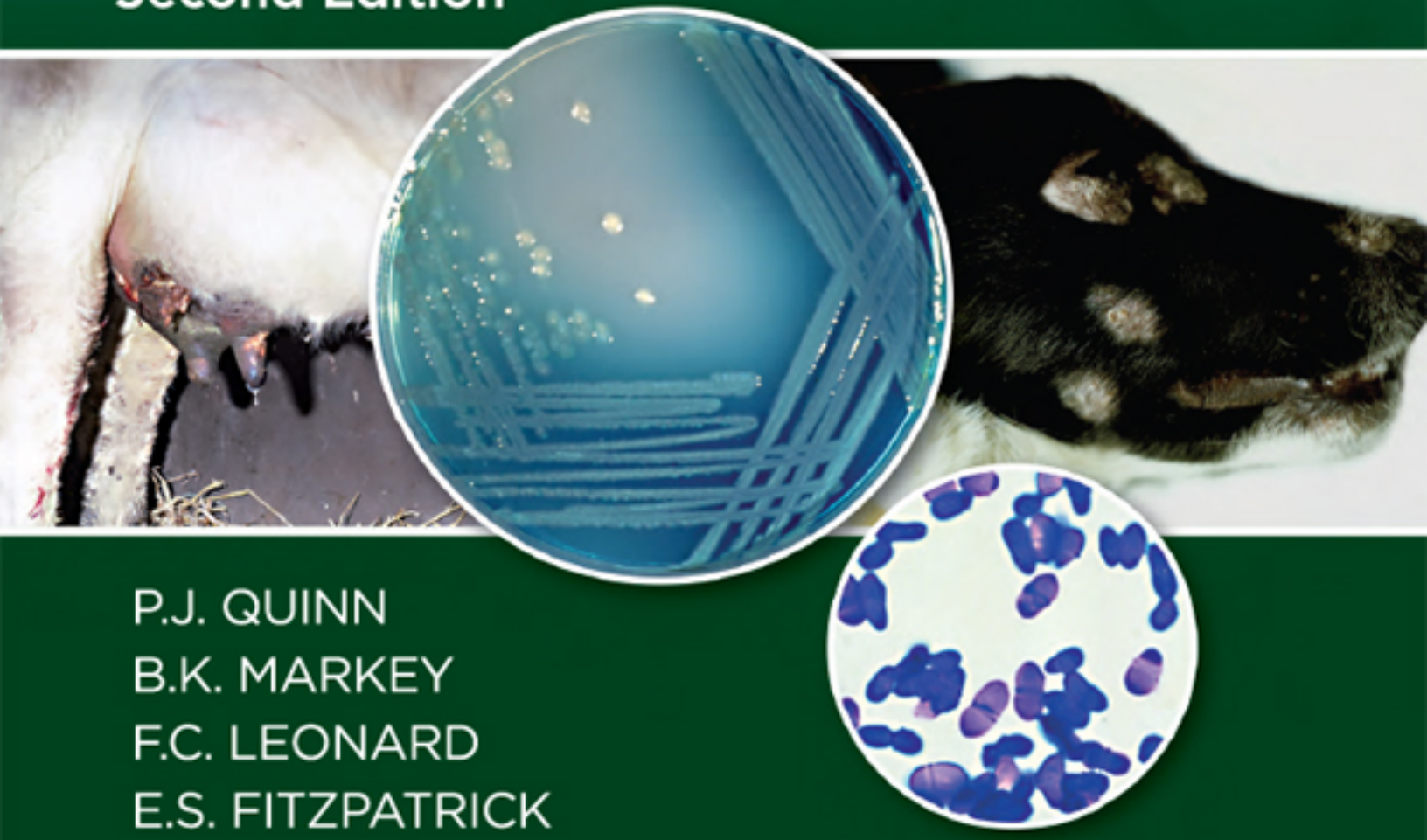
Concise Review of Veterinary Microbiology

Second Edition



P.J. QUINN
B.K. MARKEY
F.C. LEONARD
E.S. FITZPATRICK
S. FANNING

with website

WILEY Blackwell

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P.J. Quinn MVB, PhD, MRCVS
Professor Emeritus
Former Professor of Veterinary Microbiology and Parasitology
School of Veterinary Medicine
University College Dublin

B.K. Markey MVB, PhD, MRCVS, Dip. Stat
Senior Lecturer in Veterinary Microbiology
School of Veterinary Medicine
University College Dublin

F.C. Leonard MVB, PhD, MRCVS
Senior Lecturer in Veterinary Microbiology
School of Veterinary Medicine
University College Dublin

E.S. FitzPatrick FIBMS, FRMS
Former Chief Technical Officer
School of Veterinary Medicine
University College Dublin

S. Fanning BSc, PhD
Professor of Food Safety and Zoonoses
Director of UCD Centre for Food Safety
School of Public Health, Physiotherapy and Sports Science
University College Dublin

WILEY Blackwell

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John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK

Editorial offices:
9600 Garsington Road, Oxford, OX4 2DQ, UK
The Atrium, Southern Gate, Chichester, West Sussex, PO19 8SQ, UK
1606 Golden Aspen Drive, Suites 103 and 104, Ames, Iowa 50010, USA

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Preface

The first edition of this book provided undergraduate veterinary students with a brief introduction to veterinary microbiology and diseases caused by pathogenic microorganisms. Since its publication in 2003, there have been many changes in veterinary microbiology, some related to the classification of pathogenic microorganisms and others associated with the increased understanding of the pathogenesis of infectious diseases. Developments in molecular aspects of microbiology have broadened the scope of diagnostic methods and have improved our understanding of the epidemiological characteristics of many infectious diseases. New developments relating to the emergence of antibacterial resistance are of particular importance in veterinary therapeutics and in public health.

The second edition of this book includes new chapters on bacterial genetics, antibacterial resistance, immunology, antifungal chemotherapy, biosecurity and vaccination. Topics of particular importance in veterinary medicine are given extended coverage. Important changes which have occurred in veterinary microbiology in recent years are presented in relevant chapters. There are five sections in this book and the Appendix includes a list of relevant websites to facilitate readers requiring additional information on topics referred to in the book. Colour has been used to enhance the quality of the illustrations and to facilitate interpretation of complex diagrams.

Acknowledgements

We wish to acknowledge the assistance provided by colleagues who reviewed chapters, provided scientific, technical and editorial advice or who assisted in other ways: James Buckley, Rory Breathnach, Louise Britton, Jill Bryan, Marguerite Clyne, Hubert Fuller, James Gibbons, Stephen Gordon, Laura Luque-Sastre, Aidan Kelly, Pamela Kelly, Dores Maguire, Marta Martins, Kerri Malone, Jarlath Nally, David Quinn, Michael Quinn, Eoin Ryan, John Ryan, Patrick Raleigh, Shabarinath Srikumar, Graham Tynan, Patrick Wall and Annetta Zintl.

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Dublin, January 2015

Abbreviations and definitions

AGID

agar gel immunodiffusion

ATP

adenosine triphosphate

BCG

bacille Calmette–Guérin

bp

base pairs

cAMP

cyclic adenosine monophosphate

CD

cluster of differentiation

CFT

complement fixation test

CNS

central nervous system

cELISA

competitive enzyme-linked immunosorbent assay

DNA

deoxyribonucleic acid

ELISA

enzyme-linked immunosorbent assay

EU

European Union

FA

fluorescent antibody

Fc

crystallizable fragment, portion of an immunoglobulin without an antigen combining site

IFA

indirect fluorescent antibody

IFN

interferon

Ig

immunoglobulin

LPS

lipopolysaccharide

KOH

potassium hydroxide

MBC

minimal bactericidal concentration

MHC

major histocompatibility complex

MIC

minimal inhibitory concentration

MLST

multi-locus sequence typing

mRNA

messenger RNA

MRSA

methicillin-resistant *Staphylococcus aureus*

MZN

modified Ziehl–Neelsen

nm

nanometre, 10^{-9} metre

NK cells

natural killer cells

OIE

Office International des Épizooties (World Organization for Animal Health)

ORF

open reading frame

PAS

periodic acid–Schiff

PCR

polymerase chain reaction

PFGE

pulsed-field gel electrophoresis

RFLP

restriction fragment length polymorphism

RNA

ribonucleic acid

rRNA

ribosomal RNA

RT-PCR

reverse transcriptase-polymerase chain reaction

RTX

repeats-in-toxin

SMEDI

stillbirth, mummification, embryonic death, infertility

V factor

nicotinamide adenine dinucleotide

VP

viral protein

UK

United Kingdom

µm

micrometre or micron, 10^{-6} metre

USA

United States of America

UV light

ultraviolet light

X factor

haemin

ZN

Ziehl–Neelsen

°C

degrees Celsius

About the companion website

This book is accompanied by a companion website:

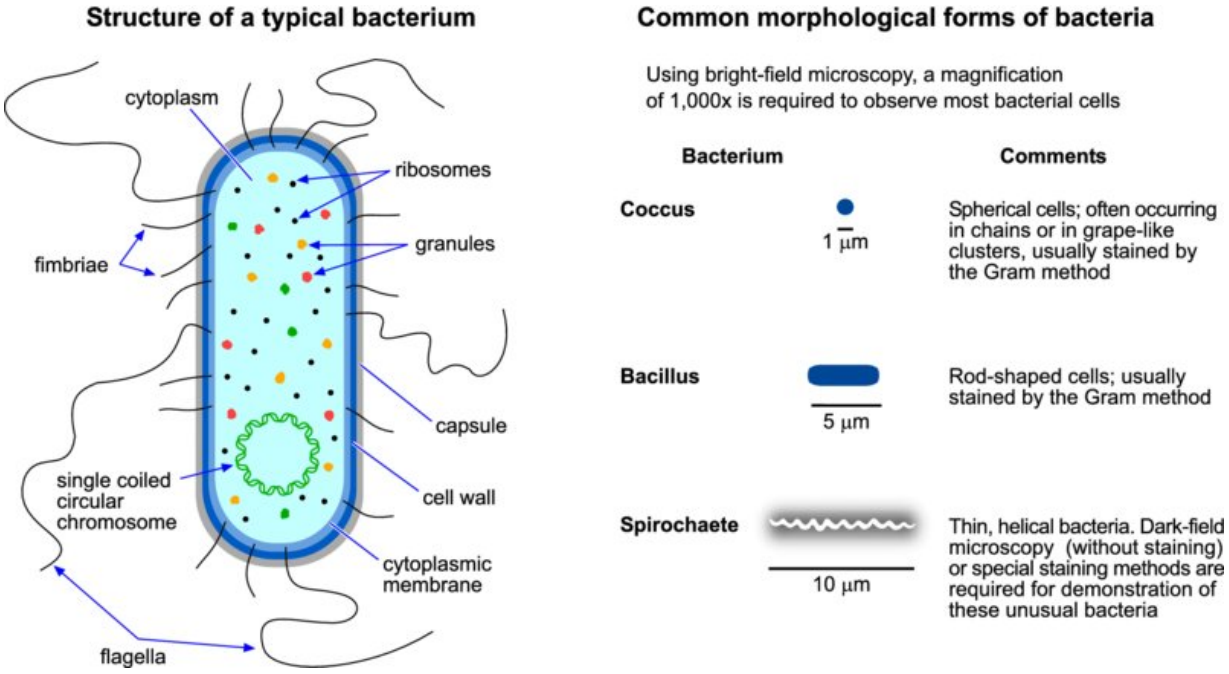
www.wiley.com/go/quinn/concise-veterinary-microbiology

The website includes:

- PowerPoint figures from the book for downloading

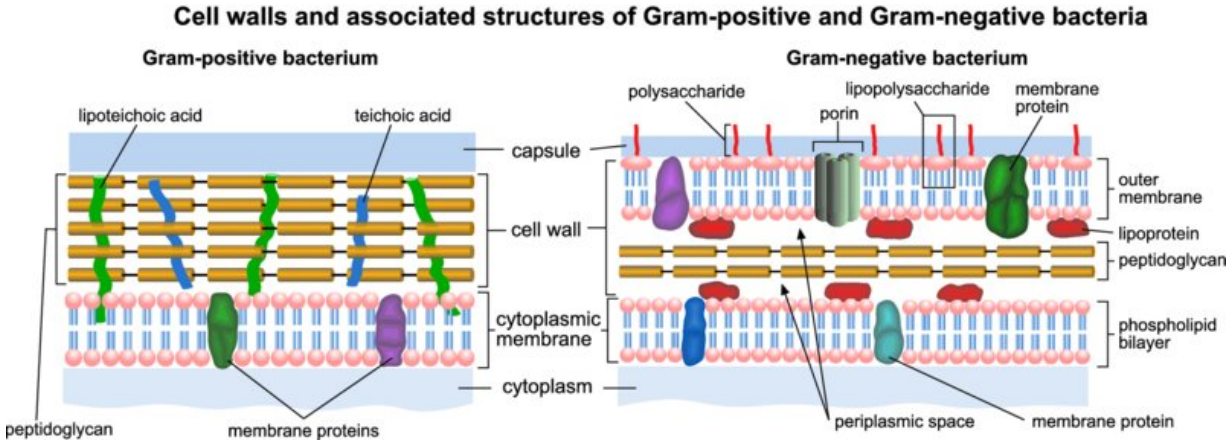
Section I
Introductory Bacteriology

1 Structure of bacterial cells



Bacteria are unicellular organisms and usually occur in simple shapes such as rods, cocci, spiral forms and occasionally as branching filaments. They typically have rigid cell walls containing a peptidoglycan layer and multiply by binary fission. Bacteria are smaller and less complex than eukaryotic cells and do not contain membrane-bound organelles. Genetic information essential for organism survival, the core genome, is usually contained in a single circular chromosome; a nuclear membrane and a nucleolus are absent. Some bacteria have more than one chromosome and chromosomes in certain bacteria are linear. The accessory genome encodes non-essential cell functions and may include plasmids and bacteriophages (see Chapter 3). Despite their morphological diversity, most bacteria are between 0.5 and

5 µm in length. Motile bacteria possess flagella by which they can move through liquids *in vivo* and *in vitro*.



Most bacteria found in nature are not harmful to humans, animals or plants. Some bacteria make an important contribution to the utilization of nutrients in soil, in water and in the digestive tracts of animals. Bacteria which cause disease in animals or humans are referred to as pathogenic bacteria.

A typical bacterial cell is composed of a capsule, cell wall, cell membrane, cytoplasm (containing nuclear material) and appendages such as flagella and pili. Some species of bacteria can produce dormant forms termed spores or endospores, structures which are resistant to environmental influences. The principal structural components of bacterial cells are presented in Table 1.1. Some bacteria can synthesize extracellular polymeric material, termed a capsule, which forms a well-defined structure, closely adherent to the cell wall. In the body, capsules of pathogenic bacteria interfere with phagocytosis. The tough, rigid cell walls of bacteria protect them from mechanical damage and osmotic lysis. Differences in the structure and chemical composition of the cell walls of bacterial species account for variation in their pathogenicity and influence other characteristics, including staining properties. Mycoplasmas, an important