THE GENUS SERRATIA:
ITS TAXONOMY AND NOMENCLATURE

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SUMMARY: Proposals are made regarding the nomenclature and taxonomy of the genus Serratia Bizio (type species Serratia marcescens Bizio) which is placed in the tribe Klebsiellae Trevisan.

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Studies on the biochemical reactions given by cultures of Serratia published during the last five years have led to a clearer understanding of the constitution of the genus and its relationship to other groups within the family Enterobacteriaceae. In the fourth edition of Bergey's Manual (1934) the genus Serratia was classified in the tribe Chromobacterieae, but in subsequent editions of the Manual, including the 7th (1957), it was classified as the sole genus in the tribe Serratiae. Others, e.g. Krasil'nikov (1949, quoted by Martinec and Kocur, 1961a) placed these bacteria in the genus Chromobacterium.

On the basis of their studies, Davis et al. (1957) and Ewing et al. (1959) placed the Serratia group in the same principal division with the Klebsiella and Aerobacter groups because of their obvious relationship to members of those groups. These investigators concluded that there was no need for a separate tribe Serrateae, erected as it was on the basis of pigment production alone, since pigment formation was not a cardinal characteristic of the group (Table 1). Incorporation of the Serratia into the genus Chromobacterium is regarded as untenable.

Davis et al. (1957) suggested that only one species of Serratia (Serratia marcescens) was needed and Ewing et al. (1959) concluded the single species with one subspecies or variety, Serratia marcescens var. kiliensis (Lehmann and

Neumann, Bergey et al., Ewing et al., comb. nov.), was sufficient. The subspecific or varietal name was applied to strains that differed from S. marcescens in that they gave negative Voges - Proskauer reactions. Cultures labeled Serratia indica, S. anolium, S. plymuthicum, S. pyoseptica, S. urinae, S. esseyana, etc., could not be distinguished from S. marcescens or S. marcescens var. kiliensis by means at the disposal of the above-mentioned investigators. Martinec and Kocur (1960, 1961a, c) who studied strains of S. kiliensis and S. plymuthica (sic) concluded that they were indistinguishable from S. marcescens, and agreed with the conclusion of Davis et al. (1957) regarding a single species in the genus. Also, Martinec and Kocur (1961b) studied a number of other strains that had been described as species of Serratia by other authors and reported that some of these (e.g. S. piscatorum and S. fuchsina) were S. marcescens while others, such as those described as S. saponaria I, II, did not belong in the genus Serratia and placed them provisionally in the genus Alcaligenes. These investigators (1961c) agreed with conclusions of Ewing et al. (1959) regarding the names S. marcescens and S. marcescens var. kiliensis. However, it should be noted that the late Professor Breed previously had concluded that several of the above-mentioned bacteria could not be distinguished from S. marcescens (v. Bergey's Manual 5th Ed., 1939; and 6th Ed., 1948). For example, he considered S. esseyana, S. pyoseptica, and S. fuchsina all to be S. marcescens. Also, S. anolium was omitted from the 6th Ed. (1948) although it had appeared as a separate species in the 5th Ed. (1939) of Bergey's Manual. Two of the strains described by Stevenson (1959) as Aeromonas margarita were found by Ewing et al. (1960) to be typical S. marcescens strains.

The Serratia group was defined by Davis et al. (1957) and the definition was adopted by the International Enterobacteriaceae Subcommittee in the 1958 Report. This definition was emended by Ewing et al. (1959) by inclusion of additional characteristics. These definitions may be restated as follows:*

* This definition is based upon the reactions given by 203 cultures submitted for identification (Table 1).

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The genus Serratia is composed of Gram-negative, motile bacteria that conform to the definition of the family Enterobacteriaceae. When gas is formed from fermentable substrates the volumes are small (bubble to about 10%). Visible gas is not formed from glycerol, inositol, or cellobiose. Sorbitol usually is fermented, but acid rarely is produced from arabinose, rhamnose, or raffinose. The Voges-Proskauer test is positive except in strains of the subspecies (variety) Serratia marcescens var. kiliensis. Gelatin is rapidly liquefied. Some strains produce pink, red, or magenta pigment; in some cultures the rods are encapsulated.

The type species is Serratia marcescens Bizio.

The genus Serratia belongs to the tribe Klebsiellae Trevisan, which also contains the genus Klebsiella and the genus Aerobacter (or Enterobacter):

Tribe	<u>Klebsiellae</u> Trevisan
Genus 1	<u>Klebsiella</u> Trevisan
Genus 2	<u>Aerobacter</u> Beijerinck (or <u>Enterobacter</u> Hormaeche and Edwards, 1960**)
Genus 3	<u>Serratia</u> Bizio

Since the generic name Klebsiella Trevisan 1885 has been conserved, it follows that the name of the tribe that contains this genus should be Klebsiellae, as indicated by priority and as used by Trevisan (1887, v. Bergey's Manual, 4th Ed., 1934, p.123).

In conclusion, it may be added that in the fourth edition of Bergey's Manual (1934), 27 species were listed in the genus Serratia. Two of these were described as polarly flagellated bacteria and ten others were characterized as nonmotile forms. It is suggested that all of the specific epithets listed therein should be rejected with the exceptions of marcescens in S. marcescens, kilensis (sic) in S. kiensis, and the two specific epithets used in connection with the polarly flagellated bacteria. The epithets marcescens and kiensis (kilensis or kiliensis) should be conserved for use in S. marcescens and S. marcescens var. kiliensis. The other two specific epithets may be needed for use with polarly flagellated bacteria and should not be rejected until this point is investigated. In the seventh edition of Bergey's

** Action is pending regarding Aerobacter vs. Enterobacter.

Table 1. The biochemical reactions of cultures of *Serratia* based upon the reactions given by 203 strains submitted for identification.

Substrate or test			% + (% +)*
Glucose	+		100
Gas	+ or -		68 **
Lactose	- or (+)		0.8 (35.5)
Sucrose	+		98.4 (0.8)
Maltose	+		97 (3.)
Mannitol	+		100
Dulcitol	-		0
Rhamnose	-		0
Arabinose	-		0.5
Inositol	d		70.2 (11.4)
Xylose	d		7.9 (16.3)
Raffinose	-		0.5 (0.5)
Sorbitol	+		98.5
Salicin	+		97.4 (1.7)
Adonitol	d		44.3 (28.3)
Trehalose	+		100
Cellobiose	+		22.2 (47.2)
Glycerol	+		89.2 (9.0)
Indol	-		0
Methyl red	37C	- or +vw	22.5
	22C	- or +vw	11.0
Voges-Proskauer	37C	+	99.5
	22C	+	99.5
Citrate, Simmons'		+	99.5
Urease		- or (+w)	43.2

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Table 1. (Continued)

Substrate or test		% + (% +)
Hydrogen sulfide (TSI)	-	0 (43.2w)
Nitrite	+	100
Gelatin	22C +	98.5 (1.5)
Phenylalanine deaminase	-	5.9w
Malonate	-	3.6
Potassium cyanide broth	+	98.4
Lysine decarboxylase	+	100
Arginine dihydrolase	-	(6.4)
Ornithine decarboxylase	+	99.5
Mucate	-	0
Ammonium salts glucose agar	+	99
Pigment	- or +	26.6
Motility	+	99.5

- * Figures in parentheses indicate percentage of delayed positive reactions (3 or more days).
- ** When gas is formed, volumes are small, 10% or less.
- + Positive in 1 or 2 days.
- (+) Delayed reaction.
- No reaction or negative test.
- d Different biochemical reactions.
- w Weakly positive reaction.
- vw Very weakly positive reaction.

Manual (1957) only five species of Serratia were listed, since Professor Breed had found that many of the epithets employed in the earlier editions were synonyms of S. marcescens. However, it is suggested that the epithets indica, plymuthica, and piscatorum also may be rejected as later synonyms of S. marcescens.

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