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International Committee on Systematics of Prokaryotes. Subcommittee on the Taxonomy of Phototrophic Bacteria: Minutes of the meetings, 4 August 2015, Tübingen, Germany

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SESSION 1. CLOSED MEETING

Minute 1. Call to order

The meeting was held at the University of Tübingen (Germany) on 4 August 2015. It was called to order by the chairman J.F. Imhoff at 15:00 (CET).

Minute 2. Record of attendance

The subcommittee members present were R.W. Castenholz (Eugene, OR, USA), V. Gorlenko (Moscow, Russia), M. Gugger (Paris, France), M. Herdman (Paris, France), J.F. Imhoff (chairman, Kiel, Germany), J. Overmann (Braunschweig, Germany), R. Rippka (Paris, France), Ch. Sasikala (Hyderabad, India) and A. Wilmotte (secretary, Liege, Belgium).

Minute 3. Approval of agenda

The agenda was approved.

Minute 4. Minutes of the previous meeting

The draft of the manuscript prepared by the chairman based on the proposals and discussions during a previous online meeting (10–30 June 2014) had been approved by all the attending members. The subcommittee members were informed by the chairman that the Minutes have been published [1].

Minute 5. Changes in membership

R.W. Castenholz expressed his regrets that this was probably his last attendance, since he wished to resign from the subcommittee. P. Caumette and F. Garcia-Pichel (not present at the meeting) had informed the chairman by correspondence of their intention to resign as members of the subcommittee.

Three new members for the subcommittee were proposed and approved. All of them are active in research on the taxonomy of anoxygenic phototrophic bacteria: P. Anil Kumar (India), M. Tank (Japan, now at DSMZ Germany) and Ch. V. Ramana (India).

Minute 6. Adjournment

The meeting was adjourned at 15:30 (CET).

SESSION 2. OPEN MEETING

Minute 7. Call to order

The open meeting was called to order by the chairman J.F. Imhoff at 15:30 (CET).

Minute 8. Record of attendance

All members of the closed meeting attended the open meeting. In addition, the new members, P. Anil Kumar and M. Tank, were present.

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Keywords: cyanobacteria; anoxygenic phototrophic bacteria; nomenclature; taxonomy.
Abbreviations: ICN, International Code of Nomenclature for algae, fungi, and plants; ICNP, International Code of Nomenclature of Prokaryotes.

Minute 9. Chairman's report

The chairman presented the topics discussed during the online meeting (10–30 June 2014): the proposal of recommended standards for the description of cyanobacterial species, the preparation of an approved list of names of species of cyanobacteria, and nomenclatural aspects/problems of treating cyanobacteria under the International Code of Nomenclature of Prokaryotes (ICNP). A summary of these discussions has been published in the Minutes of that meeting [1]. This publication also includes a summary of the activities of this subcommittee since 2000 with respect to validly naming cyanobacterial species under the ICNP for genera that have nomenclatural standing under the International Code of Nomenclature for algae, fungi, and plants (ICN). Regrettably, although efforts towards this goal were initiated as early as 1985 [2], no progress has been made on this issue over the last decades. However, with the suggestion of initiating steps for requesting changes to General Consideration 5, Principle 2, and Rule 51b of the ICNP [1], it is hoped that better progress will be made in the future.

Minute 10. New taxa of anoxygenic phototrophic bacteria

A list of new taxa of phototrophic purple bacteria that have been published between 2012 and 2015 was presented by Ch. Sasikala.

Among *Alphaproteobacteria*, these include the new order *Rhodothalassiales* ord. nov. and the new family *Rhodothalassiaceae* fam. nov. [3]. and a number of new species including: *Rhodopseudomonas pseudopalustris* sp. nov. [4], *Rhodopseudomonas parapalustris* sp. nov. [4], *Rhodopseudomonas harwoodii* sp. nov. [4], *Rhodopseudomonas pentothenatexigens* sp. nov. [5], *Rhodopseudomonas thermotolerans* sp. nov. [5], *Rhodoplanes piscinae* sp. nov. [6], *Rhodoplanes oryzae* sp. nov. [7], *Phaeospirillum tilakii* sp. nov. [8], *Rhodobacter viridis* sp. nov. [9], *Rhodovulum salis* sp. nov. [10], *Rhodovulum viride* sp. nov. [10], *Rhodovulum tesquicola* sp. nov. [11], *Rhodovulum mangrovi* sp. nov. [12], *Rhodovulum bhavnagarense* sp. nov. [13], *Rhodomicrobium udaipurense* sp. nov. [14] and *Rhodospirillum oryzae* sp. nov. [15].

New combinations were: *Pararhodospirillum photometricum* comb. nov. [16], *Pararhodospirillum sulfurexigens* comb. nov. [16] and *Pararhodospirillum oryzae* comb. nov. [16]. Several species were combined in new genera, *Rhodobacter* species in *Cereibacter* gen. nov. [17] and *Rhodospirillum* species in *Pararhodospirillum* gen. nov. [16].

Among the *Gammaproteobacteria*, new species and combinations include *Thiophaeococcus fuscus* sp. nov. [18], *Phaeobacterium nitratireducens* gen. nov. and sp. nov. [19], *Phaeochromatium fluminis* gen. nov., comb. nov. [20] and *Lamprobacter roseus* comb. nov [21].

Ch. Sasikala also addressed again the difficulties of depositing type strains in two culture collections in different countries, which still is a serious and ongoing problem for the valid description of new species names, as already reported previously [22].

Minute 11. Aspect on the taxonomy of cyanobacteria

There was no progress regarding recommended standards for the description of new species of cyanobacteria, an approved list of names of species and nomenclatural aspects since the last online subcommittee meeting in 2014 [1].

M. Herdman presented the progress of his phylogenetic analyses based on more than 6000 cyanobacterial sequences of the 16S rRNA gene. Almost 2800 were used for tree-building and corresponded to 176 genera and 567 named species. Using a threshold of 98.7–99% 16S rRNA gene sequence identity for defining a species [23] and a threshold of 96.5–96.9% sequence identity for delimiting a genus, there was in general good congruence between the phylogenetic clusters in the tree and the relationships deduced from genome sequences by *in silico* DNA–DNA hybridization [24] and average nucleotide identity [25]. Therefore, these higher cut-off values seem to be more appropriate for defining the species and genus boundaries of cyanobacteria than those (70 and 95%) originally proposed by Wayne *et al.* [26] and Stackebrandt and Goebel [27], respectively, for other bacterial groups.

M. Herdman is willing to make the data base available to all those interested. [note added by the chairman prior to submission in 2021: The data are available at a website created by M. Herdman and R. Rippka since 2017, currently the version 11 is active: http://cyanophylogeny.scienceontheweb.net/]. It may serve as a basis for the delineation of cyanobacterial taxa and for proposing a Validation List of genus and species names under the ICNP. He also discussed in detail some of the major problems that became evident from these sequence analyses: controversial genus and species names within a given phylogenetic species cluster, the same genus or species name in widely divergent phylogenetic clusters, lack of documentation on morphology and ecology for many of the sequenced strains, lack of cultured strains of validly published taxa names, missing stretches of the 5′-region in a large number of published sequences, chimeric sequences, as well as the total lack of sequences for most traditional botanical type species entirely based on herbarium specimens or drawings.

R. Rippka reported on problems related to the valid description of cyanobacterial species names under the ICNP. These include: the lack of standing in nomenclature under the ICNP of genera names validly described under the ICN; different type material under the two Codes (axenic strains under the ICNP; uniquely herbarium specimens or drawings for taxa described in the past under the ICN); the creation of heterotypic homonyms, and finally the retroactive Rule 30 [28] requiring the deposition of type strains in two culture collections in different countries. Most of all, she concluded that there was presently no appropriate format for validly describing

cyanobacterial species names under the ICNP. This was examplified by her discussion of a recent publication [29]. These authors attempted to emend the description of the validly described name of the botanical genus *Planktothrix* and describe three new species names under the ICNP. The type of *P. agardhii* under the ICN is the description given by Anagnostidis and Komarek [30] based on the herbarium type *Oscillatoria agardhii* Gomont 1892, whereas under the ICNP the type would be a viable and axenic strain of the emended type species *Planktothrix agardhii*. As this could lead to a heterotypic homonym under the two Codes, the authors proposed the unconventional introduction of the superscript ICNP for this (and the other) *Planktothrix* species. This distinction was meant to indicate that the newly proposed living type of the type species would merely represent the non-living botanical type under the ICNP. As rightly pointed out in his Comments to this publication by Oren [31], the proposal by Gaget *et al.* [29] would require modifications to the provisions of the ICNP, which need to be formally addressed to the International Commission on Systematics of Prokaryotes (ICSP) and approved by the ICSP plenary. Until such a formal request, published as required in the *International Journal of Systematic and Evolutionary Microbiology* has not been made, there is no chance that the species names described in the proposal of Gaget *et al.* [29] will gain nomenclatural standing under the ICNP.

Regarding the establishment of an Approved List of names of cyanobacterial taxa, it was suggested to rely on the phylogenetic tree of 16S rRNA gene sequences by M. Herdman as a working basis. A coordinating task group was proposed, consisting initially of R. Rippka, M. Herdman, M. Gugger, K. Palińska and A. Wilmotte. As external experts M.F. Fiore (Brazil) and M.M. Watanabe (Japan) had been asked to join the group.

Minute 12. Present membership

L. Giovannetti (Florence, Italy), V. M. Gorlenko (Moscow, Russia), M. Gugger (Paris, France), M. Herdman (Paris, France), A. Hiraishi (Toyohashi, Japan), J. F. Imhoff (Chairman, Kiel, Germany), J. Komárek (Třeboň, Czech Republic), P. Anil Kumar (Chandigarh, India), A. Oren (Jerusalem, Israel), J. Overmann (Braunschweig, Germany), K.A. Palinska (Gdynia, Poland), Ch. Venkata Ramana (Hyderabad, India), R. Rippka (Paris, France), Ch. Sasikala (Hyderabad, India), M. Tank (Braunschweig, Germany), S. Ventura (Florence, Italy). B. Whitton (Durham, England), A. Wilmotte (Secretary, Liège, Belgium). V. Yurkov (Winnipeg, Manitoba, Canada).

Minute 13. Adjournment

The open meeting was adjourned at 17:50 (CET) on 04 August 2015.

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

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