

CONTENTS

List of Contributors	vi		
List of Advisory Committee Members	xii		
Preface to Eighth Edition	xv		
Preface to First Edition	xviii		
Obituary. R. E. Buchanan	xx		
Introduction			
On Using the Manual	1		
A Place for Bacteria in the Living World	4		
The Mechanism of Identification	10		
Reference Collections of Bacteria—The Need and Requirements for Type and Neotype Strains	14		
Key to the 19 Parts	18		
KINGDOM PROCARYOTAE	21		
Division I. The Cyanobacteria	22		
Division II. The Bacteria	23		
PART 1.			
PHOTOTROPHIC BACTERIA	24		
Order I. <i>Rhodospirillales</i>	24		
Family I. <i>Rhodospirillaceae</i>	26		
Genus I. <i>Rhodospirillum</i>	26		
Genus II. <i>Rhodopseudomonas</i>	29		
Genus III. <i>Rhodomicrobium</i>	33		
Family II. <i>Chromatiaceae</i>	34		
Genus I. <i>Chromatium</i>	36		
Genus II. <i>Thiocystis</i>	39		
Genus III. <i>Thioaerobium</i>	40		
Genus IV. <i>Thiospirillum</i>	41		
Genus V. <i>Thiocapsa</i>	42		
Genus VI. <i>Lamprocystis</i>	43		
Genus VII. <i>Thiodictyon</i>	44		
Genus VIII. <i>Thiopedia</i>	45		
Genus IX. <i>Amoebobacter</i>	46		
Genus X. <i>Ectothiorhodospira</i>	47		
Family III. <i>Chlorobiaceae</i>	51		
Genus I. <i>Chlorobium</i>	52		
Genus II. <i>Prosthecochloris</i>	55		
Genus III. <i>Chloropseudomonas</i>	55		
Genus IV. <i>Pelodictyon</i>	56		
Genus V. <i>Clathrochloris</i>	57		
PART 2.			
THE GLIDING BACTERIA	76		
Order I. <i>Myxobacterales</i>	76		
Family I. <i>Myxococcaceae</i>	79		
Genus I. <i>Myxococcus</i>	79		
Family II. <i>Archangiaceae</i>	83		
Genus I. <i>Archangium</i>	83		
Family III. <i>Cystobacteraceae</i>	86		
Genus I. <i>Cystobacter</i>	87		
Genus II. <i>Melittangium</i>	89		
Genus III. <i>Stigmatella</i>	90		
Family IV. <i>Polyangiaceae</i>	92		
Genus I. <i>Polyangium</i>	92		
Genus II. <i>Nannocystis</i>	96		
Genus III. <i>Chondromyces</i>	96		
Order II. <i>Cytophagales</i>	99		
Family I. <i>Cytophagaceae</i>	99		
Genus I. <i>Cytophaga</i>	101		
Genus II. <i>Flexibacter</i>	105		
Genus III. <i>Herpetosiphon</i>	107		
Genus IV. <i>Flexithrix</i>	109		
Genus V. <i>Saprospira</i>	109		
Genus VI. <i>Sporocytophaga</i>	111		
Family II. <i>Beggiatoaceae</i>	112		
Genus I. <i>Beggiatoa</i>	113		
Genus II. <i>Vitreoscilla</i>	114		
Genus III. <i>Thioploca</i>	115		
Family III. <i>Simonsiellaceae</i>	116		
Genus I. <i>Simonsiella</i>	116		
Genus II. <i>Alysiella</i>	117		
Family IV. <i>Leucotrichaceae</i>	118		
Genus I. <i>Leucothrix</i>	118		
Genus II. <i>Thiothrix</i>	119		
Families and Genera of Uncertain Affiliation	120		
Genus <i>Toxothrix</i>	120		
Family <i>Achromatiaceae</i>	120		
Genus <i>Achromatium</i>	121		
Family <i>Pelonemataceae</i>	122		
Genus <i>Pelonema</i>	122		
Genus <i>Achroonema</i>	123		
Genus <i>Peloploca</i>	125		
Genus <i>Desmanthos</i>	127		

PART 3.**THE SHEATHED BACTERIA . . . 128**

Genus	<i>Sphaerotilus</i>	128
Genus	<i>Leptothrix</i>	129
Genus	<i>Streptothrix</i>	133
Genus	<i>Lieskeella</i>	134
Genus	<i>Phragmidiothrix</i>	134
Genus	<i>Crenothrix</i>	135
Genus	<i>Clonothrix</i>	136

PART 4.**BUDDING and/or APPENDAGED****BACTERIA 148**

Genus	<i>Hyphomicrobium</i>	148
Genus	<i>Hyphomonas</i>	150
Genus	<i>Pedomicrobium</i>	151
Genus	<i>Caulobacter</i>	153
Genus	<i>Asticcacaulis</i>	155
Genus	<i>Ancalomicrobium</i>	156
Genus	<i>Prosthecomicrobium</i>	157
Genus	<i>Thiodendron</i>	158
Genus	<i>Pasteuria</i>	158
Genus	<i>Blastobacter</i>	159
Genus	<i>Seliberia</i>	160
Genus	<i>Gallionella</i>	160
Genus	<i>Nevskia</i>	161
Genus	<i>Planctomyces</i>	162
Genus	<i>Metallogenium</i>	163
Genus	<i>Caulococcus</i>	165
Genus	<i>Kusnezovia</i>	166

PART 5.**THE SPIROCHETES 167**

Order I.	<i>Spirochaetales</i>	167
Family I.	<i>Spirochaetaceae</i>	167
Genus	I. <i>Spirochaeta</i>	168
Genus	II. <i>Cristispira</i>	171
Genus	III. <i>Treponema</i>	175
Genus	IV. <i>Borrelia</i>	184
Genus	V. <i>Leptospira</i>	190

PART 6.**SPIRAL AND CURVED BACTERIA****196**

Family I.	<i>Spirillaceae</i>	196
Genus	I. <i>Spirillum</i>	196
Genus	II. <i>Campylobacter</i>	207

Genera of Uncertain Affiliation 212

Genus	<i>Bdellovibrio</i>	212
Genus	<i>Microcyclus</i>	214
Genus	<i>Pelosigma</i>	215
Genus	<i>Brachyarcus</i>	216

PART 7.**GRAM-NEGATIVE AEROBIC****RODS AND COCCI 217**

Family I.	<i>Pseudomonadaceae</i>	217
Genus	I. <i>Pseudomonas</i>	217
Genus	II. <i>Xanthomonas</i>	243
Genus	III. <i>Zoogloea</i>	249

Genus	IV. <i>Gluconobacter</i>	251
Family II.	<i>Azotobacteraceae</i>	253
Genus	I. <i>Azotobacter</i>	254
Genus	II. <i>Azomonas</i>	255
Genus	III. <i>Beijerinckia</i>	256
Genus	IV. <i>Derxia</i>	260
Family III.	<i>Rhizobiaceae</i>	261
Genus	I. <i>Rhizobium</i>	262
Genus	II. <i>Agrobacterium</i>	264
Family IV.	<i>Methylomonadaceae</i>	267

Genus	I. <i>Methylomonas</i>	268
Genus	II. <i>Methylococcus</i>	269
Family V.	<i>Halobacteriaceae</i>	269
Genus	I. <i>Halobacterium</i>	270

Genera of Uncertain Affiliation 273

Genus	<i>Alcaligenes</i>	273
Genus	<i>Acetobacter</i>	276
Genus	<i>Brucella</i>	278
Genus	<i>Bordetella</i>	282
Genus	<i>Francisella</i>	283
Genus	<i>Thermus</i>	285

PART 8.**GRAM-NEGATIVE FACULTATIVELY ANEROBIC RODS 290**

Family I.	<i>Enterobacteriaceae</i>	290
Genus	I. <i>Escherichia</i>	293
Genus	II. <i>Edwardsiella</i>	296
Genus	III. <i>Citrobacter</i>	296
Genus	IV. <i>Salmonella</i>	298
Genus	V. <i>Shigella</i>	318
Genus	VI. <i>Klebsiella</i>	321
Genus	VII. <i>Enterobacter</i>	324
Genus	VIII. <i>Hafnia</i>	325
Genus	IX. <i>Serratia</i>	326
Genus	X. <i>Proteus</i>	327
Genus	XI. <i>Yersinia</i>	330
Genus	XII. <i>Erwinia</i>	332

Family II. *Vibriomaceae* 340

Genus	I. <i>Vibrio</i>	340
Genus	II. <i>Aeromonas</i>	345
Genus	III. <i>Plesiomonas</i>	348
Genus	IV. <i>Photobacterium</i>	349
Genus	V. <i>Lucibacterium</i>	351

Genera of Uncertain Affiliation 352

Genus	<i>Zymomonas</i>	352
Genus	<i>Chromobacterium</i>	354
Genus	<i>Flavobacterium</i>	357
Genus	<i>Haemophilus</i>	364
	(<i>H. vaginalis</i>)	368
Genus	<i>Pasteurella</i>	370
Genus	<i>Actinobacillus</i>	373
Genus	<i>Cardiobacterium</i>	377
Genus	<i>Streptobacillus</i>	378
Genus	<i>Calymmatobacterium</i>	381
Parasites of	<i>Paramecium</i>	382

**PART 9.
GRAM-NEGATIVE ANAEROBIC**

BACTERIA	384
Family I. <i>Bacteroidaceae</i>	384
Genus I. <i>Bacteroides</i>	385
Genus II. <i>Fusobacterium</i>	404
Genus III. <i>Leptotrichia</i>	416
Genera of Uncertain Affiliation	418
Genus <i>Desulfoobirio</i>	418
Genus <i>Butyrionobrio</i>	420
Genus <i>Succinioobrio</i>	422
Genus <i>Succinirnonas</i>	422
Genus <i>Lachnospira</i>	423
Genus <i>Selenomonas</i>	424

PART 10.

GRAM-NEGATIVE COCCI AND COCCOBACILLI	427
Family I. <i>Neisseriaceae</i>	427
Genus I. <i>Neisseria</i>	428
Genus II. <i>Branhamella</i>	432
Genus III. <i>Moraxella</i>	433
Genus IV. <i>Acinetobacter</i>	436
Genera of Uncertain Affiliation	438
Genus <i>Paracoccus</i>	438
Genus <i>Lampropedia</i>	440

PART 11.

GRAM-NEGATIVE ANAEROBIC COCCI	445
Family I. <i>Veillonellaceae</i>	445
Genus I. <i>Veillonella</i>	446
Genus II. <i>Acidarninococcus</i>	447
Genus III. <i>Megasphaera</i>	448

PART 12.

GRAM-NEGATIVE, CHEMO- LITHOTROPHIC BACTERIA	450
a. Organisms oxidizing ammonia or nitrite	450
Family I. <i>Nitrobacteraceae</i>	450
Genus I. <i>Nitrobacter</i>	451
Genus II. <i>Nitrospina</i>	452
Genus III. <i>Nitrococcus</i>	452
Genus IV. <i>Nitrosomonas</i>	453
Genus V. <i>Nitrosospira</i>	454
Genus VI. <i>Nitrosococcus</i>	454
Genus VII. <i>Nitrosolobus</i>	455
b. Organisms metabolizing sulfur	456
Genus <i>Thiobacillus</i>	456
Genus <i>Sulfobolus</i>	461
Genus <i>Thiobacterium</i>	462
Genus <i>Macromonas</i>	462
Genus <i>Thiooobrium</i>	463
Genus <i>Thiospira</i>	464
c. Organisms depositing iron or manganese oxides	464
Family I. <i>Siderocapsaceae</i>	464
Genus I. <i>Siderocapsa</i>	465
Genus II. <i>Naurnanniella</i>	467

Genus III. <i>Ochrobiaurn</i>	467
Genus IV. <i>Siderococcus</i>	468

PART 13.

METHANEPRODUCING BAC- TERIA	472
Family I. <i>Methanobacteriaceae</i>	472
Genus I. <i>Methanobacterium</i>	473
Genus II. <i>Methanosarcina</i>	476
Genus III. <i>Methanococcus</i>	477

PART 14.

GRAM-POSITIVE COCCI	478
a. Aerobic and/or facultatively ana- erobic	478
Family I. <i>Micrococcaceae</i>	478
Genus I. <i>Micrococcus</i>	478
Genus II. <i>Staphylococcus</i>	483
Genus III. <i>Planococcus</i>	489
Family II. <i>Streptococcaceae</i>	490
Genus I. <i>Streptococcus</i>	490
Genus II. <i>Leuconostoc</i>	510
Genus III. <i>Pediococcus</i>	513
Genus IV. <i>Aerococcus</i>	515
Genus V. <i>Gemella</i>	516
b. Anaerobic	
Family III. <i>Peptococcaceae</i>	517
Genus I. <i>Peptococcus</i>	518
Genus II. <i>Peptostreptococcus</i>	522
Genus III. <i>Ruminococcus</i>	525
Genus IV. <i>Sarcina</i>	527

PART 15.

ENDOSPOREFORMING RODS AND COCCI	529
Family I. <i>Bacillaceae</i>	529
Genus I. <i>Bacillus</i>	529
Genus II. <i>Sporolactobacillus</i>	550
Genus III. <i>Clostridium</i>	551
Genus IV. <i>Desulfotomaculum</i>	572
Genus V. <i>Sporosarcina</i>	573
Genus of Uncertain Affiliation	574
Genus <i>Oscillospira</i>	574

PART 16.

GRAM-POSITIVE, ASPOROGE- NOUS RODSHAPED BACTERIA	576
Family I. <i>Lactobacillaceae</i>	576
Genus I. <i>Lactobacillus</i>	576
Genera of Uncertain Affiliation	593
Genus <i>Listeria</i>	593
Genus <i>Erysipelothrix</i>	597
Genus <i>Caryophanon</i>	598

PART 17.

ACTINOMYCETES AND RELATED ORGANISMS	599
Coryneform Group of Bacteria	599
Genus I. <i>Corynebacterium</i>	602
a. Human and Animal Parasites and Pathogens	602

b. Plant Pathogenic Corynebacteria	611	Genus VI. <i>Micropolyspora</i>	861
c. Non-pathogenic Corynebacteria	617	PART 18.	
Genus II. <i>Arthrobacter</i>	618	THE RICKETTSIAS	882
<i>Genem incertae sedis</i>	625	Order I. <i>Rickettsiales</i>	882
<i>Breuibacterium</i>	625	Family I. <i>Rickettsiaceae</i>	883
<i>Microbacterium</i>	628	Tribe I. <i>Rickettsieae</i>	883
Genus III. <i>Cellulomonas</i>	629	Genus I. <i>Rickettsia</i>	883
Genus IV. <i>Kurthia</i>	631	Genus II. <i>Rochalimaea</i>	890
Family I. <i>Propionibacteriaceae</i>	633	Genus III. <i>Coxiella</i>	891
Genus I. <i>Propionibacterium</i>	633	Tribe II. <i>Ehrlichieae</i>	893
Genus II. <i>Eubacterium</i>	641	Genus IV. <i>Ehrlichia</i>	893
Order I. <i>Actinornycetales</i>	657	Genus V. <i>Cowdria</i>	895
Family I. <i>Actinornycetaceae</i>	659	Genus VI. <i>Neorickettsia</i>	896
Genus I. <i>Actinomyces</i>	660	Tribe III. <i>Wolbachieae</i>	897
Genus II. <i>Arachnia</i>	668	Genus VII. <i>Wolbachia</i>	898
Genus III. <i>Bifidobacterium</i>	669	Genus VIII. <i>Syrnbiotes</i>	900
Genus IV. <i>Bacterionerna</i>	676	Genus IX. <i>Blattabacterium</i>	901
Genus V. <i>Rothia</i>	679	Genus X. <i>Rickettsiella</i>	901
Family II. <i>Mycobacteriaceae</i>	681	Family II. <i>Bartonellaceae</i>	903
Genus I. <i>Mycobacterium</i>	682	Genus I. <i>Bartonella</i>	904
Family III. <i>Frankiaceae</i>	701	Genus II. <i>Grahamella</i>	905
Genus I. <i>Frankia</i>	702	Family III. <i>Anaplasmataceae</i>	906
Family IV. <i>Actinoplanaceae</i>	706	Genus I. <i>Anaplasma</i>	907
Genus I. <i>Actinoplanes</i>	708	Genus II. <i>Paranaplasma</i>	908
Genus II. <i>Spirillospora</i>	711	Genus III. <i>Aegyptionella</i>	909
Genus III. <i>Streptosporangiurn</i>	711	Genus IV. <i>Haernobartonella</i>	910
Genus IV. <i>Arnorphosporangiurn</i>	715	Genus V. <i>Eperythrozoon</i>	912
Genus V. <i>Ampullariella</i>	716	Order II. <i>Chlamydiales</i>	914
Genus VI. <i>Pilimelia</i>	718	Family I. <i>Chlamydiaceae</i>	914
Genus VII. <i>Planornonospora</i>	719	Genus I. <i>Chlamydia</i>	915
Genus VIII. <i>Planobispora</i>	720	PART 19.	
Genus IX. <i>Dactylosporangiurn</i>	721	THE MYCOPLASMAS	929
Genus X. <i>Kitasatoa</i>	722	Class I. <i>Mollicutes</i>	929
Family V. <i>Derrnatophilaceae</i>	723	Order I. <i>Mycoplasmatales</i>	930
Genus I. <i>Derrnatophilus</i>	723	Family I. <i>Mycoplasmataceae</i>	930
Genus II. <i>Geoderrnatophilus</i>	724	Genus I. <i>Mycoplasmna</i>	930
Family VI. <i>Nocardiaceae</i>	726	Family II. <i>Acholeplasmataceae</i>	949
Genus I. <i>Nocardia</i>	726	Genus I. <i>Acholeplasmna</i>	949
Genus II. <i>Pseudonocardia</i>	746	Genera of Uncertain Affiliation	952
Family VII. <i>Streptornycetaceae</i>	747	Genus <i>Therrnoplasmna</i>	952
Genus I. <i>Streptornyces</i>	748	Genus <i>Spiroplasmna</i>	953
Genus II. <i>Streptouerticilliurn</i>	829	Mycoplasma-like Bodies in Plants ..	954
Genus III. <i>Sporichthya</i>	842	Appendices	
Genus IV. <i>Microellobosporia</i>	843	List of Culture Collections	956
Family VIII. <i>Microronosporaceae</i>	846	Glossary	959
Genus I. <i>Microronospora</i>	846	References	967
Genus II. <i>Thermoactinomyces</i>	855	A Key for the Determination of the	
Genus III. <i>Actinobifida</i>	856	Generic Position of Organisms Listed	
Genus IV. <i>Therrnornonospora</i>	858	in the Manual ..	1098
Genus V. <i>Microbispora</i>	859	Index of Scientific Names ..	1149
		Addendum and Corrigendum ..	1247