Some Taxonomic Recommendations and a Proposal of Neotype Strains for Nineteen Species of *Enterobacteriaceae* ICSB Subcommittee on Taxonomy of *Enterobacteriaceae*

It is recommended by the ICSB Subcommittee on the Taxonomy of *Enterobacteriaceae* that the organism originally named *Aerobacter liquefaciens* by Grimes and Hennerty be regarded as a member of the genus *Serratia* rather than *Enterobacter* and that the organism originally named *Pseudomonas proteamaculans* by Paine and Stansfield be regarded as a member of the genus *Serratia* rather than *Erwinia*. In these positions, the correct names of these organisms are *Serratia liquefaciens* (Grimes and Hennerty) Bascomb et al. and *Serratia proteamaculans* (Paine and Stansfield) Grimont et al., respectively. The Subcommittee also proposes the following strains as neotypes for their respective species: *Erwinia ananas* NCPPB 1846; *E. cancerogena* NCPPB 2176; *E. carotovora* NCPPB 312; *E. dissolvens* NCPPB 1850; *E. herbicola* NCPPB 2971; *E. milletiae* NCPPB 2519; *E. paradisiaca* NCPPB 2511; *E. stewartii* NCPPB 2295; *E. tracheiphila* NCPPB 2452; *Escherichia blattae* CDC 9005-74; *Klebsiella oxytoca* ATCC 13182; *K. ozaenae* ATCC 11296; *K. pneumoniae* ATCC 13883; *K. rhinoscleromatis* ATCC 13884; *Proteus mirabilis* ATCC 29906; *Providencia rettgeri* ATCC 29944; *P. stuartii* ATCC 29914; *Shigella flexneri* ATCC 29903; and *S. sonnei* ATCC 29930.

The members of the ICSB Subcommittee on Taxonomy of the *Enterobacteriaceae* (ISTE) made the following recommendations and proposals at, and subsequent to, the 12th International Congress for Microbiology held at Munich, Germany, in September 1978.

(i) The ISTE recommended that, on the basis of the biochemical and genetic evidence (2, 32), the organism originally named *Aerobacter liquefaciens* by Grimes and Hennerty be regarded as a member of the genus *Serratia* rather than of the genus *Enterobacter*. In this position, the correct name of the organism is *Serratia liquefaciens* (Grimes and Hennerty) Bascomb et al. (Syn.: *Aerobacter liquefaciens* Grimes and Hennerty; *Enterobacter liquefaciens* (Grimes and Hennerty) Ewing).

(ii) The ISTE also recommended that, on the same basis mentioned above (18), the organism originally named *Pseudomonas proteamaculans* by Paine and Stansfield be regarded as a member of the genus *Serratia* rather than of the genus *Erwinia*. In this position, the correct name of the organism is *Serratia proteamaculans* (Paine and Stansfield) Grimont et al. (Syn.: *Pseudomonas proteamaculans* Paine and Stansfield; *Erwinia proteamaculans* (Paine and Stansfield) Dye).

(iii) The ISTE here proposes as neotypes those strains listed in Table 1. To our knowledge, strains on which the original descriptions of these species were based are no longer extant. With the exception of the *Erwinia* strains, the

characters of the proposed neotype strains are given in Table 2. The cell morphology of these strains conforms to that given in *Bergey's Manual* (12) for the *Enterobacteriaceae*; motile cells are peritrichous. The characteristics of the *Erwinia* strains are given by Young et al. (36). Cultures of the proposed neotype strains are available from the culture collections cited in Table 1.

REPRINT REQUESTS

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LITERATURE CITED

1. Abel, R. 1893. Bakteriologische Studien über *Ozaena simplex*. Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. 1 Orig. 13:161-173.
2. Bascomb, S., S. P. Lapage, W. R. Willcox, and M. A. Curtis. 1971. Numerical classification of the tribe *Klebsiellae*. J. Gen. Microbiol. 66:279-295.
3. Bergey, D. H., F. C. Harrison, R. S. Breed, B. W. Hammer, and F. M. Huntoon. 1923. Bergey's manual of determinative bacteriology, 1st ed. The Williams & Wilkins Co., Baltimore.
4. Bergey, D. H., F. C. Harrison, R. S. Breed, B. W. Hammer, and F. M. Huntoon. 1925. Bergey's manual of determinative bacteriology, 2nd ed. The Williams & Wilkins Co., Baltimore.
5. Brenner, D. J., G. R. Fanning, C. V. Miklos, and A. G. Steigerwalt. 1973. Polynucleotide sequence relatedness among *Shigella* species. Int. J. Syst. Bacteriol. 23:1-7.
6. Brenner, D. J., J. J. Farmer III, G. R. Fanning, A. G. Steigerwalt, P. Klykken, H. G. Wathen, F. W. Hickman, and W. H. Ewing. 1978. Deoxyribonucleic

TABLE 1. *Proposed neotype strains of 19 species of Enterobacteriaceae^a*

Species	Proposed neotype strain	Reference to genetic and/or biochemical characters of the strain
<i>Erwinia ananas</i> Serrano 1928 (29)	NCPPB 1846 = PDDCC 1850	36
<i>E. cancerogena</i> Urošević 1966 (34)	NCPPB 2176 = PDDCC 5706	36
<i>E. carotovora</i> (Jones 1901) Bergey et al. 1923 (3, 22)	NCPPB 312 = PDDCC 5702 = ATCC 15713	36
<i>E. dissolvens</i> (Rosen 1922) Burkholder 1948 (9, 27)	NCPPB 1850 = PDDCC 1570 = ATCC 23373	32, 36
<i>E. herbicola</i> (Löhnis 1911) Dye 1964 (15, 25)	NCPPB 2971 = PDDCC 272	36
<i>E. milletiae</i> (Kawakami and Yoshida 1920) Magrou 1937 (23, 26)	NCPPB 2519 = PDDCC 5843	36
<i>E. paradisiaca</i> Fernandez-Borrero and Lopez-Doque 1970 (17)	NCPPB 2511	36
<i>E. stewartii</i> (Smith 1898) Dye 1963 (14, 31)	NCPPB 2295 = PDDCC 257 = ATCC 8199	36
<i>E. tracheiphila</i> (Smith 1895) Bergey et al. 1923 (3, 30)	NCPPB 2452 = PDDCC 5845	36
<i>Escherichia blattae</i> Burgess et al. 1973 (8)	CDC 9005-74	8
<i>Klebsiella oxytoca</i> (Flügge 1886) Brenner et al. 1977 (7)	ATCC 13182	21
<i>K. ozaenae</i> (Abel 1893) Bergey et al. 1925 (1, 4)	ATCC 11296 = NCTC 5050	
<i>K. pneumoniae</i> (Schroeter 1886) Trevisan 1887 (28, 33)	ATCC 13883 = NCTC 9633 = DSM 30104 = CDC 298-53	13
<i>K. rhinoscleromatis</i> Trevisan 1887 (33)	ATCC 13884 = NCTC 5046	13
<i>Proteus mirabilis</i> Hauser 1885 (20)	ATCC 29906	7
<i>Providencia rettgeri</i> (Hadley et al. 1918) Brenner et al. 1978 (6, 19)	ATCC 29944	7
<i>P. stuartii</i> (Buttiaux et al. 1954) Ewing 1962 (10, 16)	ATCC 29914	7
<i>Shigella flexneri</i> Castellani and Chalmers 1919 (11)	ATCC 29903	5
<i>S. sonnei</i> (Levine 1920) Weldin 1927 (24, 35)	ATCC 29930	5

^a Abbreviations: ATCC, American Type Culture Collection, Rockville, Md.; CCM, Czechoslovak Collection of Microorganisms, 662 Brno, tr. Obrancu miru 10, Czechoslovakia; IIUP, Istituto di Igiene, Facoltà di Scienze, Università, Perugia, Italy; ISM, Istituto Sieroterapico Milanese "S. Belfanti," Milan, Italy; ISVT SCLAVO, Istituto Sieroterapico Vaccinogeno Toscano "SCLAVO," Siena, Italy; NCIB, National Collection of Industrial Bacteria, Aberdeen, Scotland; NCTC, National Collection of Type Cultures, Central Public Health Laboratory, London NW9 5HT, England.

- acid relatedness of *Proteus* and *Providencia* species. Int. J. Syst. Bacteriol. **28**:269-282.
- Brenner, D. J., J. J. Farmer III, F. W. Hickman, M. A. Asbury, and A. G. Steigerwalt. 1977. Taxonomic and nomenclature changes in *Enterobacteriaceae*. CDC Publications, Atlanta, Ga.
 - Burgess, N. R. H., S. N. McDermott, and J. Whiting. 1973. Anaerobic bacteria occurring in the hind-gut of the cockroach, *Blatta orientalis*. J. Hyg. **71**:1-7.
 - Burkholder, W. H. 1948. Genus I. *Erwinia* Winslow et al., p. 463-478. In R. S. Breed, E. G. D. Murray, and A. P. Hitchens (ed.), Bergey's manual of determinative bacteriology, 6th ed. The Williams & Wilkins Co., Baltimore.
 - Buttiaux, R., R. Osteux, R. Fresnoy, and J. Moriametz. 1954. Les propriétés biochimiques caractéristiques du genre *Proteus*. Inclusion souhaitable des *Providencia* dans celui-ci. Ann. Inst. Pasteur (Paris) **87**:375-386.
 - Castellani, A., and A. J. Chalmers. 1919. Manual of tropical medicine, 3rd ed. Williams Wood and Co., New York.
 - Cowan S. T. 1974. FAMILY I. ENTEROBACTERIACEAE RAHN, 1937, 281 *Nom. gen. cons.* Opin. 15, Jud. Comm. 1958, 73, p. 290-340. In R. E. Buchanan and N. E. Gibbons (ed.), Bergey's manual of determinative bacteriology, 8th ed. The Williams & Wilkins Co., Baltimore.
 - Cowan, S. T., K. J. Steel, C. Shaw, and J. P. Duguid. 1960. A classification of the *Klebsiella* group. J. Gen. Microbiol. **23**:601-612.
 - Dye, D. W. 1963. The taxonomic position of *Xanthomonas stewartii* (Erw. Smith 1914) Dowson 1939. N. Z. J. Sci. **6**:495-506.
 - Dye, D. W. 1964. The taxonomic position of *Xanthomonas trifolii* (Huss 1907) James 1955. N. Z. J. Sci. **7**: 261-269.
 - Ewing, W. H. 1962. The tribe *Proteeae*: its nomenclature

TABLE 2. Biochemical characteristics of 10 of the proposed neotype strains^a

Test	<i>Escherichia blatae</i> CDC 9005-74 ^a	<i>Klebsiella oxytoca</i> ATCC 13182 ^a	<i>Klebsiella ozaenae</i> ATCC 11296 ^b	<i>Klebsiella pneumoniae</i> ATCC 13883 ^c	<i>Klebsiella rhinoscleroma- tis</i> ATCC 13884 ^c	<i>Proteus mirabilis</i> ATCC 22906 ^a	<i>Providencia rettgeri</i> ATCC 29944 ^a	<i>Providencia stuartii</i> ATCC 29914 ^a	<i>Shigella flexneri</i> ATCC 29903 ^a	<i>Shigella sonnei</i> ATCC 29930 ^a
Indole	-	+	-	-	-	-	+	+	+	-
Methyl red	+	-	+	+	+	+	+	+	+	+
Voges-Proskauer	-	+	-	-	-	-	-	-	-	-
Citrate (Simmons')	+	+	+	+	+	+	+	+	+	-
H ₂ S	-	-	-	+	+	+	-	-	-	-
Urea	-	+	+	+	+	+	+	+	-	-
Phenylalanine deaminase	-	-	-	-	-	-	-	-	-	-
Lysine decarboxylase	+	+	+	+	+	-	-	-	-	-
Arginine dihydrolase	+	-	-	-	-	+	-	-	-	+
Ornithine decarboxylase	+	-	-	-	-	+	+	+	-	-
Motility	-	-	-	-	-	+	+	+	-	-
Gelatin (22°C)	-	(+)	-	-	-	-	-	-	-	-
KCN (growth)	-	+	+	-	+	+	+	+	-	-
Malonate	+	+	-	+	+	-	-	-	-	-
Acid from:										
D-Glucose	+	+	+	+	+	+	+	+	+	+
Lactose	-	+	-	+	-	-	(+)	(+)	-	-
Sucrose	-	+	-	+	+	-	+	-	+	+
D-Mannitol	-	+	-	+	-	-	-	-	-	-
Dulcitol	-	+	+	+	+	-	+	-	-	-
Salicin	-	+	+	+	+	-	+	-	-	-
Adonitol	-	+	+	+	+	-	+	+	-	-
D-Inositol	-	+	+	+	+	-	-	-	-	-
D-Sorbitol	-	+	+	+	+	-	-	-	-	-
L-Arabinose	+	+	+	+	+	-	-	-	+	+
Raffinose	-	+	+	+	+	-	-	-	+	+
L-Rhamnose	+	+	+	+	+	-	-	-	+	+
Maltose	+	+	+	+	+	-	-	-	+	+
D-Xylose	+	+	+	+	+	+	-	-	+	+
Trehalose	+	+	+	+	+	+	-	-	+	+
Cellobiose	-	+	+	+	+	-	-	-	-	-
α-Methyl glucoside	-	+	-	-	-	-	-	-	-	-
Erythritol	-	-	-	-	-	-	(+)	-	-	-
Esculin	-	+	-	-	-	-	+	-	+	-
Melibiose	-	-	-	-	-	-	-	-	-	-
D-Arabinol	-	+	-	-	-	-	-	-	+	-
Glycerol	+	+	+	+	+	+	+	+	+	+
D-Mannose	+	+	-	-	(+)	(+)	+	+	+	-
Mucate	+	+	-	-	-	-	-	-	-	-

[illegible]

^a Biochemical reactions from CDC. See footnote *a* to Table 1 for abbreviations. Symbols: +, positive within 48 h; (+), positive between 3 and 14 days; -, negative.

^b Biochemical reactions from ATCC (R. Gherna, personal communication).

^c Biochemical reactions from reference 13.

- and taxonomy. Int. Bull. Bacteriol. Nomencl. Taxon. 12:93-102.
17. Fernandez-Borrero, O., and S. López-Duque. 1970. Pudrición acuosa de suédo tallo del platano (*Musa paradisiaca*) causada por *Erwinia paradisiaca* n. sp. Cenicafe 21:3-14.
18. Grimont, P. A. D., F. Grimont, and M. P. Starr. 1978. *Serratia proteamaculans* (Paine and Stansfield) comb. nov., a senior subjective synonym of *Serratia liquefaciens* (Grimes and Hennerty) Bascomb et al. Int. J. Syst. Bacteriol. 28:503-510.
19. Hadley, P, M. W. Elkins, and D. W. Caldwell. 1918. The colon-typhoid intermediates as causative agents of disease in birds. R. I. Agric. Exp. Stn. Bull. 174:1-216.
20. Hauser, G. 1885. Über Fäulnisbakterien und deren Beziehungen zur Septicämie. Ein Beitrag zur Morphologie der Spaltpilze. Vogel, Leipzig.
21. Jain, K., K. Redsak, and W. Mannheim. 1974. Differentiation of the *Oxytocum* group from *Klebsiella* by deoxyribonucleic acid-deoxyribonucleic acid hybridization. Int. J. Syst. Bacteriol. 24:402-407.
22. Jones, L. R. 1901. *Bacillus carotovorus* n. sp., die Ursache einer weichen Faulnis der Mohre. Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. 2 7:12-21.
23. Kawakami, K., and S. Yoshida. 1920. Bacterial gall on *Milletia* plant (*Bacillus milletiae* n. sp.). Bot. Mag. (Tokyo) 34:110-115.
24. Levine, M. 1920. Dysentery and allied bacilli. J. Infect. Dis. 27:31-39.
25. Löhnis, F. 1911. Landwirtschaftlichbakteriologisches Praktikum. Gebrüder Borntraeger, Berlin.
26. Magrou, J. 1937. In Hauduroy et al. (ed.), Dictionnaire des bactéries pathogènes. Masson and Co., Paris.
27. Rosen, H. R. 1922. The bacterial pathogen of corn stalk rot. Phytopathology 12:497-499.
28. Schroeter, J. 1886. In F. Cohn (ed.), Kryptogamen flora von Schlesien. Bd. 3, Heft 3, Pilze. J. U. Kern's Verlag, Breslau.
29. Serrano, F. B. 1928. Bacterial fruitlet brownrot of pineapple in the Philippines. Philipp. J. Sci. 36:271-305.
30. Smith, E. F. 1895. *Bacillus tracheiphilus* sp. nov. die Ursache des Verwelkens verschiedener Curcubitaceen. Zentralbl. Bakteriol. Parasitenkd. Infektionskr. Hyg. Abt. 2 7:364-373.
31. Smith, E. F. 1898. Notes on Stewart's sweet corn germ, *Pseudomonas stewarti* n. sp. Proc. Am. Assoc. Adv. Sci. 47:422-426.
32. Steigerwalt, A. G., G. R. Fanning, M. A. Fife-Asbury, and D. J. Brenner. 1976. DNA relatedness among species of *Enterobacter* and *Serratia*. Can. J. Microbiol. 22:121-137.
33. Trevisan, V. 1877. Sul micrococco della rabbia e sulla possibilità di riconoscere durante il periodo d'incubazione, dall'esame del sangue della persona morsicata, se ba contratta l'infezione rabbia. R. C. Inst. Lomb. (Ser. II) 20:797-804.
34. Urošević, B. 1966. Canker of poplar caused by *Erwinia cancerogena* n. sp. Lesn. Cas. 12:493-505.
35. Weldin, J. C. 1927. The colon-typhoid group of bacteria and related forms. Relationships and classification. Iowa State J. Sci. 1:121-197.
36. Young, J. M., D. W. Dye, J. F. Bradbury, C. G. Panagopoulos, and C. F. Robbs. 1978. A proposed nomenclature and classification for plant pathogenic bacteria. N. Z. J. Agric. Res. 21:153-177.

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