

18TH
EDITION

Remington's

ALFONSO R GENNARO

*Editor, and Chairman
of the Editorial Board*

Pharmaceutical Sciences

1990

MACK PUBLISHING COMPANY

First Edition, 1990

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 Joseph P Remington Estate

Copyright 1943, 1951, by The Philadelphia College of Pharmacy and Science

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

All Rights Reserved

Library of Congress Catalog Card No. 60-53334

ISBN 0-912734-04-3

*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.*

Printed in the United States of America by the Mack Printing Company, Easton, Pennsylvania

Remington's Pharmaceutical Sciences . . . 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, *Chairman*

Thomas Medwick

Grafton D Chase

Edward G Rippe

Ara Der Marderosian

Joseph B Schwartz

Stewart C Harvey

Ewart A Swinyard

Daniel A Hussor

Gilbert L Zink

AUTHORS

The 109 chapters of this edition of *Remington's Pharmaceutical Sciences* were written by the editors, by members of the Editorial Board, and by other authors listed on pages ix to xi.

Managing Editor

John E Hoover

Editorial Assistant

Donnie Brigham Packer

Director

Allen Misher 1985–1990

Eighteenth Edition—1990

Published in the 170th year of the
PHILADELPHIA COLLEGE OF PHARMACY AND SCIENCE

Table of Contents

Part 1 Orientation

1	Scope	3
2	Evolution of Pharmacy	8
3	Ethics	20
4	The Practice of Community Pharmacy	28
5	Opportunities for Pharmacists in the Pharmaceutical Industry	33
6	Pharmacists in Government	38
7	Drug Information	49
8	Research	60

Part 2 Pharmaceutics

9	Metrology and Calculation	69
10	Statistics	104
11	Computer Science	138
12	Calculus	145
13	Molecular Structure, Properties and States of Matter	158
14	Complex Formation	182
15	Thermodynamics	197
16	Solutions and Phase Equilibria	207
17	Ionic Solutions and Electrolytic Equilibria	228
18	Reaction Kinetics	247
19	Disperse Systems	257
20	Rheology	310

Part 3 Pharmaceutical Chemistry

21	Inorganic Pharmaceutical Chemistry	329
22	Organic Pharmaceutical Chemistry	356
23	Natural Products	380
24	Drug Nomenclature—United States Adopted Names	412
25	Structure-Activity Relationship and Drug Design	422

Part 4 Testing and Analysis

26	Analysis of Medicinals	435
27	Biological Testing	484
28	Clinical Analysis	495
29	Chromatography	529
30	Instrumental Methods of Analysis	555
31	Dissolution	589

Part 5 Radioisotopes in Pharmacy and Medicine

32	Fundamentals of Radioisotopes	605
33	Medical Applications of Radioisotopes	624

Part 6 Pharmaceutical and Medicinal Agents

34	Diseases: Manifestations and Pathophysiology	655
35	Drug Absorption, Action and Disposition	697
36	Basic Pharmacokinetics	725
37	Clinical Pharmacokinetics	746
38	Topical Drugs	757
39	Gastrointestinal Drugs	774
40	Blood, Fluids, Electrolytes and Hematologic Drugs	800
41	Cardiovascular Drugs	831

44	Cholinomimetic Drugs	889
45	Adrenergic and Adrenergic Neuron Blocking Drugs	898
46	Antimuscarinic and Antispasmodic Drugs	907
47	Skeletal Muscle Relaxants	916
48	Diuretic Drugs	929
49	Uterine and Antimigraine Drugs	943
50	Hormones	948
51	Vitamins and Other Nutrients	1002
52	Enzymes	1035
53	General Anesthetics	1039
54	Local Anesthetics	1048
55	Sedatives and Hypnotics	1057
56	Antiepileptics	1072
57	Psychopharmacologic Agents	1082
58	Analgesics and Antipyretics	1097
59	Histamine and Antihistamines	1123
60	Central Nervous System Stimulants	1132
61	Antineoplastic and Immunosuppressive Drugs	1138
62	Antimicrobial Drugs	1163
63	Parasiticides	1242
64	Pesticides	1249
65	Diagnostic Drugs	1272
66	Pharmaceutical Necessities	1286
67	Adverse Drug Reactions	1330
68	Pharmacogenetics	1344
69	Pharmacological Aspects of Drug Abuse	1349
70	Introduction of New Drugs	1365

Part 7 Biological Products

71	Principles of Immunology	1379
72	Immunizing Agents and Diagnostic Skin Antigens	1389
73	Allergenic Extracts	1405
74	Biotechnology and Drugs	1416

Part 8 Pharmaceutical Preparations and Their Manufacture

75	Preformulation	1435
76	Bioavailability and Bioequivalency Testing	1451
77	Separation	1459
78	Sterilization	1470
79	Tonicity, Osmoticity, Osmolality and Osmolarity	1481
80	Plastic Packaging Materials	1499
81	Stability of Pharmaceutical Products	1504
82	Quality Assurance and Control	1513
83	Solutions, Emulsions, Suspensions and Extractives	1519
84	Parenteral Preparations	1545
85	Intravenous Admixtures	1570
86	Ophthalmic Preparations	1581
87	Medicated Applications	1596
88	Powders	1615
89	Oral Solid Dosage Forms	1633
90	Coating of Pharmaceutical Dosage Forms	1666
91	Sustained-Release Drug Delivery Systems	1676
92	Aerosols	1694

Part 9 Pharmaceutical Practice

93	Ambulatory Patient Care	1715
94	Institutional Patient Care	1737

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.