors think that these two separate things should be conflated. Moreover, this statement is incorrect in that General Consideration 5<sup>1</sup> states that the ICNP “applies to all Prokaryotes” (irrespective of whether ‘readily cultured’ or not).</p>
<p>“two freely shared culture collections”</p>	<p>The authors mean that, since January 2001, subcultures of type strains of species being named (or reclassified) must be available from two publicly accessible culture collections in different countries (as specified in ICNP Rule 30<sup>1</sup>). In exceptional cases, exemptions may be applied for.</p>
<p>“classification is a model of the evolutionary relationships among organisms”</p>	<p>This is not necessarily true as it conflates classification with phylogenetic analysis. Whilst we expect few would disagree that a classification should ideally reflect evolutionary relationships, a classification can in fact be formed on the basis of any criterion deemed appropriate in the opinion of the taxonomist, subject to satisfying the peer review process. Indeed, Principle 1(4)<sup>1</sup> of the ICNP prominently protects freedom of ‘taxonomic opinion’. For example, a taxonomist has freedom to classify bacteria simply into cocci, filaments, rods and spirilli, although this would now be unlikely to receive endorsement in the wider scientific community.</p>
<p>“The ICSP relies on strict nomenclature rules and experts in microbial subgroups to ensure that nomenclature is stable and follows a polyphasic classification combining phenotype and genotype”</p>	<p>Incorrect: the ICNP makes no comment on how classification should be performed, and as noted above protects freedom of ‘taxonomic opinion’. Indeed, General Consideration 4 of the ICNP states “Rules of nomenclature do not govern the delimitation of taxa nor determine their relations” and the terms genotype and phenotype do not occur in the Rules of the ICNP. Decisions regarding appropriate methodological approaches (e.g., the need for ‘polyphasic classification’) rest with the Editors (and peer reviewers) of journals publishing taxonomic studies. Note also that the ICSP Statutes<sup>4</sup> specify that the Subcommittees on Taxonomy (“subgroups”) “cannot legislate on classification but may contribute materially towards the general acceptance of a classification”.</p>
<p>“Others cannot overcome the slow and expensive naming process”</p>	<p>The naming process <i>per se</i> is not expensive. Perhaps the authors mean the process of taxonomic characterisation of cultures is expensive? However, this is also debatable relative to other fields of science.</p>

<p>“the Silva database has largely replaced ICSP for both nomenclature and classification”</p>	<p>Aside from this being an unsubstantiated matter of opinion, it is incorrect in the sense that the ICSP does not deal with classification and makes no attempt to provide any form of classification: the work of the ICSP is purely focussed on prokaryotic nomenclature and its governance. In contrast, SILVA (<a href="https://www.arb-silva.de/">https://www.arb-silva.de/</a>) is a specialised resource aiding use of rRNA sequence data, so it is a false comparison to imply Silva and ICSP have the same goals.</p>
<p>“some members of the validly named genus <i>Geobacter</i> were reassigned <i>Citrifermentans</i>, even though no <i>Geobacter</i> culture has been shown to ferment citrate”</p>	<p>This classification is a matter of taxonomic opinion. Whilst the name <i>Citrifermentans</i> is not ideal, it is not inherently problematic in respect of the Rules of nomenclature as Principle 4 of the ICNP states “The primary purpose of giving a name to a taxon is to supply a means of referring to it rather than to indicate the characters or the history of the taxon.” Note also that “validly named genus” is a misunderstanding – there are only ‘validly published’ names of genera.</p>
<p>“<i>Citrifermentans</i> remains on the List of Prokaryotic Names with Standing in Nomenclature (LPSN).”</p>	<p>This statement implies that LPSN has some sort of status as an official repository. Note instead that LPSN is in fact a service, provided by DSMZ as a curated resource about nomenclature<sup>5</sup>. The entry of a name in LPSN is simply information to be interpreted by the user, as the listings contain both validly published and other names, as well as highlighting correct and illegitimate names. It is also notable that the entry for <i>Citrifermentans</i> records that this name is both validly published and a heterotypic synonym of <i>Geomonas</i> Xu et al. 2020 (<a href="https://lpsn.dsmz.de/genus/citrifermentans">https://lpsn.dsmz.de/genus/citrifermentans</a>; accessed 17/01/22).</p>
<p>“Environmental microbiologists recently proposed a roadmap for incorporating genomes as type material into ICSP”</p>	<p>Incorrect: changes were proposed to the nomenclatural code i.e., the authors have confused the ICSP and the ICNP.</p>
<p>“ICSP voted recently to decide phylum names<sup>1</sup>.”</p>	<p>Incorrect: the ICSP did not “decide” on any names, only to revise the ICNP to include the rank of phylum. Note also that reference #1 cited is a secondary citation. The article explaining the decision of the ICSP to include the rank of phylum in the ICNP is Oren et al. (2021)<sup>2</sup>.</p>
<p>“On one hand, we have ICSP.... On the other hand, we have GTDB”</p>	<p>As with the earlier reference to SILVA, this is a false comparison. ICSP is an organisation responsible for maintaining a code of nomenclature, the ICNP; GTDB is an “initiative to establish a standardised microbial taxonomy” (<a href="https://qtdb.ecogenomic.org/about">https://qtdb.ecogenomic.org/about</a>) that reflects the methodology and taxonomic opinion of those that developed and maintain it<sup>6</sup>.</p>

<p>“There appears to be some merging of the two, as the originator of the GTDB, Phil Hugenholtz, has recently become a member of ICSP”</p>	<p>We emphasise that Professor Hugenholtz is a member of ICSP by virtue of being the Australian Society for Microbiology’s delegate. He does not represent GTDB.</p>
<p>“ICSP has proposed to change these historic and widely used names three times.”</p>	<p>Incorrect: the ICSP has never proposed any changes to phylum names! The authors mistakenly conflate two proposals to modify the ICNP (references 9 and 10 in their article) with the proposal of names for phyla, which was done by Oren and Garrity (2021)<sup>3</sup> and has nothing to do with the ICSP.</p>
<p>“First, the suffix -aeota was introduced for phylum names”...“Soon after, the suffix was changed to -ota”</p>	<p>The only suffix that has ever been approved for use in the valid publication of phylum names under the ICNP is -ota. The authors mean “First, the suffix -aeota was <u>proposed</u> for phylum names” and subsequently it was <u>proposed</u> that -ota is a more user-friendly suffix. This latter proposal was approved by the ICSP in 2021<sup>2</sup>.</p>
<p>“Most recently, ICSP has changed the abovementioned phylum names”</p>	<p>Incorrect: ICSP has not changed any names. As noted above, the proposal of phylum names was made independently by Oren and Garrity (2021)<sup>3</sup>. Decision on whether to adopt names rests with the scientific community (e.g., curators, in the case of databases), although ICSP encourages the use of the correct names.</p>
<p>“Such frequent changes...”</p>	<p>It is not accurate to refer to the name changes that are the consequence of the proposals of Oren and Garrity (e.g., the colloquial name Actinobacteria to validly published name <i>Actinomycetota</i>)<sup>3</sup> as being ‘frequent changes’: it was a single event.</p>
<p>“...give the impression that the ICSP does not consider impacts on the global microbiological community before implementing them”</p>	<p>The reverse is true – the members of the ICSP took into account the fact that the rank of phylum is widely used by the ‘global microbiological community’ when they voted to introduce phyla into the ICNP, following a public email discussion<sup>2</sup> (minuted on the ICSP website, <a href="https://www.the-icsp.org/reports">https://www.the-icsp.org/reports</a>). Also, note again that the name changes were not ‘implemented’ by the ICSP.</p>
<p>Because nomenclature is not science, ICSP should have kept these useful names to aid research efforts</p>	<p>This is not for ICSP to decide. Whilst the application of the Rules of the ICSP determines which names are validly published and correct, the wider community will still decide which names it wishes to adopt.</p>
<p>“They should also loosen their strict nomenclature rules to reflect the fact that consistency and stability are often more important than using proper Latin and Greek, especially in cases in which emergent names have filled a long- standing gap left by ICSP.”</p>	<p>The ICNP recognises the importance of stability of names, as articulated in Principle 1(1)<sup>1</sup>. The authors appear to be mostly objecting to a small number of specific name changes such as “<i>Firmicutes</i>” to <i>Bacillota</i>, and “<i>Thaumarchaeota</i>” to <i>Nitrososphaerota</i>. These are not</p>

	changes necessitated by the pedantic application of 'proper Latin and Greek' but because the Rules of the ICNP state that the stem used in phylum names must derive from the name of the type genus. This latter provision in the ICNP adds value to the names by indicating the nomenclatural type, whilst having a standardised suffix (-ota) has the advantage of unambiguously identifying the taxonomic rank of the names.
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## References

1. Parker, C. T., Tindall, B. J. & Garrity, G. M. International Code of Nomenclature of Prokaryotes (2008 Revision). *Int. J. Syst. Evol. Microbiol.* **69**, S1–S111 (2019). <https://dx.doi.org/10.1099/ijsem.0.000778>
2. Oren, A., Arahal, D.R., Rosselló-Móra, R., Sutcliffe, I.C. & Moore, E.R.B. Emendation of Rules 5b, 8, 15 and 22 of the International Code of Nomenclature of Prokaryotes to include the rank of phylum. *Int. J. Syst. Evol. Microbiol.* **71**, 004851 (2021). <https://dx.doi.org/10.1099/ijsem.0.004851>
3. Oren, A. & Garrity, G. M. Valid publication of the names of forty-two phyla of prokaryotes. *Int. J. Syst. Evol. Microbiol.* **71**, 005056 (2021). <https://dx.doi.org/10.1099/ijsem.0.005056>
4. Whitman, W.B., Bull, C.T., Busse, H-J., Fournier, P-E., Oren, A. & Ventura, S. Request for revision of the Statutes of the International Committee on Systematics of Prokaryotes. *Int. J. Syst. Evol. Microbiol.* **69**, 584-593 (2019). <https://dx.doi.org/10.1099/ijsem.0.003117>
5. Parte, A.C., Sardà Carbasse, J., Meier-Kolthoff, J.P., Reimer, L.C. and Göker, M. List of Prokaryotic names with Standing in Nomenclature (LPSN) moves to the DSMZ. *Int. J. Syst. Evol. Microbiol.* **70**, 5607-5612 (2020). <https://dx.doi.org/10.1099/ijsem.0.004332>

6. Parks, D.H., Chuvochina, M., Rinke C., Mussig, A., Chaumeil, P-A. and Hugenholtz, P. GTDB: an ongoing census of bacterial and archaeal diversity through a phylogenetically consistent, rank normalized and complete genome-based taxonomy. *Nucl. Acids Res.* 50: D785–D794 (2022). <https://dx.doi.org/10.1093/nar/gkab776>