

Remington's

PRACTICE OF PHARMACY

A treatise on the manufacturing, standardizing, and dispensing of pharmaceutical products, with biological and chemical properties and tests, assays, uses, and doses; also a guide to the legal obligations of the pharmacist and the professional services rendered in helping to maintain community health . . . A textbook and reference guide for pharmacists, physicians, and other medical scientists

EDITORS

Eric W. Martin E. Fullerton Cook

E. Emerson Leuallen Arthur Osol Linwood F. Tice

Clarence T. Van Meter

Assistant to the Editors

John E. Hoover

With the cooperation of more than 250 assistant editors and contributors

OVER 1,000 ILLUSTRATIONS

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who, in succession, for one hundred years
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The Assistant Editors

The following individuals either prepared original manuscript or revised one or more chapters for the Twelfth Edition of Remington's Practice of Pharmacy

- Julian L. Ambrus, M.D., Ph.D.** Principle Cancer Research Scientist, New York State, Roswell Park Memorial Institute, Buffalo. Revised Chapter 97 on "Poison Control."
- Clara M. Ambrus, M.D., Ph.D.** Senior Cancer Research Scientist, New York State, Roswell Park Memorial Institute, Buffalo. Collaborated with Dr. Julian L. Ambrus in revising Chapter 97 on "Poison Control."
- Kenneth E. Avis, B.Sc., M.Sc., D.Sc.** Associate Professor in Pharmacy, Philadelphia College of Pharmacy and Science. Prepared and edited the original manuscript for all of the unofficial sections of R.P.P. XII, including all the specialties of the pharmaceutical manufacturers. Contributed to the arrangement of the nonofficial drugs of Part V.
- Martin Barr, B.Sc., M.Sc., Ph.D.** Professor of Physical Pharmacy and Pharmaceutical Research, Philadelphia College of Pharmacy and Science. Prepared original material and revised Chapter 18 on "Surfactants." Prepared original manuscript for new Chapter 39 on "Aerosols."
- Rudolph H. Blythe, Ph.C., Phar.D.** Director, Pharmaceutical Research, Smith, Kline and French Laboratories. Prepared original manuscript for new Chapter 4 on "The Pharmacist in Industry."
- Joseph R. Bove, B.S., M.D.** Assistant Director of Clinical Laboratories and Director of Blood Bank, Yale-New Haven Medical Center. Collaborated with Dr. Seligson and Dr. Brahen in the preparation of Chapter 86 on "Clinical Analysis."
- Louis Brahen, A.B., M.S., M.D.** Director of Clinical Microscopy Laboratory, Yale-New Haven Medical Center. Collaborated with Dr. Seligson and Dr. Bove in the preparation of Chapter 86 on "Clinical Analysis."
- John H. Brewer, A.B., A.M., Ph.D.** Director of Biological Research, Hynson, Westcott and Dunning, Inc. Revised Chapter 25 on "Sterilization" and Chapter 33 on "Parenteral Preparations."
- Grafton D. Chase, B.Sc., M.A., Ph.D.** Associate Professor of Chemistry and Director, Radiochemical Laboratory, Philadelphia College of Pharmacy and Science. Revised Chapter 21 on "Rheology." Prepared original manuscript for new Chapter 80 on "Radiopharmacy-General Principles" and Chapter 82 on "Radiopharmacy-Industrial and Other Nonmedical Applications." Prepared original material for sections of new Chapter 81 on "Radiopharmacy-Medical Applications" in collaboration with Dr. Tabern.
- Joseph L. Ciminera, B.Sc.** Chief Biometrician, Merck Sharp and Dohme. Contributed to Chapter 9 on "Statistics."
- Elsa Ehrenstein, Apothecary (University of Goettingen), B.Sc.** Associate Professor in Pharmacy, Philadelphia College of Pharmacy and Science. Revised Chapter 29 on "Aqueous Preparations" and Chapter 30 on "Non-Aqueous Solutions." Contributed to Chapter 16 on "Colligative Properties and Isotonic Solutions."
- Robert P. Fischelis, B.Sc., Ph.M., Phar.D., Sc.D.** Consultant in Pharmacy, Journalism, and Professional Organization; Special Consultant to Government Agencies, including Department of the Army, Public Health Service, and Social Security Administration. Revised Chapter 5 on "The Pharmacist in Government Service."
- Herbert L. Flack, B.Sc., M.Sc.** Director of Pharmacy Service, Jefferson Medical College Hospital. Collaborated with Dr. Francke in the revision of Chapter 89 on "Hospital Pharmacy."
- W. B. Fortune, B.S., M.S., Ph.D.** Executive Director of Control, Eli Lilly and Company. Revised Chapter 7 on "Research in Pharmacy and Medicine."
- Don E. Francke, B.S., M.S., D.Sc.** Director of Pharmacy Service, University Hospital, University of Michigan. Collaborated with Mr. Flack in the revision of Chapter 89 on "Hospital Pharmacy."
- Edward H. Frieden, A.B., M.A., Ph.D.** Coordinator for Research and Director, Arthur G. Rotch Laboratory, The Boston Dispensary. Revised Chapter 58 on "Hormones."
- J. B. Fullerton, A.B., M.S., Sc.D.** Director of Control, The Upjohn Company. Revised Chapter 40 on "Control in Manufacturing Pharmacy."
- Alfonso R. Gennaro, B.Sc., M.Sc., Ph.D.** Associate Professor of Chemistry, Philadelphia College of Pharmacy and Science. Prepared original manuscript for new Chapter 15 on "Complexation." Prepared original material and revised Chapter 83 on "The Physical and Chemical Analysis of Medicinals" and Chapter 84 on "Official Requirements and Tests."
- Elmer G. Gerwe, B.S., M.A., Ph.D.** Director, Biological Control Department, Eli Lilly and Company. Prepared original material and revised Chapter 75 on "Fundamentals of Biological Pharmacy," Chapter 76 on "Products for Active Immunization," Chapter 77 on "Products for Passive Immunization," and Chapter 78 on "Diagnostic Biological Products."
- Anthony J. Glazko, Ph.D.** Research Biochemist, Parke, Davis and Company. Revised Chapter 23 on "Chromatography."
- Samuel W. Goldstein, Ph.G., Ph.C., B.S., M.S., Ph.D.** Assistant Director, Scientific Division, American Pharmaceutical Association. Revised Chapter 8 on "Metrology."
- Stewart C. Harvey, Ph.D.** Associate Professor of Pharmacology, College of Medicine, University of Utah. Collaborated with Dr. Ewart A. Swinyard in the complete and thorough revision of the pharmacological discussions and therapeutic use statements, the preparation of introductory statements for the chapters of Part V, and the classification of the official and nonofficial drugs of Part V.
- John Henderson, M.D., F.A.C.S.** Medical Director, Johnson and Johnson. Collaborated with Dr. Stonehill in the revision of Chapter 91 on "Surgical Supplies" and Chapter 92 on "First Aid."
- Richard A. Huebner, V.M.D.** Veterinary Medical Director, Wyeth Laboratories. Revised Chapter 90 on "Veterinary Service" and prepared veterinary use and dose statements throughout Part V.
- Charles I. Jarowski, B.S., Ph.D.** Director, Pharmaceutical Research and Development, Chas. Pfizer and Company, Inc. Prepared original material and revised Chapter 36 on "Tablets, Capsules, and Pills."
- Joseph L. Kanig, B.S., M.S., Ph.D.** Associate Professor of Pharmacy, College of Pharmacy, Columbia University. Revised Chapter 93 on "Dental Preparations."

- Arnold Kaufman, B.S., M.A.** Group Leader in Chemical Engineering Research, Merck Sharp and Dohme Research Laboratories, Rahway, New Jersey. Collaborated with Dr. Macek on Chapter 13 on "Comminution."
- Amiel Kirshbaum, B.S., LL.B.** Director of Control Laboratories, Division of Antibiotics, U. S. Food and Drug Administration. Revised Chapter 70 on "Antimicrobial Drugs" in collaboration with Dr. Welch.
- O. Lee Kline, Ph.D.** Director, Division of Nutrition, U. S. Food and Drug Administration. Revised Chapter 59 on "Vitamins and Nutrients."
- E. F. Knipling, B.S., M.S., Ph.D.** Chief, Entomology Research Branch, Agricultural Research Service, U. S. Department of Agriculture, Plant Industry Station, Beltsville, Maryland. Prepared original material for sections of Chapter 72 on "Pesticides" in collaboration with Mr. Ward.
- Frederick D. Lascoff, B.A., B.S., Ph.G., Phar.D.** President of J. Leon Lascoff Apothecary. Contributed to Chapter 99 on "Useful Formulas."
- Thomas J. Macek, B.S., M.S., Ph.D.** Manager, Pharmaceutical Research, Merck Sharp and Dohme Research Laboratories, West Point, Pennsylvania. Collaborated with Mr. Kaufman on Chapter 13 on "Comminution." Prepared original manuscript for new Chapter 28 on "Formulation."
- John N. McDonnell, B.Sc., M.Sc., D.Sc.** Vice President and General Manager, Pharmaceutical Laboratories Division, Schieffelin and Company, Inc. Revised and prepared numerous illustrations for Chapter 87 on "Professional Services."
- Joseph D. McEvilla, B.S., M.S., Ph.D.** Associate Professor and Head of the Department of Pharmacy Administration, School of Pharmacy, University of Pittsburgh. Prepared original manuscript for new Chapter 96 on "Pharmacy Administration."
- Eino Nelson, B.S., Ph.D.** Associate Professor of Pharmacy and Pharmaceutical Chemistry, University of California Medical Center. Prepared original manuscript for the new Chapter 38 on "Sustained Action Medication."
- Paul C. Olsen, A.B., A.M., Ph.D.** Director of Marketing Research and Management Problems Editor, *Drug Topics* and *Drug Trade News*. Revised Chapter 95 on "The Business of Pharmacy."
- William H. Parsons, B.Sc., M.A., M.Sc., Ph.D.** Associate Professor of Mathematics and Physics, Philadelphia College of Pharmacy and Science. Prepared original material on *Phase Solubility Analysis* for Chapter 14 on "Solution."
- George L. Phillips, B.S., M.S.** Assistant Director of Pharmacy Service, University Hospital, University of Michigan. Revised Chapter 79 on "Allergenic Extracts."
- Paul A. Pumpian, B.S., LL.B.** Secretary, Wisconsin State Board of Pharmacy. Revised Chapter 94 on "Laws Governing Pharmacy."
- Lila Knudsen Randolph, B.S.** Consultant on Statistics and Design of Experiments. Prepared original material and revised Chapter 9 on "Statistics."
- Louis A. Reber, Ph.G., Ph.C., B.Sc., M.Sc., Ph.D.** Professor of Chemistry, Philadelphia College of Pharmacy and Science. Revised Chapter 19 on "The Colloidal State."
- G. Victor Rossi, B.S., M.S., Ph.D.** Director, Department of Pharmacology, Philadelphia College of Pharmacy and Science. Prepared original material and revised Chapter 85 on "Biological Testing." Prepared biological and microbiological assay statements throughout Part V.
- David Seligson, B.S., Sc.D., M.D.** Director of Clinical Laboratories and Director of School of Medical Technology, Yale-New Haven Medical Center. Prepared original manuscript for new Chapter 86 on "Clinical Analysis" in collaboration with Dr. Bove and Dr. Brahen.
- Glenn Sonnedecker, B.Sc., M.Sc., Ph.D.** Director, American Institute of the History of Pharmacy. Revised Chapter 2 on "The History and Ethics of Pharmacy."
- Albert A. Stonehill, Ph.C., B.S., Ph.D.** Chief, Department of Pharmaceutical Chemistry, Ethicon, Inc. Collaborated with Dr. Henderson in the revision of Chapter 91 on "Surgical Supplies" and Chapter 92 on "First Aid."
- Irene M. Strieby, A.B., B.S.** Library Consultant. Prepared original material and revised Chapter 6 on "The Literature of Pharmacy."
- Douglas M. Surgenor, A.B., M.S., Ph.D.** Professor of Biochemistry, School of Medicine, University of Buffalo. Revised Chapter 48 on "Blood, Fluids, and Electrolytes."
- Ewart A. Swinyard, B.S., B.S. (Pharm.), M.S., Ph.D.** Professor of Pharmacology and Director of Pharmaceutical Research, College of Pharmacy, University of Utah. Collaborated with Dr. Stewart C. Harvey in the complete and thorough revision of the pharmacological discussions and therapeutic use statements, the preparation of introductory statements for the chapters of Part V, and the classification of the official and nonofficial drugs of Part V.
- Donalee L. Tabern, B.S., M.S., Ph.D.** Director, Radioisotope Education, Picker Nuclear Corp. Prepared original manuscript for Chapter 81 on "Radiopharmacy-Medical Applications" in collaboration with Dr. Chase.
- Alfred A. Tytell, Ph.D.** Director of Cell Biology, Division of Virus Research, Merck Institute for Therapeutic Research, West Point, Pennsylvania. Revised Chapter 60 on "Enzymes."
- John G. Wagner, Phm.B., B.S.P., B.A., Ph.D.** Head, Pharmacy Research Section, Product Research and Development Department, The Upjohn Company. Prepared original material and revised Chapter 37 on "Coating of Tablets, Capsules, and Pills."
- Justus C. Ward, B.S., M.S.** Chief, Pesticides Regulation Branch, Plant Pest Control Division, Agricultural Research Service, U. S. Department of Agriculture, Washington, D. C. Prepared original material and revised Chapter 72 on "Pesticides" in collaboration with Dr. Knipling.
- Henry Welch, Ph.D., D.Sc.** Retired. Formerly, Director, Division of Antibiotics, U. S. Food and Drug Administration. Revised Chapter 70 on "Antimicrobial Drugs" in collaboration with Mr. Kirshbaum.
- Morris L. Yakowitz, B.S.** Chief of the Drug, Device, and Cosmetic Branch, Bureau of Enforcement, U. S. Food and Drug Administration, Washington, D. C. Prepared original material and revised the section on *Labeling Regulations* of Chapter 94 on "Laws Governing Pharmacy."
- John C. Young, B.S., M.S., Ph.D.** Assistant Professor of Pharmacy, Philadelphia College of Pharmacy and Science. Prepared original material and revised Chapter 88 on "The Prescription."
- Louis C. Zopf, Ph.G., B.S., M.S., D.Sc.** Dean and Professor, College of Pharmacy, State University of Iowa. Revised Chapter 34 on "Medicated Applications."

Contributors

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- Robert E. Abrams, Philadelphia, Pa.
 Frank Albus, Philadelphia, Pa.
 W. F. Allen, Kalamazoo, Mich.
 T. C. Anderson, Detroit, Mich.
 H. J. Anslinger, Washington, D. C.
 H. Elizabeth Bachofner, Summit, N. J.
 Nathan Back, Buffalo, N. Y.
 Karl Bambach, Washington, D. C.
 Edward Barker, St. Louis, Mo.
 Richard H. Barry, Bloomfield, N. J.
 Ava Bartfay-Szabo, Buffalo, N. Y.
 George D. Beal, Merritt Island, Fla.
 Arthur Bechtold, Brooklyn, N. Y.
 L. A. Beemer, Detroit, Mich.
 O. K. Behrens, Indianapolis, Ind.
 George Bender, Detroit, Mich.
 Terry L. Benney, Philadelphia, Pa.
 Alex Berman, Ann Arbor, Mich.
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 Paul Blanc, Geneva, Switzerland
 M. E. Bliss, New Rochelle, N. Y.
 Vernon B. Bowen, Milwaukee, Wis.
 Edward W. Brady, Evansville, Ind.
 Joanne B. Branson, Ann Arbor, Mich.
 R. L. Brault, Worcester, Mass.
 Mildred D. Bray, Lansdowne, Pa.
 Nancy H. Brown, Drexel Hill, Pa.
 Albert Q. Butler, St. Louis, Mo.
 Leonard T. Capell, Columbus, Ohio
 Robert Case, Buffalo, N. Y.
 M. A. Chambers, Cincinnati, Ohio
 G. Robert Clark, Washington, D. C.
 Helen Marr Cook, Media, Pa.
 John T. Connor, Rahway, N. J.
 D. M. Copley, Norwich, N. Y.
 Patrick H. Costello, Chicago, Ill.
 Barbara A. Craddock, Philadelphia, Pa.
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 James R. Cuozzo, Drexel Hill, Pa.
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 Lee Eiler, Dayton, Ohio
 John A. Ellegood, West Point, Pa.
 R. C. Ellingson, Evansville, Ind.
 W. B. Ennis, Jr., College Heights, Md.
 Elias Epstein, Brooklyn, N. Y.
 C. W. Ferry, Tuckahoe, N. Y.
 John W. Flack, Philadelphia, Pa.
 Issac Fleischman, Washington, D. C.
 Harris L. Friedman, Milwaukee, Wis.
 V. Froelicher, Yonkers, N. Y.
 Ricardo Galbis, Havana, Cuba
 Richard Giovine, New York, N. Y.
 Marvin Goldberg, Drexel Hill, Pa.
 Samuel M. Gordon, Richmond Hill, N. Y.
 A. R. Greenlaw, Philadelphia, Pa.
 Robert E. Gundel, New York, N. Y.
 Ephraim Gunsberg, New York, N. Y.
 Dorothy Hanlon, Upper Darby, Pa.
 Anne Harris, Buffalo, N. Y.
 F. Howard Hedger, Brooklyn, N. Y.
 O. K. Houston, New York, N. Y.
 Florence Huber, Drexel Hill, Pa.
 C. Lee Huyck, St. Louis, Mo.
 Albert E. Jarvis, Indianapolis, Ind.
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 C. T. Kasline, Clifton, N. J.
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 Richard L. Kenyon, Washington, D. C.
 Alfred P. Knapp, Long Island City, N. Y.
 Richard T. Knies, New York, N. Y.
 Donald G. Kortekamp, Cincinnati, Ohio
 Joseph W. Kouten, New Brunswick, N. J.
 John E. Kramer, Philadelphia, Pa.
 K. A. Krieger, Philadelphia, Pa.
 Charles L. Kroll, New Brunswick, N. J.
 E. O. Krueger, North Chicago, Ill.
 R. Kuramoto, Summit, N. J.
 E. L. Kuryloski, Philadelphia, Pa.
 Louise C. Lage, Indianapolis, Ind.
 George P. Larrick, Washington, D. C.
 A. J. W. LeBien, Indianapolis, Ind.
 Bertram H. Lebeis, Pearl River, N. Y.
 Dorothy Lowenthal, Drexel Hill, Pa.
 B. J. Ludwig, New Brunswick, N. J.
 John S. McCutcheon, New York, N. Y.
 Eugene J. McGlynn, New York, N. Y.
 Francis McGrath, Bethesda, Md.
 Alan G. MacDiarmid, Philadelphia, Pa.
 Dorothy Macy, Sr., Media, Pa.
 Fred T. Mahaffey, Chicago, Ill.
 Edward J. Matson, North Chicago, Ill.
 R. R. McGregor, Midland, Mich.
 Robert McKowen, Lancaster, Pa.
 C. Baxter McLaughlin, Baltimore, Md.
 E. F. Mertis, New York, N. Y.
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 Fred A. Morecombe, St. Louis, Mo.
 Harry E. Morton, Philadelphia, Pa.
 James A. Murphy, Elkhart, Ind.
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 Alexander B. Neill, Norwich, N. Y.
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 Adley B. Nichols, New York, N. Y.
 Howard E. Parker, Bryan, Ohio
 Mary Anne Parker, Drexel Hill, Pa.
 Earl Pierson, Rahway, N. J.
 E. Ruiz Ponseti, Mexico City, Mexico
 Paul R. Portje, New York, N. Y.
 Irving Porush, Northridge, Cal.
 Justin L. Powers, Washington, D. C.
 C. H. Pressel, Tuckahoe, N. Y.
 John A. Purinton, Jr., Chicago, Ill.
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 L. C. Riesch, Philadelphia, Pa.
 Clara Robeson, Boston, Mass.
 C. A. Rockefeller, Brooklyn, N. Y.
 E. Rohrmann, Indianapolis, Ind.
 Charles F. Rosica, Philadelphia, Pa.
 Ward Ross, Madison, Wis.
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 J. C. Scheller, Newark, N. J.
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 Garth R. Seavy, New York, N. Y.
 Winifred Sewell, New Brunswick, N. J.
 James V. Shannon, Jr., New York, N. Y.
 Warren C. Shaw, Silver Spring, Md.
 A. W. Shelton, Rochester, N. Y.
 H. H. Shull, Philadelphia, Pa.
 Irwin S. Shupe, New York, N. Y.
 Catherine N. Sideri, Philadelphia, Pa.
 Gertrude H. Sink, Middletown, Ohio
 A. E. Slesser, Philadelphia, Pa.
 C. W. Sondern, Morris Plains, N. J.
 Anthony P. Sorrentino, Drexel Hill, Pa.
 John H. Spær, Chicago, Ill.
 Frank J. Steele, Greenwich, Conn.
 Robert Stevens, Philadelphia, Pa.
 G. C. Straayer, Bloomfield, N. J.
 T. A. Sullivan, Salem, Mass.
 David F. Svoboda, Grand Rapids, Mich.
 Eugene H. Swanzey, Pearl River, N. Y.
 F. O. Taylor, Detroit, Mich.
 J. K. Traer, Kalamazoo, Mich.
 Beulah H. Tullar, Lansdowne, Pa.
 Henry L. Verhulst, Washington, D. C.
 Donald R. Ward, Philadelphia, Pa.
 George S. Warner, Baltimore, Md.
 G. F. Whattam, Baltimore, Md.
 Robert C. White, Morris Plains, N. J.
 Katherine Willis, Los Angeles, Cal.
 E. H. Woodruff, Kalamazoo, Mich.
 A. G. Worton, Columbus, Ohio
 R. Wyckoff, Bethesda, Md.
 George W. Wyllie, Nutley, N. J.

Preface to the Twelfth Edition

The rapid advances which have occurred in the past few years have necessitated very extensive revision of this textbook. Within the last decade alone, radioactive pharmaceuticals have been officially recognized, poliomyelitis has been conquered, some types of cancer have been controlled, outstanding improvements in instrumentation for research have been made, and a vast array of new, more potent, and more specific pharmaceutical products have been made available to the medical profession.

Pharmacy has grown almost completely away from extemporaneous compounding by the individual pharmacist. The profession is now characterized by mass production of pharmaceutical products under rigidly controlled conditions based on statistically analyzed data, with the resulting advantages of lowered costs, improved quality, and accelerated research. Greater specificity, greater probability that official specifications for a product are being met at the time it is dispensed, and higher therapeutic indices are major objectives being consistently achieved.

There is also an increasingly greater differentiation between the druggist who specializes in proprietaries, toiletries, household drugs, etc. and the more highly scientifically trained pharmacist who serves as a consultant to the physicians in his neighborhood or as a member of a team in pharmaceutical research and development.

In recognition of the trend toward greater utilization of the pharmacist as a therapeutic consultant, a drastic change in the arrangement of the drugs in this edition has been made. For the first time since this text was first published in 1885, all official and important nonofficial drugs have been classified pharmacologically. The chemical classification, as in former editions, has also been retained. This dual treatment, unique with this book, provides countless opportunities for correlating chemical structures with pharmacologic activity.

Since most pharmacists must know something about compounding or manufacturing and should understand the biological and physicochemical methods employed today in the control laboratory and in research in addition to the legal, economic, and professional requirements of the pharmacy, this text covers all of these subjects.

The constantly increasing complexity of pharmaceutical theory and practice, as well as the accelerated rate of development of modern medicinal agents, has compelled the editors to delegate responsibility for major portions of the content of this textbook to authorities in the numerous fields encompassed. The preparation of an authoritative, comprehensive, and accurate treatment of the entire field of pharmacy was facilitated by asking a group of outstanding and capable scientists to serve as editors and authors.

Dr. E. Fullerton Cook, internationally renowned pharmacist, has edited more editions of this textbook than any other person. He became associated with the original author, Professor Joseph P. Remington, at the turn of the century and has been the major factor in perpetuating the "Remington" and keeping it up-to-date for more than 60 years. All who have worked with him during the last nine revisions have

been proud to be his associate and are grateful for the leadership he has provided.

Dr. E. Emerson Leuallen, with the able assistance of his colleagues, was responsible for Chapters 2 to 5, 24, 34, 35, 75 to 79, 87, 88, and 90 to 99, which deal primarily with *Pharmacy Orientation, Biological Pharmacy, and Professional Practice*.

Dr. Arthur Osol was primarily responsible for the sections on *Physical Pharmacy, Analytical Pharmacy, and Radiopharmacy*. He and his competent staff were responsible for Chapters 8, 10 to 12, 14 to 17, 21 to 23, 26, 39, and 80 to 86.

Dr. Linwood F. Tice, with the help of his capable associates, was responsible for Chapters 1, 6, 7, 9, 13, 18 to 20, 25, 27 to 33, 36 to 38, 40, and 89. These include material on *Pharmacy Orientation, Physical Pharmacy, Manufacturing Pharmacy, and Hospital Pharmacy*.

Dr. Clarence T. Van Meter is specially commended for the outstanding contributions he has made to the sections on *Pharmaceutical Chemistry*. He was personally responsible for chemical nomenclature, molecular and atomic weights, structural and empirical formulas, methods of synthesis, and the concise chemical statements appearing in Chapters 46 to 74 dealing with *Official and Nonofficial Drugs*. He personally wrote Chapters 41 to 45 inclusive. The tremendous amount of time and effort spent by Dr. Van Meter, particularly in reorganizing Part IV and supplying chemical information for Part V, has greatly increased the value of the text for all users.

Dr. Ewart A. Swinyard, with the assistance of Dr. Stewart C. Harvey, has completely and thoroughly revised the pharmacological discussions and therapeutic use statements. These pharmacologists at the University of Utah completely rewrote all introductions to the Chapters in Part V and rearranged the official and nonofficial drugs into Chapters 46 to 74 according to their pharmacologic properties. The latest, authoritative information for all official and many nonofficial drugs has been presented.

John E. Hoover has served in a most dedicated manner as managing editor. Through his efficient hands passed all manuscripts, proofs, and other paper work which becomes so voluminous in coordinating the activities of more than 225 editors, authors, and contributors. The editors have deeply appreciated his splendid assistance.

Beulah H. Tullar, who has prepared the index for all editions of this textbook since 1917, has once again carefully compiled this very important part of the book with the assistance of Dr. Catherine N. Sideri. The editors wish to express their deep appreciation for their conscientious dedication to the task and their meticulous attention to detail.

The editorial staff especially desires to express its sincere thanks to President Cyrus S. Fleck and the other officers of the Mack Publishing Company whose continued confidence in the project encouraged the editors while undertaking the enormous task of revision, and whose efficient staff has once again brought it to completion.

Philadelphia
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ERIC W. MARTIN
Editor-in-Chief

Preface to the First Edition

The rapid and substantial progress made in Pharmacy within the last decade has created a necessity for a work treating of the improved apparatus, the revised processes, and the recently introduced preparations of the age.

The vast advances made in theoretical and applied chemistry and physics have much to do with the development of pharmaceutical science, and these have been reflected in all the revised editions of the Pharmacopœias which have been recently published. When the author was elected in 1874 to the chair of Theory and Practice of Pharmacy in the Philadelphia College of Pharmacy, the outlines of study which had been so carefully prepared for the classes by his eminent predecessors, Professor William Procter, Jr., and Professor Edward Parrish, were found to be not strictly in accord, either in their arrangement of the subjects or in their method of treatment. Desiring to preserve the distinctive characteristics of each, an effort was at once made to frame a system which should embody their valuable features, embrace new subjects, and still retain that harmony of plan and proper sequence which are absolutely essential to the success of any system.

The strictly alphabetical classification of subjects which is now universally adopted by pharmacopœias and dispensatories, although admirable in works of reference, presents an effectual stumbling block to the acquisition of pharmaceutical knowledge through systematic study; the vast accumulation of facts collected under each head being arranged lexically, they necessarily have no connection with one another, and thus the saving of labor effected by considering similar groups together, and the value of the association of kindred subjects, are lost to the student. In the method of grouping the subjects which is herein adopted, the constant aim has been to arrange the latter in such a manner that the reader shall be gradually led from the consideration of elementary subjects to those which involve more advanced knowledge, whilst the groups themselves are so placed as to follow one another in a natural sequence.

The work is divided into six parts. Part I is devoted to detailed descriptions of apparatus and definitions and comments on general pharmaceutical processes.

The Official Preparations alone are considered in Part II. Due weight and prominence are thus given to the Pharmacopœia, the National authority, which is now so thoroughly recognized.

In order to suit the convenience of pharmacists who prefer to *weigh solids* and *measure liquids*, the official formulas are expressed, in addition to parts by weight, in *avoirdupois weight* and *apothecaries' measure*. These equivalents are printed in *bold type* near the margin,

and arranged so as to fit them for quick and accurate reference.

Part III treats of Inorganic Chemical Substances. Precedence is of course given to official preparations in these. The descriptions, solubilities, and tests for identity and impurities of each substance are systematically tabulated under its proper title. It is confidently believed that by this method of arrangement the valuable descriptive features of the Pharmacopœia will be more prominently developed, ready reference facilitated, and close study of the details rendered easy. Each chemical operation is accompanied by equations, whilst the reaction is, in addition, explained in words.

The Carbon Compounds, or Organic Chemical Substances, are considered in Part IV. These are naturally grouped according to the physical and medical properties of their principal constituents, beginning with simple bodies like cellulin, gum, etc., and progressing to the most highly organized alkaloids, etc.

Part V is devoted to Extemporaneous Pharmacy. Care has been taken to treat of the practice which would be best adapted for the needs of the many pharmacists who conduct operations upon a moderate scale, rather than for those of the few who manage very large establishments. In this, as well as in other parts of the work, operations are illustrated which are conducted by manufacturing pharmacists.

Part VI contains a formulary of Pharmaceutical Preparations which have not been recognized by the Pharmacopœia. The recipes selected are chiefly those which have been heretofore rather difficult of access to most pharmacists, yet such as are likely to be in request. Many private formulas are embraced in the collection; and such of the preparations of the old Pharmacopœias as have not been included in the new edition, but are still in use, have been inserted.

In conclusion, the author ventures to express the hope that the work will prove an efficient help to the pharmaceutical student as well as to the pharmacist and the physician. Although the labor has been mainly performed amidst the harassing cares of active professional duties, and perfection is known to be unattainable, no pains have been spared to discover and correct errors and omissions in the text. The author's warmest acknowledgments are tendered to Mr. A. B. Taylor, Mr. Joseph McCreery, and Mr. George M. Smith for their valuable assistance in revising the proof sheets, and to the latter especially for his work on the index. The outlines illustrations, by Mr. John Collins, were drawn either from the actual objects or from photographs taken by the author.

Philadelphia, October, 1885

J.P.R.

General Notices

of REMINGTON'S PRACTICE OF PHARMACY

A Guide to the Use of R. P. P. XII

1. Guidance to the Reader—The attention of the reader is directed to Chapter 84 on "Official Requirements and Tests" (page 1479), especially to the selected and abstracted material from the General Notices of the U. S. P. and N. F. (pages 1479 and 1480). This material provides interpretations and general statements which attach special significance to official monographs and standards, tests, assays, and other requirements contained in this text. Chapter 84 also assists the reader in correlating the contents of R. P. P. XII with related subject matter in the official compendia. The primary authorities for the drug standards found in this text are the *U. S. P. XVI*, *N. F. XI*, recent editions of the *N. N. D.*, the *Food, Drug, and Cosmetic Act* of 1939 and its Regulations, the *Federal or Harrison Narcotic Law* and its Regulations, the *Federal Insecticide, Fungicide, and Rodenticide Act* of 1947 and its Regulations, and the *Federal Public Health Service Act* of 1944 and its Regulations. Pertinent information from the *B. P. 1958*, *Ph. I. First Edition*, *Vols. I and II* and the *Supplement*, and other authoritative sources has also been included.

Correlations among various types of pharmaceutical information, e.g., therapeutic activity and chemical composition, have been facilitated by arranging the contents of R. P. P. XII into well defined areas (see page xi), and by classifying all official and important non-official drugs both chemically and pharmacologically.

2. Use of Text—Permission to use in this volume certain portions of the text of the *United States Pharmacopeia Sixteenth Revision*, the *National Formulary, Eleventh Edition*, and recent editions of the *New and Nonofficial Drugs* has been granted by the appropriate authorities (page iv).

3. Patents and Trade-marks—The inclusion in The U. S. P., N. F., or R. P. P. of any drug in respect to which patent or trade-mark rights may exist shall not be deemed, and is not intended as, a grant of, or authority to exercise, any right or privilege protected by such patent or trade-mark. All such rights and privileges are vested in the patent or trade-mark owner, and no other person may exercise the same without express permission, authority, or license secured from such patent or trade-mark owner. In R. P. P. XII official items which are patented are marked with an asterisk and a footnote, "Patented" is provided.

It is to be understood that compilation of these trade-marks herein must not be interpreted as constituting or implying authority to dispense any product other than the one prescribed or ordered under the trade-mark

specified in the prescription or order. Substitution of one trade-marked product for another, even though both trade-marks are listed herein as synonyms for the official preparation, is a breach of professional pharmacy ethics and is to be condemned.

When a drug is prescribed, or otherwise ordered, by an official or other nonproprietary name, followed by a trade-mark, the product supplied under the trade-mark of the manufacturer specified must be dispensed. When a drug is specified in a prescription, or is otherwise ordered by an official or other nonproprietary name without reference to a specific trade-mark, any product bearing the official name may be dispensed.

4. Compliance with Federal Statutes—The fact that a drug appears in the U. S. P. or N. F. does not exempt it from compliance with requirements of Acts of Congress or with regulations and rulings issued by agencies of the United States Government under authority of these Acts. Revisions of the federal requirements that affect the official standards will be made the subject of U. S. P. or N. F. Supplements as promptly as practicable.

5. B. P. and Ph. I. Titles—In this text, the abbreviations B. P. and Ph. I. are placed after those U. S. P. and N. F. titles which also receive official recognition in the *British Pharmacopœia 1958* or the first edition of the *International Pharmacopoeia, First Edition*, *Vols. I and II* and the *Supplement*. The inclusion of these abbreviations in the title does not indicate, necessarily, that the title or the standards of strength, purity, and quality are identical with those of the U. S. P. or N. F. Frequently there are discrepancies, but these are usually minor. For exact specifications, the original compendia should be consulted.

6. Synonyms—Comprehensive lists of chemical, trade, and other names have been included under the official titles as an aid in identifying pharmaceutical products. Note the statements concerning patent rights and substitution in paragraph 3 above.

7. Metric System—The use of the metric system to express doses and quantities in formulas has received almost universal acceptance, and the use of the ancient and cumbersome apothecary system has been almost completely abandoned. Tables of exact equivalents (pages 86 and 87) and approximate equivalents (page 83 and inside the front cover) have been retained for ready reference in the occasional instances when conversion from one system to the other is desired.

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PART I

Pharmacy Orientation

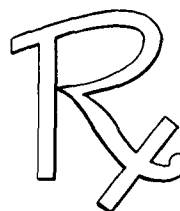


Medicine

Symbolized by the staff of Æsculapius, ancient god of healing. The serpent entwined about the staff denotes wisdom and the ability to heal, cure diseases, and prolong life.

Pharmacy

Symbolized by R_x. This inscription, which has been used on prescriptions and formulas for more than 6000 years, is an abbreviation of "recipe," Latin word for "take thou." Originally used as an invocation to Jupiter, the lucky planet which guarded the sick.



Dentistry

Symbolized by the serpent encircled about an ancient cautery. The leaves and berries in the background represent the two sets of teeth, while the triangle and circle are derived from the Greek letters—delta for "dens" and omicron for "odons," both words meaning tooth.

Nursing

Symbolized by the lamp of Florence Nightingale. During the Crimean War, she introduced many hospital improvements, including new standards of comfort and cleanliness. The profession of nursing owes much to the pioneering work of "The Lady of the Lamp."



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The Scope of Pharmacy

Definition of Pharmacy—opportunities in pharmacy—pharmacy curriculum—U. S. colleges of pharmacy—pharmaceutical survey

PHARMACY is that health profession which is concerned with the preparation and the distribution of medicinal products. It embraces the art and science of preparing from natural or synthetic sources suitable and convenient materials for the prevention, diagnosis, or treatment of disease. The preparation of these materials entails a knowledge of identification, selection, pharmacologic action, preservation, combination, analysis, and standardization of drugs.

Pharmacy also embraces the professional, legal, and economic function of distributing medicinal products properly and safely. It has this responsibility whether these products are dispensed on the prescription of a licensed practitioner (physician, dentist, veterinarian, osteopath, podiatrist, etc.) or, in those instances where it may legally be done, dispensed without a prescription, or sold in original packages directly to the consumer.^{1,2}

By supplying drugs and drug products to the public in conformity with federal and state drug laws, and according to fundamental ethical principles as they apply to pharmacy, the profession safeguards public health.

Pharmacy and Pharmacist

The word pharmacy is also used to designate the place where medicines are compounded, dispensed, and sold. This place may be found in a hospital, clinic, medical center, retail drug store, or wherever a licensed practitioner of pharmacy distributes medicines.

The *compounding* of medicines usually requires the scientific combination of two or more ingredients as prescribed by a physician, but *dispensing* may only require the transfer of manufactured products to a prescription container. Both services demand special knowledge, experience, and high professional standards. The law recognizes the importance of these services where public health is concerned, and accordingly supervises the special status and conduct of the pharmacist.

A licensed pharmacist, *i.e.*, a Registered Pharmacist (R.Ph.), is a person who is licensed to practice pharmacy in the particular state which has issued his license. A license is granted only after a pharmacist has demonstrated scientific and professional competence in his knowledge of and the handling, compounding, and dispensing of drugs. Each state pharmacy law specifies certain minimum requirements for education and experience which must be met before a license is granted.

In *The Pharmaceutical Survey* (page 8) Dr. Edward C. Elliott states:

"The Pharmacist is a member of society, as well as of a pharmaceutical society. . . . He should be diligent in the discharge of his civil, social, and moral obligations, as well as in the exercise of his professional skills. The pharmacist's social and moral obligations are emphasized by a code of ethics adopted by his profession for its own regulation. This statement of principles is based upon an idealistic concept of the obligations assumed by pos-

sessors of special knowledge and skills. It reminds him of the duty to act to the limit of his capacity for good and to refuse to act in any circumstances which he knows or suspects to be harmful to others. . . ."

"The pharmacist is a person as well as a pharmacist. Like other individuals in modern life, he has many interests outside his professional activities. He needs the enrichment of life that comes from an understanding and appreciation of civilization, and he should develop a personal philosophy of living that is satisfactory to him and makes for a well-adjusted life.

"The pharmacist must be a professional man who understands thoroughly what he is doing, who comprehends the scientific bases of drugs and drug action, who is able to evaluate critically the products he handles, who is competent to advise physicians and members of the other health professions concerning drugs and their uses, who works at his profession creatively and advances its service."

Definition of Drug

According to the interpretation of the United States Food, Drug and Cosmetic Act,

"the term 'drug' means (1) articles recognized in the official United States Pharmacopeia, official Homeopathic Pharmacopeia of the United States, or official National Formulary, or any supplement to any of them; and (2) articles intended for use in the diagnosis, cure, mitigation, treatment, or prevention of disease in man or other animals; and (3) articles (other than food) intended to affect the structure or any function of the body of man or other animals and (4) articles intended for use as a component of any article specified in clause (1), (2), or (3), but does not include devices or other components, parts, or accessories."

The Major Segments of Pharmacy

From primitive beginnings amidst superstition and ignorance, when medicine, pharmacy, and theology were all practiced by the same person, pharmacy over the centuries has slowly evolved into its present position as a vast and vital profession with many facets. By utilizing practically all of the physical, biological, and medical sciences and by fostering teamwork among pharmacists, physicians, and scientists pharmacy has largely been responsible for conquering one dread disease after another and thereby prolonging life itself. As one result of the intensified scientific collaboration, the mother science of pharmacy has given birth during recent decades to a number of important new disciplines, including pharmacology, psychopharmacology, psychochemistry, and biochemistry.

The major segments of pharmacy are found in education, industry, distribution, and government. All of the segments are highly interdependent. Any political, social, or economic factors affecting one, eventually affect all.³

Education—A national network of 76 accredited colleges of pharmacy, meeting high academic standards, each year graduate some 4000 eminently qualified specialists in the art and science of creating and handling medicines. About 1000 educators and assistants teach a wide variety of scientific and professional subjects to a student body of 17,000. No longer is knowledge in the field of pharmacy transmitted from

¹ This definition is based upon that prepared by the Joint Committee to Redefine the Term "Pharmacy" and submitted to the American Association of Colleges of Pharmacy and the National Association of Boards of Pharmacy, at Cincinnati, August, 1959.

² Editorial, *J. Am. Pharm. Assoc., Pr. Ed.*, 19, 411 (1958).

³ Editorials, *J. Am. Pharm. Assoc., Pr. Ed.*, 18, 467 (1957); 19, 29 (1958).

one generation to the next through preceptors to their apprentices. Modern college curricula have superseded this outmoded procedure in pharmacy just as in medicine.

Industry—About 1400 drug manufacturing companies employ some 102,000 scientists, engineers, physicians, administrators, technicians, etc. About 5000 are registered pharmacists. All companies are engaged in the intensely competitive activity of creating, mass-producing, and marketing new and improved pharmaceutical products. The major goal of the drug manufacturers is to provide those who are suffering from diseases and other ailments with ever more effective, more specific, safer medication.

Automatic and semi-automatic mass production of medicinal products has almost entirely replaced the crude, outmoded hand preparation of pills, suppositories, plasters, galenicals, and other drug products. Maintenance of high standards of quality, establishment of strict control procedures, and specialization of manpower in research, development, production, and promotional activities, now guarantees that the consumer can consistently purchase drug products meeting stringent standards of purity, potency, and stability. In fact, a total of about 400 new drug products meeting such standards are made available each year. See Chapter 4 (page 39).

Distribution—The gigantic drug distribution network in the United States consists of nearly 3000 wholesale drug outlets, 54,000 retail pharmacies, about 8000 of which are members of drug chains, and nearly 4000 hospital pharmacies in the 7000 hospitals of this country. A total of \$7,500,000,000 worth of drugs and other products are sold annually and more than 2,000,000 prescriptions are dispensed daily. Roughly one-quarter of total retail pharmacy income is derived from prescriptions. Total personnel in the distribution segment of pharmacy number several hundred thousand. Of the 110,000 licensed pharmacists in this country there are roughly 100,000 in retail pharmacy and nearly 4000 in hospital pharmacy. See page 28.

Government—Approximately 1000 registered pharmacists serve in the hospitals, laboratories, and other areas of the U. S. Public Health Service, the Veterans Administration, the Food and Drug Administration, the Army, Navy, and Air Force, the Department of Commerce, the Internal Revenue Department, the Bureau of Narcotics, and other agencies. Duties and responsibilities run the gamut from those that are strictly pharmaceutical to those of drug law enforcement, inspection, laboratory supervision, and administration. See Chapter 5 (page 46).

Opportunities in Pharmacy

Pharmacists serve in a wide variety of professional activities related to public health. Many of these are discussed in detail in subsequent chapters.

The opportunities in pharmacy are so boundless that the progress of the individual is limited only by his own initiative, intelligence, industry and ability to cooperate. Since practically all sciences found their roots in this profession, and since pharmaceutical training is so adaptable and broad in its scope, it is not surprising that vast horizons await the graduate of a college of pharmacy. The need for the type of professional and scientific leadership which pharmacists are capable of exerting is becoming ever greater in the continuous fight waged by medical science against disease and death. In subsequent paragraphs are outlined briefly

a few of the numerous ways in which a graduate of a college of pharmacy may serve.

Retail Pharmacy—Retail pharmacy is the area of pharmaceutical service most familiar to the general public and, in fact, the only activity generally associated with the word pharmacy in the minds of many people. Up to 75 per cent of the graduates of the colleges of pharmacy enter retail pharmacy. This career affords the pharmacist an opportunity for close personal contact with his fellow man and enables him to enjoy that intense personal pride and satisfaction that result from development and supervision of his own business.

The retail pharmacist simultaneously shoulders the responsibilities of the professional man and the duties of the business man. In the establishment which restricts itself to professional services, the business aspects are limited to certain essential operations such as record keeping, purchase of goods, and professional promotion. The main objectives of professional pharmacy are to compound prescriptions and to assist the physician, dentist, and other members of the healing professions, by supplying them with professional information as well as reagents, instruments, and pharmaceutical products. By keeping abreast of the latest developments in medicine and pharmacy, pharmacists can make available to practitioners much useful information. This includes data on the physical, chemical, and pharmacological properties of drugs, also on their uses, doses, comparative effectiveness, side effects, modes of administration, and special precautions in handling. Pharmacists can also provide information concerning sources, dosage forms, synonyms, generic and trade names, and incompatibilities.

The majority of retail pharmacists, however, practice in the neighborhood type of drug store. Here a great many items related to health problems are sold, and the pharmacist, through his training and his sense of moral and legal responsibility, is uniquely suited for their safe handling. The corner pharmacy has earned an enviable reputation as a source of community health service. Its proprietor has more frequent and more personal contact with the general public than any other business or professional man. See Chapters 3 and 87.

Hospital Pharmacy—This service is recognized as an important factor in providing the patient with superior care. Because of his technical and scientific training, a pharmacist is logically placed in charge of the hospital pharmacy. Such hospital practice provides a real challenge and a fine opportunity for rendering professional services. In this environment the pharmacist can utilize his knowledge of medicinal standards and the uses, costs, formulas, and characteristics of pharmaceutical specialties. He is the director of the hospital manufacturing laboratory, he has control of hospital medical supplies and narcotics, and he is responsible for purchasing many of the hospital supplies. He may be asked to instruct the student nurses and he is frequently consulted by the physicians, surgeons, interns, and clinical laboratory technicians. He has an opportunity to edit the hospital formulary, to develop new formulas, and to have a voice in the determination of policies regarding medical care. For further discussion see Chapter 89.

Manufacturing Pharmacy—Most pharmaceutical products can be manufactured skillfully and economically only in large well-organized establishments, and these products are most advantageously distributed through large wholesale houses. However, many of today's prominent manufacturing establishments had

humble beginnings in the small prescription laboratories of retail pharmacies. The same opportunity is offered to enterprising pharmacists today and some of the large drug houses of tomorrow will grow from the small pharmacies of today. These large organizations offer pharmacists attractive positions as executives, professional service representatives (so-called "detail men"), production managers, control chemists, and research workers in the intensely interesting occupation of developing and introducing products to world-wide markets. For further details see Chapters 27 to 40.

Pharmaceutical Education—This field offers special advantages to those who are properly qualified. In addition to possessing superior knowledge obtained by concentrated and extensive study, the college professor must have infinite patience, a personality which demands respect, and the ability to present his subject in a clear, concise, and interesting manner, so that he may guide and train young minds properly. Outstanding students begin as instructors, some advance to professorships, and a few become college deans and presidents. In addition to their duties at the colleges, many participate in special research projects, editorial work, and public speaking. Consulting and medico-legal work may also be part of the daily routine.

Government Service—The Federal Government employs pharmacists in the Army, the Navy, the Marine Corps, the Public Health Service, the Bureau of Narcotics, the Food and Drug Administration, the Federal Security Agency, the Indian Bureau, and the Veterans Administration. Pharmacists are also engaged as law enforcement officers in maintaining federal food and drug standards. The state governments employ pharmacists as members of the state boards of pharmacy, as pharmaceutical chemists and research workers, and as officers for enforcing the laws pertaining to pharmacy. The Personnel Classification Division, U. S. Civil Service Commission, places pharmacy in the professional and scientific service; the Federal Government has been recognizing more and more the specialized qualifications of the trained pharmacist. For further details see Chapter 5.

Pharmaceutical Journalism—This vocation attracts pharmacists able to select and express in print interesting subjects of educational value to other members of the profession. Journalism offers splendid returns in

personal recognition and an opportunity for leadership in pharmacy and science. Not only editors of pharmaceutical journals and house organs, but also secretaries of the American Pharmaceutical Association and other local and national pharmaceutical organizations must be journalists. Publishers of technical books have openings for pharmacists who possess, in addition to their technical background, a propensity for detail, a methodical mind, perseverance, and the ability to communicate.

Women in Pharmacy—The changing order of life has facilitated woman's professional development. Elisabeth Marshall (1768–1836), daughter of the first president of the Philadelphia College of Pharmacy and Science, was the first woman pharmacist in the United States, although women were not admitted as students in colleges of pharmacy until 1876. Other women since then have followed in her footsteps in ever-increasing numbers, many attaining prominent positions with world-wide recognition and honors from famous scientific and professional institutions. Today women pharmacists are to be found in all areas of pharmaceutical service—in retail pharmacy, hospital pharmacy, journalism, education, research, pharmaceutical development, sanitation, public health work, and technical laboratory work. Women, also, hold important offices in local, state, and national organizations.

Related Vocations—During their college careers, some students become enthusiastic about one or more of the scientific or professional courses offered and as a result do not enter the profession of pharmacy itself, but decide to receive additional training in one of these closely related fields. The men who specialize discover that their pharmaceutical background enables them to advance rapidly. The vocations related to pharmacy are too numerous to tabulate completely, but the following partial list will assist the reader to visualize the opportunities awaiting the graduate of a college of pharmacy. Pharmacists have become bacteriologists; physicians and surgeons; pharmacologists; toxicologists; horticulturists and plant surgeons; analysts of milk, water, and food; chemists performing analyses, syntheses, and research in the organic and pharmaceutical laboratories of the industries manufacturing cosmetics, dyes, textiles, oils, foods, and drugs; and many other types of specialists.

How To Become A Pharmacist

The man who aspires to a career in pharmacy must be mentally alert, and he must possess imagination, resourcefulness, poise, courtesy, and tact. He should have an inquiring mind and be a logical thinker. In addition he should demonstrate initiative, enthusiasm, honesty, and personal cleanliness. Armed with these resources, a candidate may seek admission to a college of pharmacy with some assurance of success in his chosen profession.

In all of the 50 states, and in the District of Columbia, an applicant for licensure as a pharmacist must have graduated from an accredited college of pharmacy, must have completed a minimum amount of practical experience, and must have passed a comprehensive examination in theoretical and practical pharmacy given by the state board of pharmacy. Having com-

pleted these requirements, he is issued a license which must be renewed annually in most states. This license authorizes him to practice pharmacy in the state where he was examined. However, by means of reciprocity, the holder of a license in one state may transfer his registration, and practice in almost every other state. The applicant desiring transfer of registration must submit his credentials to the National Association of Boards of Pharmacy, 77 W. Washington St., Chicago 2, Ill. The fundamental rule for reciprocity is as follows: "The applicant must have had the legal qualifications at the time of examination and registration in the state from which he applies which would at that time have enabled him to qualify for examination and registration in the state to which he is applying for reciprocal registration."

The Pharmacy Curriculum

In 1948 the American Council on Education released the *Findings and Recommendations of The Pharmaceutical Survey* prepared, under the direction of Dr. Edward C. Elliott, with funds provided by the American Foundation for Pharmaceutical Education. The study had been inaugurated in April, 1946. The basic plan for the survey, accepting the fact that "pharmacy has assumed a role of increasing importance in the constantly expanding public health program of the United States," covered thirteen specific areas for study and recommendations. These areas were as follows:

1. An analysis of prescriptions to determine the knowledge required in compounding them.
2. A study of the activities engaged in by pharmacists.
3. An analysis of the general knowledge that a pharmacist should have regarding pharmaceutical products as indicated by information requested by members of the medical profession and questions asked by customers.
4. A study of new fields of pharmaceutical service with their implications both for training and for employment.
5. A study of the role of pharmacy in medical care.
6. An evaluation by pharmacy graduates of their previous training in relation to activities in which they engage.
7. A study of supply of and demand for trained personnel in the field of pharmacy.
8. The relationship of pharmaceutical education to business and industry—how education can be more closely integrated with practical experience.
9. Provisions for the guidance of pharmaceutical students within the pharmaceutical colleges.
10. The establishment of criteria for the selection of pharmacy students.
11. The qualifications of faculty members and the conditions of faculty service in the pharmaceutical colleges.
12. The levels of educational preparation required in pharmaceutical services.
13. The relationship of requirements for licenses to programs in pharmaceutical education.

Based on the findings of the Survey and the study and deliberations of the Committee on Curriculum of the American Association of Colleges of Pharmacy there was published in 1952, under the authorship of Lloyd E. Blanch and George L. Webster, a comprehensive treatise entitled *The Pharmaceutical Curriculum*.

The subject matter of the pharmacy curriculum may be grouped into four broad categories: *General Education*, *Physical Sciences*, *Biological Sciences*, and *Professional Courses*.

General Education is usually represented as including four principal divisions: the humanities, the social studies, and the physical and biological sciences. In the pharmacy curriculum, the latter divisions serve also the specialized purpose of preparing the student specifically for the professional and scientific courses which are peculiar to pharmacy.

Concerning general education, Blanch and Webster have written⁴ "It provides plans and programs whereby the general concerns of society may be well served, certain educational interests and desires of individuals may be fulfilled, and broad and sound foundations can be laid upon which may be erected a superstructure of specialized training for service in the professions. General education which runs concurrent with specialized training gives perspective to such training, prevents too much narrowing of the student's interests, and may reinforce the fact that his professional service has many wide relationships to other activities in the modern world."

At various periods in their historic development, all professional curricula have tended to overemphasize the technical and the specialized subject matter and

operations of the profession. Pharmacy colleges have not required that prospective students have a sufficiently rich cultural background. The liberal arts, (grammar, rhetoric, logic, arithmetic, geometry, music, and astronomy) have not had adequate emphasis in the foundations of most pharmacy students. The increasing importance attached to liberal education in the pre-pharmacy curriculum is an attempt to avoid the shortcomings of over-specialization. It acknowledges that education in the humanities and social studies, in addition to the physical and biological sciences, is as important as training in techniques and operations.

Under the term humanities are generally included the fine arts, literature, languages, logic, philosophy, ethics, and religion. The social studies include history, education, economics, psychology, sociology, and government.

The Physical Sciences embrace a knowledge of the phenomena and composition of matter.

Physics is that science which treats of the phenomena associated with matter in general, especially its relations to energy, and of the laws governing these phenomena, excluding the special laws peculiar to living matter (biology) or to special kinds of matter (chemistry). It generally includes (1) the constitution and properties of matter, (2) mechanics, (3) sound and light, (4) heat, (5) optics, and (6) electricity and magnetism.

Chemistry is that science which explains the composition of matter and of the transformations which it undergoes. It has many divisions, such as *General Chemistry*, dealing with basic principles and inorganic substances, *Organic Chemistry*, or the chemistry of carbon compounds, *Qualitative Analysis*, *Quantitative Analysis*, *Physical Chemistry*, *Biological Chemistry* (*Biochemistry*), and many other special fields.

Mathematics is the science which treats of quantity and magnitude. It covers *Arithmetic*, *Geometry*, *Algebra*, *Trigonometry*, *Calculus*, and *Statistical Analysis*.

The Biological Sciences classify our knowledge of plant and animal physiology, morphology, development, and distribution.

Botany is the science that treats of plants with reference to their structure, functions, and classification; *Biology*, the science of life or living organisms; and *Zoology*, the science which treats of animals with reference to their structure, functions, development, analysis, nomenclature, and classification.

Pharmacognosy is the science which embraces the history, source, cultivation, collection, preparation, distribution, commerce, identification, composition, purity, and preservation of drugs of vegetable and animal origin.

Pharmacology is broadly defined as the science of drugs. Unfortunately, the name has also been used by specialists to indicate the action of drugs on living organisms and is employed synonymously with pharmacodynamics. Pharmacology includes *Materia Medica*, the study of the origin, composition, and properties of medicinal agents; *Pharmacodynamics*, which deals with the action of medicines on living structures; and *Therapeutics*, which considers the use of medicines and other agencies in the treatment of disease.

Physiology is that branch of biology that treats of the vital phenomena manifested by animals or plants, including organic functions.

Toxicology, the science of poisons; *Microscopy*, the science requiring optical instruments called microscopes; *Bacteriology*, a natural science which treats of microorganisms; and *Serology*, dealing with serum products,

⁴ Blanch, L. E., and Webster, G. L., *The Pharmaceutical Curriculum*, 1952, American Council on Education, Washington, D. C., p. 67.