Transfer of *Veillonella* Prévot and *Acidaminococcus* Rogosa from *Neisseriaceae* to *Veillonellaceae* fam. nov., and the Inclusion of *Megasphaera* Rogosa in *Veillonellaceae*

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Veillonellaceae (order *Eubacteriales*) is proposed as the name of a new family to include three genera of presently known, anaerobic, gram-negative, coccal bacteria. It is herein proposed that *Veillonella* Prévot 1933 and *Acidaminococcus* Rogosa 1969 be transferred from *Neisseriaceae* and be included together with *Megasphaera* Rogosa 1971 in *Veillonellaceae* fam. nov. The type genus is *Veillonella* Prévot.

Presently the family *Neisseriaceae* contains genera which have contrasting characteristics. There are genera whose organisms are either aerobic or anaerobic and exhibit great differences in terminal-respiration mechanisms, biochemical pathways, attack on substrates, and genetic makeup. In order to group similar organisms together, it is here proposed that *Veillonella* Prévot 1933 and *Acidaminococcus* Rogosa 1969 be transferred from *Neisseriaceae* Prévot 1933 to *Veillonellaceae* fam. nov. It is also proposed that the recently described and named genus *Megasphaera* Rogosa 1971 be placed in *Veillonellaceae*. This arrangement takes advantage of the remarkable general scientific progress since 1933 and effects a more reasonable placement of the gram-negative, aerobic cocci in *Neisseriaceae* and of the gram-negative, anaerobic cocci in *Veillonellaceae*.

The family *Neisseriaceae* was named by Prévot (9) on p. 100 as *Neisseriacées* (nouv. fam.) and was described on p. 119 as follows:

"Position dans la systématique.—Avec le genre *Neisseria* TREVISAN, il [*Veillonella*] forme la nouvelle famille des *Neisseriacées*, ou Cocci Gram-négatifs, que nous subdivision en deux tribus:

Neisseriacées (n. fam.) *Neisseriées*: genre unique *Neisseria*. *Veillonellées*: genre unique *Veillonella*."

This is the extent of the description of the family *Neisseriaceae*, although from the context it is clear that one of the genera in this family,

Veillonella, is anaerobic. Although *Neisseriaceae* was revised by Murray and Branham (8) and by Branham, Pelczar, and Murray (3) who added some detail, *Veillonella* has remained in the family *Neisseriaceae* since the original Prévot publication in 1933.

Besides *Veillonella*, other recently studied gram-negative cocci such as *Acidaminococcus* (12) and *Megasphaera* (13) present a problem because they, too, are anaerobic. Previously, *Acidaminococcus* had been placed in *Neisseriaceae* by Rogosa (12). *Megasphaera* has not yet been allocated to any family (13).

Recently Catlin (4) ably summarized the genetic and other evidence showing the distinctness of *Neisseria catarrhalis* from the type species and other species of *Neisseria* and proposed the transfer of *N. catarrhalis* to a new genus, *Branhamella* (type species: *Branhamella catarrhalis* within *Neisseriaceae*). The so-called "false neisserias" (branhamellas and acinetobacters) and/or "moraxellas" historically have been in a confused status; very similar organisms have been given names spreading through diverse genera and families (1, 2, 18). Baumann et al. (1, 2) have comprehensively studied and described such organisms under the names *Moraxella* (for the oxidase-positive strains) and *Acinetobacter* (for the oxidase-negative strains). However, they were not concerned with the position of these genera in higher taxa such as families, and they offered no discussion or opinions in this regard.

There seems to be some agreement (1, 18)

TABLE 1. Differentiation of the genera of the family *Veillonellaceae*

Genus	Cell diam. (μ m)	GC ^a	Carbohydrates fermented	Lactate fermented	Amino acids main energy source	Pyruvate utilized	Succinate decarboxylated	Gases and volatile fatty acid products in growth media					
								CO ₂	H ₂	C ₂	C ₃	C ₄	C ₅ C ₆
<i>Veillonella</i>	0.2-0.5	40.3-44.4	- ^b	+	-	+	+	+	+	+	+	-	-
<i>Acidaminococcus</i>	0.6-1.0	56.6	±	-	+	-	-	+	-	+	-	+	-
<i>Megasphaera</i>	1.7-1.9 2.4-2.6	53.1-54.1	+	+	-	+	-	+	±	+	+	+	+

^aGuanine plus cytosine moles per cent of the DNA.^bSymbols: +, positive reaction; -, negative reaction; ±, slight; ±, generally negative, slight or variable.

on *Moraxella* as the generic name for certain oxidase-positive, short, plump diplobacilli or coccobacilli and on *Acinetobacter* (2) [synonym: *Lingelsheimia* (18)] for the oxidase-negative organisms. A family *Moraxellaceae* Ryter and Piéchaud 1963 has been proposed (17) to include *Moraxella* and *Acinetobacter*. However, if rods and cocci could be included in one family as in *Lactobacillaceae*, for example, there is probably no formal reason why *Moraxella* and *Acinetobacter* could not be included in *Neisseriaceae*, provided this family is appropriately redefined. This would at least have the virtue of gathering together four genera with aerobic metabolism, namely, *Neisseria*, *Branhamella*, *Moraxella*, and *Acinetobacter*. This arrangement is consistent with the recent recommendation of the Subcommittee on the Taxonomy of *Moraxella* and Allied Bacteria of the International Committee on Nomenclature of Bacteria (7).

Enormous unresolved nomenclatural problems obviously exist. It is not my purpose to wander further in this thicket of problems where international experts have been unable to agree among themselves. However, it does not seem wise to include genera like *Neisseria*, *Branhamella*, *Veillonella*, and *Acidaminococcus*, with such divergent aerobic and anaerobic metabolisms, in a single family.

Therefore, it is proposed that the genera *Veillonella* Prévot 1933 and *Acidaminococcus* Rogosa 1969, the latter having been placed in *Neisseriaceae* by Rogosa (12), be transferred to *Veillonellaceae* fam. nov. This family also includes the genus *Megasphaera* Rogosa 1971. A description of this new family, which is placed in the order *Eubacteriales*, follows.

Veillonellaceae fam. nov.

Veil.lo.nella'ce.ae. M.L. fem. n. *Veillonella* type genus of the family; *-aceae* ending to denote a family; M.L. fem.pl.n. *Veillonellaceae* the *Veillonella* family.

Cocci, varying in diameter from small (ca. 0.3 to 0.5 μ m) to large (ca. 2.5 μ m); occur characteristically in pairs; single cells, masses, or chains may also occur, although the chains may show gaps, illustrating the basic diplococcal arrangement. Adjacent sides of cell pairs may be flattened. No endospores. Nonmotile; no flagella. Gram-negative but may have tendency to resist decolorization. Anaerobic. Cytochrome oxidase negative. Catalase negative, but some strains decompose peroxide by means of a pseudocatalase (nonheme containing). Chemoor-ganotrophic. Possess complex nutritional requirements. Gas is produced, frequently abun-

dantly, in culture. Carbohydrates may or may not be fermented. Lactic acid may not be produced and if present is not a major product; lactate is fermented by some genera with the production of CO₂, H₂, and various lower volatile fatty acids containing 2 to 6 C atoms.

Parasites of homothermic animals such as man, ruminants, rodents, and pigs, particularly found in the alimentary tract.

The type genus is *Veillonella* Prévot 1933.

The genera of *Veillonellaceae* are:

1. *Veillonella* Prévot, 1933.

Type species: *V. parvula* (Veillon and Zuber, 1898) Prévot, 1933.

Objective synonym: *Staphylococcus parvulus* Veillon and Zuber, 1898, 542.

Descriptions of genus, type species, and serotype strains were corrected and up-dated by Rogosa [11, 14-16 (see especially reference 11)].

2. *Acidaminococcus* Rogosa, 1969.

Type species: *A. fermentans* Rogosa 1969.

Descriptions of genus, type species, and type strain by Rogosa (12).

3. *Megasphaera* Rogosa, 1971.

Type species: *M. elsdenii* Rogosa 1971.

Synonyms: Organism LC of Elsden et al. 1956. *Peptostreptococcus elsdenii* Gutierrez et al. 1959.

Descriptions of genus, type species, and type strain up-dated by Rogosa (13).

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