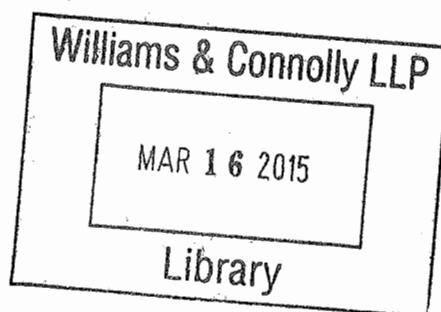


2 0 T H E D I T I O N

Remington: The Science and Practice of Pharmacy

ALFONSO R GENNARO

Chairman of the Editorial Board
and Editor



Editor: Daniel Limmer
Managing Editor: Matthew J. Hauber
Marketing Manager: Anne Smith

Lippincott Williams & Wilkins

351 West Camden Street
Baltimore, Maryland 21201-2436 USA

227 East Washington Square
Philadelphia, PA 19106

All rights reserved. This book is protected by copyright. No part of this book may be reproduced in any form or by any means, including photocopying, or utilized by any information storage and retrieval system without written permission from the copyright owner.

The publisher is not responsible (as a matter of product liability, negligence or otherwise) for any injury resulting from any material contained herein. This publication contains information relating to general principles of medical care which should not be construed as specific instructions for individual patients. Manufacturers' product information and package inserts should be reviewed for current information, including contraindications, dosages and precautions.

Printed in the United States of America

Entered according to Act of Congress, in the year 1885 by Joseph P Remington, in the Office of the Librarian of Congress, at Washington DC

Copyright 1889, 1894, 1905, 1907, 1917, by Joseph P Remington

Copyright 1926, 1936, by the Joseph P Remington Estate

Copyright 1948, 1951, by the Philadelphia College of Pharmacy and Science

Copyright 1956, 1960, 1965, 1970, 1975, 1980, 1985, 1990, 1995, by the Philadelphia College of Pharmacy and Science

Copyright 2000, by the University of the Sciences in Philadelphia

All Rights Reserved
Library of Congress Catalog Card Information is available
ISBN 0-683-306472

The publishers have made every effort to trace the copyright holders for borrowed material. If they have inadvertently overlooked any, they will be pleased to make the necessary arrangements at the first opportunity.

The use of structural formulas from USAN and the USP Dictionary of Drug Names is by permission of The USP Convention. The Convention is not responsible for any inaccuracy contained herein.

Notice—This text is not intended to represent, nor shall it be interpreted to be, the equivalent of or a substitute for the official United States Pharmacopeia (USP) and/or the National Formulary (NF). In the event of any difference or discrepancy between the current official USP or NF standards of strength, quality, purity, packaging and labeling for drugs and representations of them herein, the context and effect of the official compendia shall prevail.

To purchase additional copies of this book call our customer service department at (800) 888-8888 or for orders to (202) 894-7222.

Remington: The Science and Practice of Pharmacy . . . *A treatise on the theory and practice of the pharmaceutical sciences, with essential information about pharmaceutical and medicinal agents; also, a guide to the professional responsibilities of the pharmacist as the drug information specialist of the health team . . . A textbook and reference work for pharmacists, physicians, and other practitioners of the pharmaceutical and medical sciences.*

EDITORS

Alfonso R Gennaro, <i>Chair</i>	Nicholas G Popovich
Ara H Der Marderosian	Roger L Schnaare
Glen R Hanson	Joseph B Schwartz
Thomas Medwick	H Steve White

AUTHORS

The 119 chapters of this edition of *Remington* were written by the editors, by members of the Editorial Board, and by the authors listed on pages viii to x.

Managing Editor

John E Hoover, BSc (Pharm)

Editorial Assistant

Bonnie Brigham Packer, RNC, BA

Director

Philip P Gerbino 1995–2000

Twentieth Edition—2000

Published in the 180th year of the
PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE

Remington Historical/Biographical Data

The following is a record of the editors and the dates of publication of successive editions of this book, prior to the 13th Edition known as *Remington's Practice of Pharmacy* and subsequently as *Remington's Pharmaceutical Sciences* through the 19th Edition.

First Edition, 1886
Second Edition, 1889
Third Edition, 1897
Fourth Edition, 1905

Joseph P Remington

Fifth Edition, 1907
Sixth Edition, 1917

Joseph P Remington
Assisted by
 E Fullerton Cook

Seventh Edition, 1926

Editors

E Fullerton Cook
 Charles H LaWall

Eighth Edition, 1936

Editors

E Fullerton Cook
 Charles H LaWall

Ninth Edition, 1948
Tenth Edition, 1951

Editors
 E Fullerton Cook
 Eric W Martin

Eleventh Edition, 1956

Editors

Eric W Martin
 E Fullerton Cook

Twelfth Edition, 1961

Editors

Eric W Martin
 E Fullerton Cook
 E Emerson Leuallen
 Arthur Osol
 Linwood F Tice
 Clarence T Van Meter

Associate Editors
 Ivor Griffith
 Adley B Nichols
 Arthur Osol

Thirteenth Edition, 1965

Editor-in-Chief

Eric W Martin

Editors

Grafton D Chase
 Herald R Cox
 Richard A Deno
 Alfonso R Gennaro
 Stewart C Harvey

Managing Editor

John E Hoover

Robert E King
 E Emerson Leuallen
 Arthur Osol
 Ewart A Swinyard
 Clarence T Van Meter

Fourteenth Edition, 1970

Chairman, Editorial Board

Arthur Osol

Editors

Grafton D Chase
 Richard A Deno
 Alfonso R Gennaro

Managing Editor

John E Hoover

Robert E King
 Alfred N Martin
 Ewart A Swinyard

Fifteenth Edition, 1975

Chairman, Editorial Board

Arthur Osol

Editors

John T Anderson
 Cecil L Bendush
 Grafton D Chase
 Alfonso R Gennaro
 Melvin R Gibson

Managing Editor

John E Hoover

C Boyd Granberg
 Stewart C Harvey
 Robert E King
 Alfred N Martin
 Ewart A Swinyard

Sixteenth Edition, 1980

Chairman, Editorial Board

Arthur Osol

Editors

Grafton D Chase
 Alfonso R Gennaro
 Melvin R Gibson

Managing Editor

C Boyd Granberg
 Stewart C Harvey
 Robert E King
 Alfred N Martin
 Ewart A Swinyard
 Gilbert L Zink

Seventeenth Edition, 1985

Chairman, Editorial Board

Alfonso R Gennaro

Editors

Grafton D Chase
 Ara H Der Marderosian
 Stewart C Harvey
 Daniel A Hussar
 Thomas Medwick

Managing Editor

John E Hoover

Edward G Rippie
 Joseph D Schwartz
 Ewart A Swinyard
 Gilbert L Zink

Eighteenth Edition, 1990

Chairman, Editorial Board

Alfonso R Gennaro

Editors

Grafton D Chase
 Ara H Der Marderosian
 Stewart C Harvey
 Daniel A Hussar
 Thomas Medwick

Managing Editor

John E Hoover

Editorial Assistant

Bonnie Packer

Edward G Rippie
 Joseph D Schwartz
 Ewart A Swinyard
 Gilbert L Zink

Nineteenth Edition, 1995

Chairman, Editorial Board

Alfonso R Gennaro

Editors

Grafton D Chase
 Ara H Der Marderosian
 Glen R Hanson
 Daniel A Hussar
 Thomas Medwick

Managing Editor

John E Hoover

Editorial Assistant

Bonnie Packer

Edward G Rippie
 Joseph D Schwartz
 H Steve White
 Gilbert L Zink

Editorial Board Members and Editors

Alfonso R Gennaro, PhD / *University of the Sciences in Philadelphia*—Professor of Chemistry. Chair, Editorial Board and Editor. Coeditor of Part 6, Pharmacodynamics, and Part 7, Pharmaceutical and Medicinal Agents. Coauthor of Chapter 25.

Ara H Der Marderosian, PhD / *University of the Sciences in Philadelphia*—Professor of Pharmacognosy and Medicinal Chemistry, Scientific Director, Complementary and Alternative Medicine Institute. Editor of Part 1, Orientation. Coauthor of Chapters 7, 49, and 103.

Glen R Hanson, DDS, PhD / *College of Pharmacy and School of Medicine, University of Utah*—Professor of Pharmacology and Toxicology. Coeditor of Part 6, Pharmacodynamics, and Part 7 Pharmaceutical and Medicinal Agents. Author of Chapters 75, 76, and 83.

Thomas Medwick, PhD / *Rutgers University College of Pharmacy*—Professor Emeritus, Department of Pharmaceutical Chemistry. Editor of Part 3, Pharmaceutical Chemistry, and Part 4, Pharmaceutical Testing, Analysis, and Control. Author of Chapter 24. Coauthor of Chapter 30.

Nicholas G Popovich, PhD / *Purdue University, School of Pharmacy and Pharmacal Sciences*—Professor of Pharmacy Practice. Editor of Part 8A, Pharmacy Administration, Part 8B, Fundamentals of Pharmacy Practice, and Part 8C, Patient Care. Coauthor of Chapter 101.

Roger L Schnaare, PhD / *University of the Sciences in Philadelphia, Philadelphia College of Pharmacy*—Professor of Pharmacy, Department of Pharmaceutics. Editor of Part 2, Pharmaceutics. Coauthor of Chapter 11.

Joseph D Schwartz, PhD / *University of the Sciences in Philadelphia, Philadelphia College of Pharmacy*. Burroughs-Wellcome Fund Professor of Pharmaceutics, Director of Pharmacy Research. Editor of Part 5, Pharmaceutical Manufacturing. Coauthor of Chapters 37 and 45.

H Steve White, PhD / *College of Pharmacy, University of Utah*—Associate Professor of Pharmacology and Toxicology. Coeditor of Part 6, Pharmacodynamics, and Part 7, Pharmaceutical and Medicinal Agents. Author of Chapters 74, 79, 80, 81, 84, and 88.

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.