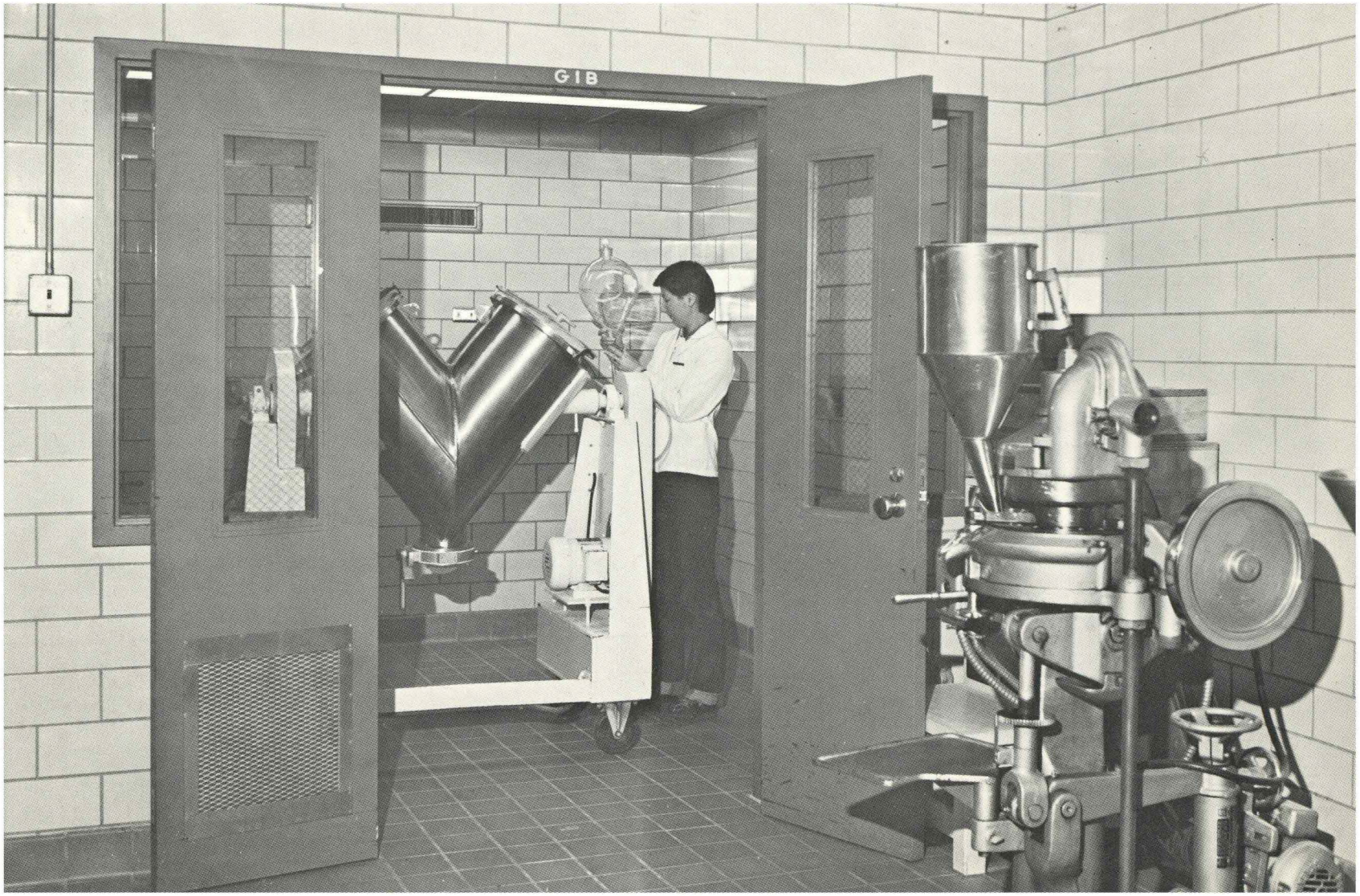
Division of Pharmaceutics Graduate Program

THE UNIVERSITY OF IOWA
FOUNDED 1847

College of Pharmacy
The University of Iowa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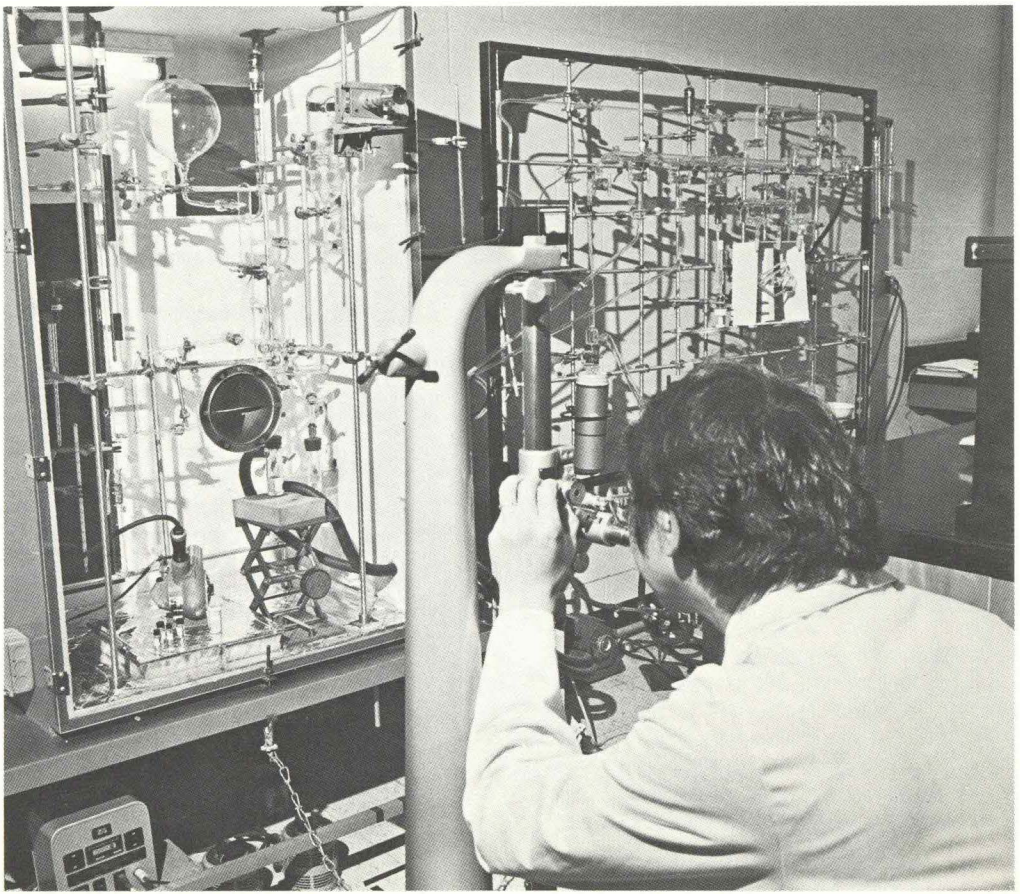
Introduction

The Division of Pharmaceutics is responsible for instruction and research concerning physiochemical and biological phenomena relevant to the design, preparation, and evaluation of, and the bioavailability from dosage forms. The Division of Pharmaceutics offers study and research leading to the Master of Science and Doctor of Philosophy degrees in the areas of biopharmaceutics, industrial pharmacy, and physical pharmacy. The M.S. requires at least 30 semester hours, which may include 6 semester hours of research, and usually a thesis. Although certain courses (two semesters of physical chemistry and an equivalent of four semesters of engineering calculus and/or differential equations and linear algebra, and nonlinear equations) are required, the Ph.D. is primarily a research degree conferred after the student has demonstrated proficiency and attainment in his chosen field of research. A comprehensive examination is taken when approximately 30 semester hours remain to be completed. After completion of his research, the student must write a thesis and defend it in a final oral examination.



Transport across excised human skin

Areas of Study

Biopharmaceutics

Biopharmaceutics is the study of the influence of formulation on the therapeutic activity of a pharmaceutical product. It is concerned with the relationship between the physical and chemical properties of the medicinal compound and its dosage forms and the biological effect observed following the administration of the drug in its various dosage forms. Pharmacokinetics, an integral part of biopharmaceutics, involves the relationship of time to the drug and metabolite concentrations and amounts in various tissues and excreta. It also involves the development of models suitable to interpret such data and their application to predicting and adjusting dosage regimens in the clinic.

Research in biopharmaceutics is concerned with determining which variables must be optimized to insure therapeutic drug concentrations.

In addition to the following courses recommended for students in the area of biopharmaceutics, selected courses (22S:158 Analysis and Design of Experiments, 22S:162 Regression Analysis, 22M:170 Numerical Analysis: Nonlinear Equations and Approximation Theory, 4:235 Chemical Kinetics, 22C:100 Introduction to Computing with Fortran, 4:228 Mechanisms of Organic Reactions, 46:206 Stability of Pharmaceuticals, 46:225 Industrial Pharmacy: Product Development) may be elected according to the research interests of the individual student.

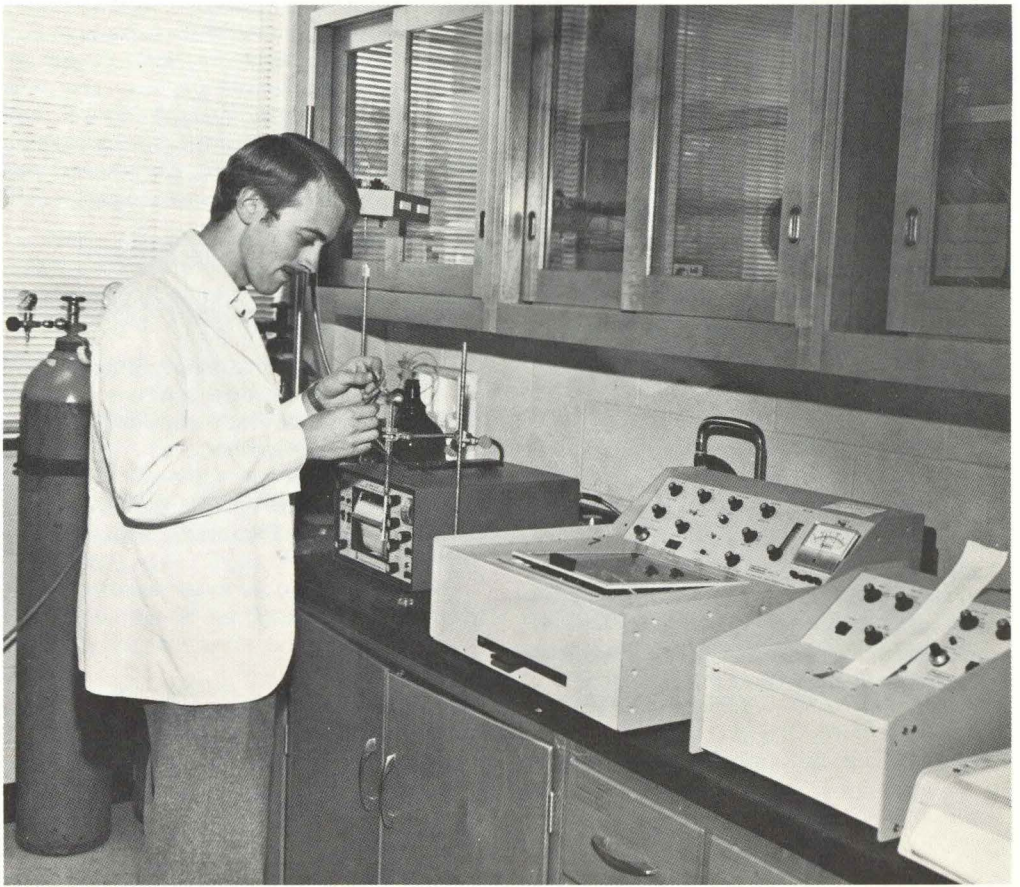
4:131	Physical Chemistry I, 3 s.h.
4:132	Physical Chemistry II, 3 s.h.
4:141	Intermediate Chemistry Laboratory, 2 s.h.
63:167	Biometrics and Bioassay, 3 s.h.
71:206	Biochemical Pharmacology, 3 s.h.
72:241	Membrane Biophysics, 2 s.h.
46:103	Physical Pharmacy, 3 s.h.
46:104	Pharmacokinetics and Biopharmaceutics, 3 s.h.
46:221	Quantitative Research Methods in Pharmacy, 3 s.h.
46:229	Advanced Pharmacokinetics and Biopharmaceutics, 2 s.h.
46:231	Pharmaceutics Seminar, 1-2 s.h.
46:233	Pharmaceutics Research, arr.
46:235	Physical Pharmacy, 3 s.h.

Industrial Pharmacy

The responsibility of the pharmaceutical scientist in industry lies in pharmaceutical research and development, production, and quality control. Research and development is concerned with the design and evaluation of dosage forms that are stable and acceptable to the patient, and effectively release the active ingredients upon administration. Production manufactures, finishes, and packages the products to be marketed and is responsible for manufacturing a maximum quantity at an economic cost while maintaining rigid standards. Quality control analyzes and tests raw materials, containers, and the finished pharmaceuticals to ensure the quality, uniformity, and safety of a product before it is released for sale.

In addition to the following courses recommended for students in the area of industrial pharmacy, selected courses (4:224 Physical Organic Chemistry, 46:121 Drug Development and Marketing, 4:222 Interpretation of Spectra, 46:229 Advanced Pharmacokinetics and Biopharmaceutics, and 4:228 Mechanism of Organic Reactions) may be elected according to the research interests of the individual student.

4:131	Physical Chemistry I, 3 s.h.
4:132	Physical Chemistry II, 3 s.h.
4:228	Mechanism of Organic Reactions, 3 s.h.
4:235	Chemical Kinetics, 3 s.h.
22S:101	Biostatistics, 3 s.h.
22C:100	Introduction to Computing with Fortran, 3 s.h.
46:103	Physical Pharmacy, 3 s.h.
46:104	Pharmacokinetics and Biopharmaceutics, 3 s.h.
46:105	Survey of Industrial Pharmacy, 3 s.h.
46:206	Stability of Pharmaceuticals, 3 s.h.
46:221	Quantitative Research Methods in Pharmacy, 3 s.h.
46:225	Industrial Pharmacy: Product Development, 3 s.h.
46:226	Industrial Pharmacy: Product Development, 3 s.h.
46:231	Pharmaceutics Seminar, 1-2 s.h.
46:233	Pharmaceutics Research, arr.
46:235	Physical Pharmacy, 3 s.h.



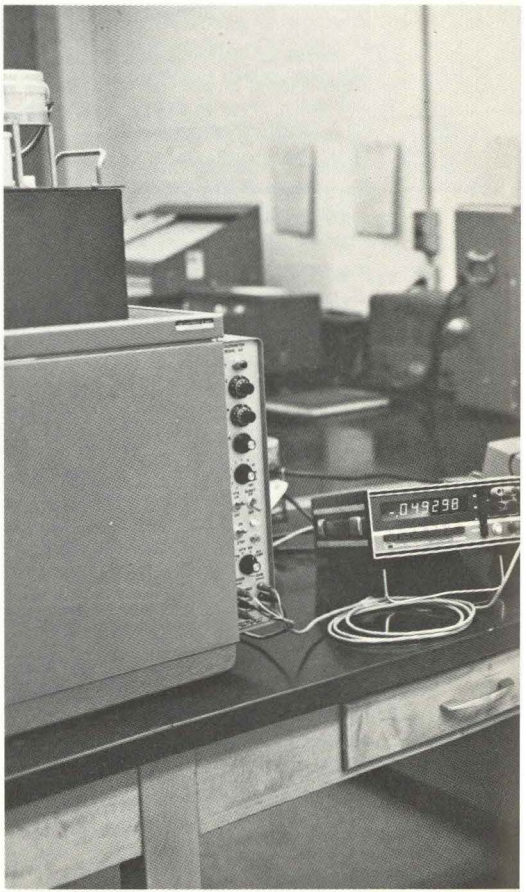
Permeation of cornea by radiolabelled medicinals

Physical Pharmacy

Physical or theoretical pharmacy deals quantitatively with complex pharmaceutical phenomena in terms of fundamental physical and chemical concepts. Thus knowledge of physical and analytical chemistry is essential. The pharmaceutical scientist qualified in physical pharmacy is concerned with basic research and preformulation investigation. Research may involve colloid and surface chemistry, complexation, dissolution, equilibria, states of matter, thermodynamics, diffusion, and rate processes. The physical pharmacist is always in demand in the scientific laboratories of universities and pharmaceutical manufacturers.

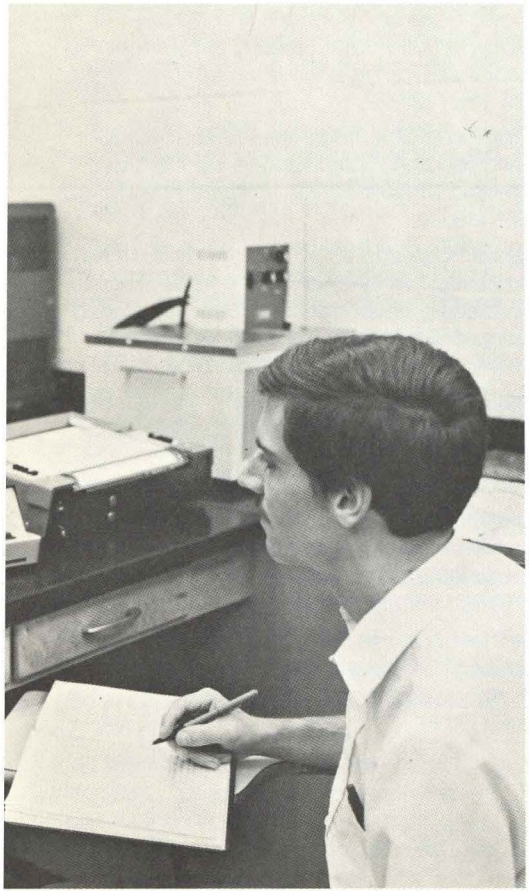
In addition to the following courses recommended for students in the area of physical pharmacy, selected courses (46:104 Biopharmaceutics, 46:229 Advanced Biopharmaceutics, 22C:100 Introduction to Computing with Fortran, 46:210 Chromatographic Methods) may be elected according to the research interests of the individual student.

4:131	Physical Chemistry I, 3 s.h.
4:132	Physical Chemistry II, 3 s.h.
4:228	Mechanisms of Organic Reactions, 3 s.h.
4:235	Chemical Kinetics, 3 s.h.
22S:101	Biostatistics, 3 s.h.
46:103	Physical Pharmacy, 3 s.h.
46:206	Stability of Pharmaceuticals, 3 s.h.
46:207	Spectrometric Interpretation, 3 s.h.
46:221	Quantitative Research Methods in Pharmacy, 3 s.h.
46:225	Industrial Pharmacy: Product Development, 3 s.h.
46:226	Industrial Pharmacy: Product Development, 3 s.h.
46:231	Pharmaceutics Seminar, 1-2 s.h.
46:233	Pharmaceutics Research, arr.
46:235	Physical Pharmacy, 3 s.h.



Heat of dilution by isoperibol calorimetry

Faculty



TING-FONG CHIN, Associate Professor of Pharmaceutics, received his B.S. (1951) from the National Defense Medical Center (Taiwan) and his M.S. (1960) and Ph.D. (1962) from The University of Iowa. His industrial experience was acquired in the Pharmaceutical Research Division of Philips Roxan Pharmaceutical Company.

Dr. Chin's research involves formulation and stability studies and the interactions of theraputically active compounds with adjuvants in dosage forms. A recent publication is:

Ting-Fong Chin and John L. Lach, "Drug Diffusion and Bioavailability: Tetracycline Metallic Chelation," *Am. J. Hosp. Pharm.,* 32, 625 (1975).

DOUGLAS R. FLANAGAN, JR., Associate Professor of Pharmaceutics, received his B.S. (1967), M.S. (1969), and Ph.D. (1971) from the University of Michigan. He was a faculty member of the School of Pharmacy at the University of Connecticut.

Dr. Flanagan's research interests include chemical kinetics, diffusion, and factors affecting the release pattern of drugs from dosage forms. Some of his recent publications are:

D.S. Greene, D.R. Flanagan, R. Quintiliani, and C.H. Nightingale, "Pharmacokinetics of Cephalexin: An Evaluation of One and Two-Compartment Model Pharmacokinetics," *J. Clin. Pharmacol.,* 16, 257 (1976).

D.R. Flanagan and A.P. Simonelli, "The S_N1 Hydrolysis of Isothioureas II," *J. Org. Chem.,* 41, 3118 (1976).

D.R. Flanagan and A.P. Simonelli, "The S_N1 Hydrolysis of Isothioureas I," *J. Org. Chem.,* 41, 3114 (1976).

A.B.C. Yu, C.H. Nightingale and D.R. Flanagan, "A Rapid Sensitive Fluorometric Method for the Analysis of Cephalosporin Antibiotics," *J. Pharm. Sci.* 66, 213 (1977).

D.R. Flanagan and S.H. Yalkowsky, "A Convection Diffusional Analysis for Drug Transport through a Tubular Polymeric Membrane," *J. Pharm. Sci.,* 66, 337 (1977).

H. Schneider, C. H. Nightingale, R. Quintiliani, and D. R. Flanagan, "The Evaluation of an Oral Prolonged-Release Antibiotic Formulation," *J. Pharm. Sci.,* 67, 1620 (1978).

J. KEITH GUILLORY, Professor of Pharmaceutics, received his B.S. (1956) from Loyola University (New Orleans) and the M.S. (1960)

and Ph.D. (1961) from the University of Wisconsin. He was a faculty member of the College of Pharmacy of Washington State University.

Dr. Guillory's research interests are in the areas of thermal analysis, polymorphism, chemical kinetics, and the factors affecting drug absorption. Some of his recent publications are:

Hwang O. Lin and J. Keith Guillory, "Physical Properties of Polymorphic Forms of Sulfanilamide I. Densities, Refractive Indexes, and X-Ray Diffraction Measurements," *J. Pharm. Sci.*, 63, 145 (1974).

J. K. Guillory and H. O. Lin, "Some Properties of Sulfanilamide Monohydrate," *Chem. Pharm. Bull.*, 24, 1675 (1976).

R. P. Juhl, R. W. Summers, J. K. Guillory, S. M. Blaug, F. H. Chen, and D. D. Brown, "Effect of Sulfasalazine on Digoxin Bioavailability," *Clin. Pharmacol. Ther.*, 20, 387 (1976).

W. C. Stagner and J. K. Guillory, "Physical Characterization of Solid Iopanoic Acid Forms," *J. Pharm. Sci.*, 68, 1005 (1979).

JOHN L. LACH, Associate Dean, Professor of Pharmaceutics and Director of Pharmaceutical Services, received his B.S. (1950) from the University of Alberta and the M.S. (1951) and Ph.D. (1954) from the University of Wisconsin. He is a Fellow of the Academy of Pharmaceutical Sciences and in 1975 received the A.Ph.A. Foundation Research Achievement Award in Physical Pharmacy.

Dr. Lach's research interests include chemical kinetics, complexation, solubility, and the use of diffuse reflectance in the investigation of chemical and physical stability. His research has demonstrated in animals and humans drug-excipient interactions in solid dosage forms. Some recent publications of the more than 70 articles that appear in the scientific literature are:

Lyle D. Bighley, James Wille, and John L. Lach, "Mixing of Additives of Glass and Plastic Intravenous Fluid Containers," *Am. J. Hosp. Pharm.*, 31, 736 (1974).

David G. Pope and John L. Lach, "Quantitation, Elimination, and Discussion of Decomposition Product Interference in N-Acetyl-p-aminophenol Colorimetry," *J. Pharm. Sci.*, 64, 466 (1975).

David Pope and John L. Lach, "Some Aspects of Solid-State Stability and Diffuse Reflectance Spectroscopy," *Pharm. Acta Helv.*, 50, 165 (1975).

Ting-Fong Chin and John L. Lach, "Drug Diffusion and Bioavailability: Tetracycline Metallic Chelation," *Am J. Hosp. Pharm.*, 32, 625 (1975).

David Pope and John L. Lach, "Diffuse Reflectance: On Its Quantitative Application to N-Acetyl-p-aminophenol Excipient Induced Degradation," *Can. J. Pharm. Sci.*, 10, 114 (1975).

David Pope and John L. Lach, "Diffuse Reflectance: On Its Application to the Evaluation and Control of Quality of Solid Dosage Forms," *Can. J. Pharm. Sci.*, 10, 109 (1975).

David Pope and John L. Lach, "Diffuse Reflectance: Investigation of Absorption Phenomena," *Can. J. Pharm. Sci.*, 10, 126 (1975).

Michael J. Akers and John L. Lach, "Evaluation of Emulsion Stability by Diffuse Reflectance Spectroscopy," *J. Pharm. Sci.*, 65, 216 (1976).

James W. McGinity and John L. Lach, "*In Vitro* Adsorption of Various Pharmaceuticals to Montmorillonite," *J. Pharm. Sci.,* 65, 896 (1976).

James W. McGinity and John L. Lach, "Sustained-Release Applications of Montmorillonite Interaction with Amphetamine Sulfate," *J. Pharm. Sci.,* 66, 63 (1977).

J. E. Sutton, John L. Lach, and R. S. Wagner, "pH-dependent Drug Release from Certain Commercial Tablets," *Am. J. Hosp. Pharm.,* 34, 1323 (1977).

LLOYD E. MATHESON, JR., Associate Professor of Pharmaceutics, received his B.S. (1964) and Ph.D. (1970) from the University of Wisconsin. He was a faculty member of North Dakota State University.

Dr. Matheson's research interests involve the development of analytical methods, *in vitro* absorption models, salt formation, and enhancement of drug solubility. Some of his recent publications are:

E. L. Parrott and L. E. Matheson, Jr., "Rectal Absorption of Nitrofurantoin," *J. Pharm. Sci.,* 67, 955 (1977).

L. E. Matheson, Jr., L. D. Bighley and L. S. Hendeles, "Drug Interference with the Schack and Waxler Plasma Theophylline Assay," *Am. J. Hosp. Pharm.,* 34, 496 (1977).

D. E. Wurster, J. A. Ostrenga, and L. E. Matheson, Jr., "The Transport of Sarin Across Excised Human Skin I. Permeability and Adsorption Characteristics," *J. Pharm. Sci.,* 68, 1406 (1979).

L. E. Matheson, Jr., D. E. Wurster, and J. A. Ostrenga, "The Transport of Sarin Across Excised Human Skin II. The Effect of Solvent Pretreatment on Permeability," *J. Pharm. Sci.,* 68, 1410 (1979).

L. E. Matheson, Jr., "Comparison of *In Vitro* Release Rates of Multisource Sustained-Release Papaverine Hydrochloride Products," *Drug Development and Industrial Pharmacy,* 5, 459 (1979).

L. E. Matheson, Jr., "The Transport of Sarin Across Excised Human Skin III. The Effect of Solvent Pretreatment of Adsorption and Desorption," *Int. J. Pharm.,* 4, 309 (1980).

EUGENE L. PARROTT, Professor of Industrial Pharmacy and Head of the Division of Pharmaceutics, received his B.S. (Honors) and Ph.D. from the University of Wisconsin in 1949 and 1954, respectively.

He was a faculty member of the University of Arizona and the University of Nebraska. His industrial experience was acquired in the Pharmaceutical Research and Development Division of Charles Pfizer and Company and Dorsey Laboratories. He is a Fellow of the Academy of Pharmaceutical Sciences. In addition to 60 publications, he is the author of or contributor to *Pharmaceutical Technology, Experimental Pharmaceutical Technology, Prescription Pharmacy, The Theory and Practice of Industrial Pharmacy, Experimental Pharmaceutics,* and *Pharmaceutical Dosage Forms: Tablets, Vol. II.*

Dr. Parrott's research interests include dosage form design and development, models and kinetics of dissolution, powder technology, equipment and process evaluation, and the availability of drugs from dosage forms. Some of his recent publications are:

Eugene L. Parrott, "Precision Solid-Solid Blending," *Drug and Cosm. Ind.,* 115, 42 (1974).

Eugene L. Parrott, "Milling of Pharmaceuticals," *J. Pharm. Sci.,* 63, 813 (1974).

Eugene L. Parrott, "Influence of Particle Size on Rectal Absorption of Aspirin," *J. Pharm. Sci.,* 64, 878 (1975).

Moshe Sabo, James F. Caputo, and Eugene L. Parrott, "Loss of Fluoride during Tablet Production," *J. Pharm. Sci.,* 65, 932 (1976).

Shirish A. Shah and Eugene L. Parrott, "Dissolution of Two-Component Solids," *J. Pharm. Sci.,* 65, 1784 (1976).

Lloyd Matheson, Jr., and Eugene L. Parrott, "Rectal Absorption of Nitrofurantoin," *J. Pharm. Sci.,* 66, 955 (1977).

Moshe Sabo and Eugene L. Parrott, "A Prolonged-Release Fluoride Tablet," *Drug Development and Industrial Pharmacy,* 3, 387 (1977).

Titus A. Iranloye and Eugene L. Parrott, "Effect of Compressional Force, Particle Size and Lubricants on Dissolution Rate," *J. Pharm. Sci.,* 67, 535 (1978).

Dah-Nan Chow and Eugene L. Parrott, "A Comparison of Dissolution from Commercial Tablets and from Capsules Containing a Powdered Tablet," *Drug Development and Industrial Pharmacy,* 4, 441 (1978).

Michael Simpson and Eugene L. Parrott, "Oral and Rectal Absorption of Chloral Hydrate and Its Betaine Complex," *J. Pharm. Sci.,* 69, 227 (1980).

M. Mitra Soci and Eugene L. Parrott, "Influence of Viscosity on Absorption from Nitrofurantoin Suspensions," *J. Pharm. Sci.,* 69, 403 (1980).

Raymond M. Fung and Eugene L. Parrott, "Measurement of Film Coating Adhesiveness," *J. Pharm. Sci.,* 69, 439 (1980).

Eugene L. Parrott, "Dissolution of a Nondisintegrating Solid," *International J. of Pharmaceutical Technology & Product Manufacture,* 1, No. 2, 22 (1980).

RONALD D. SCHOENWALD, Associate Professor of Pharmaceutics, received his B.S. (1963) from the University of Arizona and the M.S. (1968) and Ph.D. (1971) from Purdue University. He was a faculty member of the University of Washington. His industrial experience was acquired in the Biopharmaceutics Group of Alcon Laboratories. He is a contributor to *Bioavailability and the Pharmacokinetic Control of Drug Response.*

Dr. Schoenwald's research interests include bioavailability and pharmacokinetics with emphasis on factors affecting the absorption of drugs administered by various routes and the penetration of drugs through the cornea. Some of his recent publications are:

R. D. Schoenwald, "Evidence for Variable Digoxin Absorption as Estimated by Pharmacological Response Intensities," *J. Pharm. Sci.,* 63, 411 (1974).

V. E. Isaacs and R. D. Schoenwald, "Estimation of Pharmacological, Biophasic, and Biological Half-Lives of Quinidine in Rabbits," *J. Pharm. Sci.,* 63, 1119 (1974).

V. E. Isaacs and R. D. Schoenwald, "Binding of Quinidine to a Red Blood Cell Hemolysate Preparation," *J. Pharm. Sci.,* 63, 1267 (1974).

R. D. Schoenwald and V. E. Isaacs, "QT Corrected for Heart Rate: A New Approach and Its Application," *Arch. Int. Pharmacol.,* 210, 132 (1974).

V. F. Smolen and R. D. Schoenwald, "Drug Absorption Analysis from Pharmacological Data: III. Influence of Polymers and pH on Transcorneal Biophasic Availability and Mydriatic Response of Tropicamide," *J. Pharm. Sci.,* 63, 1582 (1974).

J. Gustafson, R. D. Schoenwald, and L. Z. Benet, "Limitations in the Use of Pharmacological Response Intensities in Estimating Enterohepatic Cycling of Digoxin," *J. Pharm. Sci.,* 65, 243 (1976).

R. D. Schoenwald and R. L. Ward, "Effect of Edetate Disodium and Reduced Glutathione on Absorption of Acetazolamide from GI Tract of Rats," *J. Pharm. Sci.,* 65, 677 (1976).

M. J. Akers, R. D. Schoenwald, and J. W. McGinity, "Practical Aspects of Ophthalmic Drug Development," *Drug Development Communications,* 3, 185 (1977).

R. D. Schoenwald and R. L. Ward, "Relationship Between Steroid Permeability across Excised Rabbit Cornea and Octanol-Water Partition Coefficient," *J. Pharm. Sci.,* 67, 786 (1978).

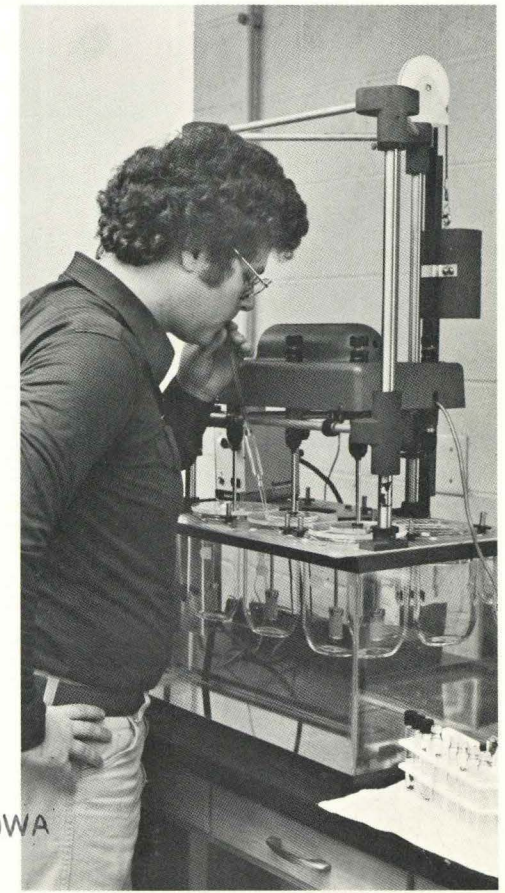
L. M. DeSantis and R. D. Schoenwald, "Lack of Influence of Rabbit Nictitating Membrane on Miosis Effect of Pilocarpine," *J. Pharm. Sci.,* 67, 1189 (1978).

R. D. Schoenwald, R. L. Ward, L. M. DeSantis, and R. E. Roehrs, "Influence of High-Viscosity Vehicles on Miotic Effects of Pilocarpine," *J. Pharm. Sci.,* 67, 1280 (1978).

R. D. Schoenwald and P. Stewart, "Effect of Particle Size on the Ophthalmic Bioavailability of Dexamethasone Suspensions in Rabbits," *J. Pharm. Sci.,* 69, 391 (1980).

DALE E. WURSTER, Dean and Professor of Pharmaceutics, received his B.S. (1942) and Ph.D. (1947) from the University of Wisconsin and served on its faculty for 24 years. He was the Dean of the College of Pharmacy at North Dakota State University. He is a Fellow of the Academy of Pharmaceutical Sciences and served as its President in 1975. In 1965 he received the A.Ph.A. Foundation Research Achievement Award in Physical Pharmacy and in 1980 the Industrial Pharmaceutical Technology Award. Among his many awards are honorary membership in and twice being cited for his research by the Romanian Society of Medical Sciences, 1971 Distinguished Service Award from the Wisconsin Pharmaceutical Association, and a citation from the U.S. Navy for superior achievement in research in solid rocket fuels.

Dr. Wurster is known worldwide for his research in dissolution and diffusion kinetics and their influence on drug release mechanisms, and percutaneous absorption in humans. He is the inventor of the air-suspension technique for coating, microencapsulation, and granulation and has more than 50 patents for these processes. He has more than a hundred articles of which one patent and seven papers are still classified.



Dissolution profiles from solid dosage forms