New Names and Combinations in the Genera *Bacteroides* Castellani and Chalmers, *Fusobacterium* Knorr, *Eubacterium* Prévot, *Propionibacterium* Delwich, and *Lactobacillus* Orla-Jensen

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Due to recent studies and to recommendations made by various taxonomic subcommittees, the descriptions of several genera of anaerobic, nonsporing bacilli were emended and a number of species with these characteristics were reclassified. Because the resultant new names and combinations and the author citations for them were not clearly indicated when the new names and combinations were originally introduced, they are listed here for the sake of clarity. In addition, five new combinations (*Fusobacterium aquatile*, *F. stabile*, *F. perfoetens*, *Eubacterium endocarditidis*, and *E. helminthoides*) and a new name (*Eubacterium helwigiae*) are proposed herein.

As a result of studies and recommendations by the International Subcommittee on the Taxonomy of the Anaerobic, Gram-Negative Rods, the definitions of the genera *Fusobacterium* Knorr and *Bacteroides* Castellani and Chalmers have been emended. These two genera of anaerobic, gram-negative, nonsporing rods, which include organisms which are nonmotile as well as those which are motile by means of peritrichous flagella, are separated from each other on the basis of differences in their metabolic activities. Members of the genus *Fusobacterium* produce butyric acid as a major metabolic product, and members of the genus *Bacteroides* usually do not produce butyric acid. The few species of *Bacteroides* which produce detectable amounts of butyric acid also produce isobutyric and isovaleric acids, which are not produced by members of the genus *Fusobacterium*. Following these recommendations, a number of new names and combinations involving species previously placed in the genera *Bacteroides*, *Dialister* Bergey et al., *Fusobacterium*, and *Sphaerophorus* Prévot (a later homonym, hence an illegitimate generic name) were proposed (17, 19, 30, 31, 33).

Similarly, the definition of the genus *Eubacterium* Prévot has been emended to include

anaerobic, gram-positive, nonsporing bacilli that do not produce, as major products of fermentation, (i) propionic acid, (ii) lactic acid alone, or (iii) acetic and lactic acids where the amount of acetic acid exceeds that of the lactic acid. Most species in this genus produce butyric and other acids; some species produce mainly acetic and formic acids and ethanol; a few species do not produce significant amounts of acids or alcohols from carbohydrates or peptone. *Eubacterium* now includes several species formerly placed in the genus *Ramibacterium* Prévot, *Catenabacterium* Prévot, or *Cillobacterium* Prévot, and a number of new combinations resulted from the transfer of these species to *Eubacterium* (18, 20).

The type species of the genus *Ramibacterium*, *R. ramosum*, is a clostridium (16), and thus the generic name *Ramibacterium* is illegitimate [Bacteriological Code (reference 21), Rule 17 (c)].

Organisms in the genus *Catenabacterium* originally were differentiated from those in *Eubacterium* by the production of long chains and filaments by the former. The original description and illustrations of the type species of *Eubacterium*, *E. foedans* Klein (24), include chains and filaments. Also, chain length and filament formation vary with the culture

medium, making these criteria unreliable for differentiation between these two groups. Hence the catenabacteria have been transferred to other genera (17, and see below).

Cillobacterium originally included the motile, nonsporing, gram-positive, anaerobic bacilli. Since we have observed nonmotile variants of some motile species of *Cillobacterium*, motility is judged not to be a reliable characteristic for differentiating between *Cillobacterium* and *Eubacterium*, and the cillobacteria have been transferred to the genus *Eubacterium* (18, 20).

Species of anaerobic, gram-positive, nonsporing bacilli that form lactic acid as the only major product of fermentation have been placed in the genus *Lactobacillus* Beijerinck (32, 34).

The anaerobic to aerotolerant species formerly classified in the genus *Corynebacterium* Lehmann and Neumann have been transferred to the genus *Propionibacterium* Orla-Jensen on the basis of their similarity in metabolic activity, particularly the production of propionic acid (29, 32). Johnson and Cummins (22) showed that these two groups of organisms have similar cell wall compositions and similar guanine plus cytosine contents in their deoxyribonucleic acids, further substantiating this reclassification.

It has been brought to our attention that when the new names and combinations that resulted from the abovementioned transfers were made, they were not clearly identified as such. Furthermore, the publications involved were written by multiple authors, and it also was not clear who was responsible for the new names and combinations in each case. The purpose of this note is to list the new combinations and the new names and to identify the authors of each. Also, according to Rule 21, Note 1 of the Bacteriological Code (21), "The proposal of a subspecific name which excludes the type of the species automatically creates another subspecific name which includes the type. The author of the species name is to be cited as the author of such automatically recognized subspecific name." Such names created automatically by our proposals of new subspecific names which excluded the types of the species are also listed here together with their proper author citations. In addition, five new combinations and a new name are proposed in this paper as the result of the transfer of six species to other genera.

In the list which follows, basionyms, i.e., epithet-bringing names, are given in brackets. Synonyms, other than those which are basi-

onyms, by which the organisms currently are generally known are given in parentheses.

Bacteroides fragilis subsp. *fragilis* (Veillon and Zuber 1898) Castellani and Chalmers 1919, 959. [*Bacillus fragilis* Veillon and Zuber 1898].

B. fragilis subsp. *vulgatus* (Eggerth and Gagnon 1933) Holdeman and Moore 1970, 35. [*Bacteroides vulgatus* Eggerth and Gagnon 1933].

B. fragilis subsp. *distasonis* (Eggerth and Gagnon 1933) Holdeman and Moore 1970, 35. [*Bacteroides distasonis* Eggerth and Gagnon 1933].

B. fragilis subsp. *ovatus* (Eggerth and Gagnon 1933) Holdeman and Moore 1970, 35. [*Bacteroides ovatus* Eggerth and Gagnon 1933].

B. fragilis subsp. *thetaiotaomicron* (Distaso 1912) Holdeman and Moore 1970, 35. [*Bacillus thetaiotaomicron* Distaso 1912] (*Bacteroides thetaiotaomicron* (Distaso) Castellani and Chalmers 1919).

B. ochraceus (Prévot et al. 1956) Holdeman and Moore 1972, 27. [*Fusiformis nucleatus* var. *ochraceus* Prévot et al. 1956] (*Bacteroides oralis* subsp. *elongatus* Loesche et al. 1964).

B. termitidis (Sebald 1962) Holdeman and Moore 1970, 33. [*Sphaerophorus siccus* subsp. *termitidis* Sebald 1962].

B. biacutus (Weinberg and Prévot 1926) Holdeman and Moore 1970, 33. [*Fusobacterium biacutum* Weinberg and Prévot 1926].

B. clostridiiformis (Burri and Ankersmit 1906) Holdeman and Moore 1970, 33. [*Bacterium clostridiiforme* Burri and Ankersmit 1906] (Holdeman and Moore (17) proposed the ternary combination *Bacteroides clostridiiformis* subsp. *clostridiiformis* but did not separately propose the binary combination *Bacteroides clostridiiformis*; the binary combination is, however, to be inferred from the ternary combination.)

B. clostridiiformis subsp. *clostridiiformis* (Burri and Ankersmit 1906) Holdeman and Moore 1970, 33. [*Bacterium clostridiiforme* Burri and Ankersmit 1906].

B. clostridiiformis subsp. *girans* (Prévot 1940) Holdeman and Moore 1970, 33. [*Fusocillus girans* Prévot 1940].

B. constellatus (Martres et al. 1952) Holdeman and Moore 1970, 33. [*Zuberella constellata* Martres et al. 1952].

B. praeacutus (Tissier 1908) Holdeman and Moore 1970, 33. [*Coccobacillus praeacutus* Tissier 1908].

B. pneumosintes (Olitsky and Gates 1921) Holdeman and Moore 1970, 33. [*Bacterium pneumosintes* Olitsky and Gates 1921].

- B. melaninogenicus* subsp. *melaninogenicus* (Oliver and Wherry 1921) Roy and Kelly 1939. [*Bacterium melaninogenicum* Oliver and Wherry 1921].
- B. melaninogenicus* subsp. *intermedius* Holdeman and Moore 1970, 33.
- B. melaninogenicus* subsp. *asaccharolyticus* Holdeman and Moore 1970, 33.
- B. niger* (Sebald 1962) Holdeman and Moore, 1970, 33. [*Sphaerophorus abscedens* subsp. *niger* Sebald 1962].
- Fusobacterium gonidiaformans* (Tunncliffe and Jackson 1925) Moore and Holdeman 1970, 45. [*Bacillus gonidiaformans* Tunncliffe and Jackson, 1925].
- F. naviforme* (Jungano 1909) Moore and Holdeman 1970, 45. [*Bacillus naviformis* Jungano 1909].
- F. varium* (Eggerth and Gagnon 1933) Moore and Holdeman 1969, 12. [*Bacteroides varius* Eggerth and Gagnon 1933].
- F. glutinosum* (Hauduroy et al. 1937) Moore and Holdeman 1970, 45. [*Bacteroides glutinosus* Hauduroy et al. 1937].
- F. necrophorum* (Flügge 1886) Moore and Holdeman 1969, 12. [*Bacillus necrophorus* Flügge 1886] (*Sphaerophorus necrophorus* (Flügge 1886) Prévot 1938).
- F. mortiferum* (Harris 1901) Moore and Holdeman 1970, 45. [*Bacillus mortiferus* Harris 1901].
- F. symbiosum* (Stevens 1956) Moore and Holdeman 1972, 21. [*Bacteroides symbiosus* Stevens 1956]. (W. C. Stevens, Ph.D. thesis, Vanderbilt Univ., Nashville, 1956.)
- F. necrogenes* (Weinberg et al. 1937) Moore and Holdeman 1970, 45. [*Bacillus necrogenes* Weinberg et al. 1937].
- F. prausnitzii* (Hauduroy et al.) Moore and Holdeman 1970, 45. [*Bacteroides prausnitzii* (sic) Hauduroy et al. 1937].
- F. bullosum* (Distaso 1912) Moore and Holdeman 1970, 45. [*Bacillus bullosus* Distaso 1912].
- F. russii* (Hauduroy et al. 1937) Moore and Holdeman 1970, 45. [*Bacteroides russii* Hauduroy et al. 1937].
- Propionibacterium avidum* (Eggerth 1935) Moore and Holdeman 1969, 7. [*Bacteroides avidus* Eggerth 1935].
- P. granulosum* (Prévot 1938) Moore and Holdeman 1970, 15. [*Corynebacterium granulosum* Prévot 1938].
- Eubacterium alactolyticum* (Prévot and Taffanel 1942) Holdeman and Moore 1970, 23. [*Ramibacterium alactolyticum* Prévot and Taffanel 1942].
- E. saburreum* (Prévot 1966) Holdeman and Moore 1970, 23. [*Catenabacterium saburreum* Prévot 1966].
- E. budayi* (Le Blaye and Guggenheim 1914) Holdeman and Moore 1970, 23. [*Bacterium budayi* Le Blaye and Guggenheim 1914].
- E. multiforme* (Distaso 1911) Holdeman and Moore 1970, 23. [*Bacillus multiformis* Distaso 1911].
- E. cylindroides* (Rocchi 1908) Holdeman and Moore 1970, 23. [*Bacterium cylindroides* Rocchi 1908].
- E. moniliforme* (Repaci 1910) Holdeman and Moore 1970, 23. [*Bacillus moniliformis* Repaci 1910; not *Bacillus moniliformis* Garnier 1907. (The former name is illegitimate as a later homonym of the latter, and *Bacillus repazii* Herter 1917 appears to be the first legitimate name proposed for Repaci's organism. Thus the correct specific epithet in the name of this organism is "repazii." However, "moniliforme" has come into common usage for this organism, and, in the interest of stability in nomenclature, this matter should be referred to the Judicial Commission of the International Committee on Systematic Bacteriology.)]
- E. cellulosolvens* (Bryant et al. 1958) Holdeman and Moore 1972, 39. [*Cillobacterium cellulosolvens* Bryant et al. 1958].
- E. combesii* (Prévot and Laplanche 1947) Holdeman and Moore 1970, 23. [*Cillobacterium combesii* Prévot and Laplanche 1947].
- E. tenue* (Bergey et al. 1923) Holdeman and Moore 1970, 23. [*Bacteroides tenuis* Bergey et al. 1923].
- Lactobacillus catenaforme* (Eggerth 1935) Moore and Holdeman 1970, 15. [*Bacteroides catenaformis* Eggerth 1935].
- L. crispatus* (Brygoo and Aladame 1953) Moore and Holdeman 1970, 15. [*Eubacterium crispatum* Brygoo and Aladame 1953].
- L. minutus* (Hauduroy et al. 1937) Moore and Holdeman 1972, 63. [*Bacteroides minutus* Hauduroy et al. 1937].
- Because of its metabolic and morphological characteristics, *Zuberella nova* Prévot 1947 was transferred to *Fusobacterium* as *Fusobacterium novum* (Prévot) Moore and Holdeman 1970 (11). However, during the preparation of manuscripts for the eighth edition of Bergey's Manual of Determinative Bacteriology (in press) and the comparison of the descriptions and data gathered on available strains, we noted that *Zuberella nova* cannot be differentiated from *Zuberella aquatilis* Prévot 1938. The latter organism was originally isolated and described by Spray and Laux (50) and later named by Prévot (38), although there is no record of Prévot ever having directly examined strains of

Z. aquatilis. Thus we regard these names as subjective synonyms, and the name *Zuberella aquatilis* has priority. Therefore the correct name of the organism previously referred to as *Fusobacterium novum* is *Fusobacterium aquatile* (Prévot) *comb. nov.*

No strains of *Capsularis stabilis* Patocka and Prévot 1947 are extant. However, this organism is sufficiently described to permit recognition if isolated again. Because it has characteristics which are possessed by members of the genus *Fusobacterium* as currently described (33), we propose that it be designated *Fusobacterium stabile* (Patocka and Prévot) *comb. nov.*

The organism described under the name *Sphaerophorus perfoetens* (Tissier) Sebald 1962 (see also 45 and 55) likewise has characteristics consistent with those of members of the genus *Fusobacterium*, and therefore it is here designated *Fusobacterium perfoetens* (Tissier) *comb. nov.*

Cillobacterium endocarditis (sic) Prévot 1938 (see also 45) has characteristics consistent with those of members of the genus *Eubacterium* as currently described (18), and this organism is therefore here designated *Eubacterium endocarditidis* (Prévot) *comb. nov.*

Catenabacterium helminthoides (Lewkowicz) Prévot 1938 (also see 45 and 55) has characteristics consistent with those of members of the genus *Eubacterium*, and thus this organism is here designated *Eubacterium helminthoides* (Lewkowicz) *comb. nov.*

The organism named *Catenabacterium ruminantium* Stellmach-Helwig 1961 also has the characteristics of members of the genus *Eubacterium*. However, on transfer to *Eubacterium* a different specific epithet must be used because "*ruminantium*" is already occupied in this genus in the name *Eubacterium ruminantium* Bryant 1959, which is the name of an organism different from that described by Stellmach-Helwig. We therefore propose the new name *Eubacterium helwigiae* for Stellmach-Helwig's organism (*hel.wig'* i.ae. M.L. gen.noun *helwigiae* of Helwig; named for R. Stellmach-Helwig, the first to describe this organism).

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