International Committee on Systematic Bacteriology Subcommittee on the Taxonomy of the Genus *Bacillus*

Minutes of the Meetings, 4 and 6 July 1994, Postgraduate Medical &
Pharmaceutical Institute, Prague, Czech Republic

Session 1. Open meeting.

Minute 1. Call to order. The meeting was called to order by the Secretary, N. A. Logan (Glasgow, United Kingdom), at 11:10 a.m. on 4 July 1994.

Minute 2. Record of attendance. The members present were N. A. Logan, D. Claus (Braunschweig, Germany), P. De Vos (Ghent, Belgium), and F. G. Priest (Edinburgh, United Kingdom). Also in attendance were N. Ali (Bristol, United Kingdom), M. Gillis (Ghent, Belgium), D. Janssens (Ghent, Belgium), P. Kämpfer (Aachen, Germany), and A. Zaritsky (Be'er-Sheva, Israel). Apologies were received from R. C. W. Berkeley and M. Goodfellow.

Minute 3. Work in progress. Presentations of recent collaborative work on the *Bacillus polymyxa* 16S rRNA group were given. P. De Vos emphasized the importance of group coordination and publication, the use of a common set of strains in studies, the examination of a sufficient number of representatives for each taxon, and a polyphasic approach to the collaborative venture agreed to at the previous meeting (April 1992, Bristol, United Kingdom), and he also expressed the expectation that minimal standards for descriptions of *Bacillus* species would emerge from this work. P. De Vos described the use of sodium dodecyl sulfate-polyacrylamide gel electrophoresis analysis of whole-cell proteins, gas-liquid chromatography of fatty acids, and amplified ribosomal DNA restriction analysis. N. Ali described the use of pyrolysis mass spectrometry and PCR restriction analysis of cell lysates, and N. A. Logan outlined the results of API tests and microscopic observations. It was stated that amplified ribosomal DNA restriction analysis, pyrolysis mass spectrometry, and API test and microscopy data have revealed similar taxonomic structures, in which the established species have been well separated; however, inclusion of strains received as *Bacillus circulans* (the type strain of which belongs to a different rRNA group) revealed that separation of these strains from *B. polymyxa* and its relatives would be difficult on the basis of phenotypic characteristics alone.

Minute 4. Adjournment. The meeting was adjourned at 1:00 p.m. on 4 July 1994.

Session 2. Open meeting (continued).

Minute 5. Call to order. The second session was called to order by the Chairman, R. C. W. Berkeley (Bristol, United Kingdom), at 1:12 p.m. on 6 July 1994. The Chairman welcomed those present and apologized for his absence from the previous session, commenting that the apologies really should come from the organizers of the meetings because of the constant changes made to the timetable, venues, and orders of the meetings both before and during the IUMS Congress; he added that such changes were inexcusable, especially given the expense of attending the IUMS Congress, and that a letter would be sent to the president of the International Union of Microbiological Societies stating that such difficulties should not occur at future congresses. All those present regretted that the format originally requested for the meetings (that is, an open session following a closed session, with neither scheduled

at the same time as symposia and colloquia of interest to taxonomists) had not been followed by the organizers, and it was agreed that the first part of the afternoon should be devoted to an open meeting for the benefit of those who had been unable to attend the previous session.

Minute 6. Record of attendance. The members present were R. C. W. Berkeley (Chairman), N. A. Logan (Secretary) (Glasgow, United Kingdom), D. Claus (Braunschweig, Germany), P. De Vos (Ghent, Belgium), and F. G. Priest (Edinburgh, United Kingdom). Also present were N. Ali (Bristol, United Kingdom), D. Fritze (Braunschweig, Germany), M. Heyndrickx (Ghent, Belgium), W. H. Holzapfel (Karlsruhe, Germany), P. Kämpfer (Aachen, Germany), and A. Zaritsky (Be'er-Sheva, Israel). Apologies for absence were received from M. Goodfellow and R. A. Slepecky.

Minute 7. Minutes of the last meeting. Minutes of open meeting held on 15 April 1992 at the University of Bristol, Bristol, United Kingdom, were proposed by P. De Vos and seconded by F. G. Priest.

Minute 8. Progress in collaborative work. N. A. Logan summarized the presentations given in Session 1 for the benefit of those who had not been present and expressed disappointment that only the Bristol, Ghent, and Glasgow laboratories had participated in the collaborative study agreed to at the open meeting held in April 1992.

Minute 9. New name for the subcommittee. The Chairman stated that there are now nine validly described genera of aerobic or facultatively anaerobic endospore-forming bacteria and that some of these genera are newly described and are represented by only a very few strains, while others were described solely on the basis of their microscopic appearance and have not been cultured and characterized or have been isolated but have not been described sufficiently for their taxonomic relationships to be clear. Some of the genera are closely related to the genus *Bacillus*, as are a number of nonsporeformers; thus, the number of organisms which the subcommittee could consider is very large. Despite the large number of genera which could fall within the ambit of the subcommittee, the main thrust of its work in the immediate future is likely to be studies of organisms belonging to the genus *Bacillus*, and it was proposed, and agreed unanimously, that the new name of the subcommittee should be the subcommittee on the Taxonomy of the Genus *Bacillus* and Related Organisms. The Chairman explained that the subcommittee does not intend to empire build, as it already has more than enough to do.

Minute 10. Minimal standards for the description of new species. The Chairman noted that although D. Claus published proposals for minimal standards for the description of new species of the genus *Bacillus* in The *Bacillus* Newsletter in April 1982 and had invited comment, none had been received and so no further progress had been made. He explained that the intention of minimal standards is to help the scientific community by providing a yardstick against which publications in which new species are described may be judged and commented that this places a great burden on those producing

such standards, for there must be the very widest possible consensus that the standards set are appropriate to the task. A first draft of a set of minimal standards (largely based on the much more demanding 1982 set of proposals) had been prepared by the Secretary and the Chairman and published in The *Bacillus* Newsletter in May 1994. These standards were discussed at length and modified, and the Secretary agreed to circulate the amended set for further comment prior to adoption.

Minute 11. Work in progress or planned. P. Kämpfer reported that he has been analyzing fatty acid methyl ester patterns of *Bacillus* species and plans to try other approaches, including polyacrylamide gel electrophoresis of proteins and traditional phenotypic characterization, in ecological studies. A. Zaritsky outlined his work on cloning five *Bacillus thuringiensis* subsp. *israelii* genes into cyanobacteria for biological control purposes; four genes have also been cloned into *Escherichia coli* for transfer to *Anabaena* sp. Another approach is to feed *Tetrahymena* sp. with *B. thuringiensis* subsp. *israelii* so that toxin is concentrated by the protozoans, which are then consumed by mosquito larvae. M. Heyndrickx summarized the work described by P. De Vos in Session 1 and commented that amplified ribosomal DNA restriction analysis is the most powerful approach which he uses; he stated that amplified ribosomal DNA restriction analysis results are consistent with polyacrylamide gel electrophoresis results, but that fatty acid methyl ester analysis is less successful. It was generally agreed that the *B. polymyxa* rRNA group cannot be defined readily phenotypically. F. G. Priest described his work with L. Rabinovitch on a search for new toxin genes in *Bacillus sphaericus*; these genes are chromosomal, transposable, and highly conserved and seem to be similar worldwide. Another approach is to transfer *B. thuringiensis* toxin genes to *B. sphaericus*. D. Fritze described a polyphasic taxonomic study of alkaliphilic *Bacillus* strains that was done in collaboration with Novo Nordisk, F. G. Priest, F. Rainey, and E. Stackebrandt. The groups identified by the different approaches generally were consistent and represented several new species; they also provided a choice of strains for sequencing studies, which indicated that there should be a new branch on the phylogenetic tree. D. Fritze also mentioned a round-spore alkaliphile isolated from Wâdi el Natrûn; this bacterium is a distinct organism that represents a new rRNA group 1 species. D. Claus described work performed at the Deutsche Sammlung von Mikroorganismen on *Bacillus aminovorans*, which is easily differentiated from other species by chemotaxonomic methods, and *Bacillus laevolacticus*; it has been found that most strains received as *Bacillus racemilacticus* are *Bacillus coagulans* or *B. laevolacticus* strains. There followed some general discussion concerning the problems of studying nonsporulating organisms and the loss of sporulation after subculturing.

Minute 12. Adjournment. Session 2 was adjourned at 2:58 p.m. on 6 July 1994.

Session 3. Closed meeting.

Minute 13. Call to order. The third session was called to order by the Chairman, R. C. W. Berkeley (Bristol, United Kingdom), at 3:06 p.m. on 6 July 1994.

Minute 14. Record of attendance, membership, and officers. The members present were R. C. W. Berkeley (Chairman), N. A. Logan (Secretary) (Glasgow, United Kingdom), D. Claus (Braunschweig, Germany), P. De Vos (Ghent, Belgium), and F. G. Priest (Edinburgh, United Kingdom). The current members of the subcommittee are H. de Barjac (Paris, France), R. C. W. Berkeley (Bristol, United Kingdom), D. Claus (Braunschweig, Germany), G. J. Bonde (Aarhus, Denmark), P. De Vos (Ghent, Belgium), I. Epstein (Jerusalem, Israel), M. Goodfellow (Newcastle, United Kingdom), N. A. Logan (Glasgow, United Kingdom), L. K. Nakamura (Peoria, Ill.), F. G. Priest (Edinburgh, United Kingdom), L. Rabinovitch (Rio de Janeiro, Brazil), and R. A. Slepecky (Syracuse, N.Y.). It was noted that some members had not replied to subcommittee correspondence for several years, and the Chairman agreed to write to these individuals to see if they wish to maintain their membership. D. Claus stated that he wished to resign from the subcommittee, and he proposed that D. Fritze (Braunschweig, Germany) should replace him (seconded by R. C. W. Berkeley); the Chairman's proposal that D. Claus become the first member emeritus of the subcommittee was carried unanimously. The Chairman reported that H. de Barjac had retired and so wished to resign from the subcommittee and that she had proposed that M.-M. Lecadet (Paris, France) should replace her on the subcommittee (seconded by R. C. W. Berkeley). P. Kämpfer (Aachen, Germany) was proposed by N. A. Logan and seconded by P. De Vos as a new member of the subcommittee. The current corresponding members are E. Afrikian (Abovian City, Armenia) and K. Aizawa (Fukuoka, Japan). T. Heulan (Nancy, France) was proposed by P. De Vos and seconded by N. A. Logan as a new corresponding member. It was agreed that a mailing list of nonmembers should be compiled.

Minute 15. Date of next meeting. The date of the next meeting was provisionally set for sometime during the 8th International Congress of Bacteriology and Applied Microbiology, which is to be held Jerusalem, Israel, in August 1996.

Minute 16. Adjournment. The meeting was adjourned at 3:30 p.m. on 6 July 1994.

Niall A. Logan, Secretary